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Applying machine learning technique to study the influence of financial decisions on firm value

Trang Do Thi Van[1*], Thang Doan Viet[2], Duong Nguyen Canh[3], Huyen Pham Ngoc[4], Mai Nguyen Thi Xuan[5]
[1,2,3,4,5]Banking Academy of Vietnam; trangdtv@hvnh.edu.vn (T.D.T.V.) thang.dv509@gmail.com (T.D.V.) cduong1008@gmail.com (D.N.C.) phamngochuyen0911@gmail.com (H.P.N.) ngtxmai2003@gmail.com (M.N.T.).

Abstract: This study investigates the impact of financial decisions on the value of listed firms in Vietnam by employing both traditional statistical methods and advanced machine learning models. Using data from 646 firms listed on the Vietnamese Stock Exchange from 2012 to 2022, the research applies various predictive models, including traditional regression methods and machine learning approaches such as Linear Regression (LR), LASSO, Generalized Additive Model (GAM), Random Forests (RF), Gradient Boosting Regression Trees (GBRT), and Deep Neural Networks (DNN). The empirical results suggest a positive correlation between investment and financing decisions and firm value during the research period. Furthermore, the impact of dividend payment decisions on company value was statistically insignificant. Notably, machine learning models, particularly GBRT, outperform traditional statistical models, demonstrating superior predictive accuracy and robustness in capturing complex financial patterns. The study underscores the growing relevance of machine learning in financial analysis, highlighting its ability to enhance forecasting and strategic decision-making. These findings provide valuable insights for corporate managers, investors, and policymakers in optimizing financial strategies to maximize firm value. Moreover, the integration of machine learning into financial modeling can mitigate limitations associated with conventional statistical methods, particularly in handling non-linear relationships and large-scale financial datasets.

Keywords: *Financial decisions, Firm value, Machine learning.*

1. Introduction

In recent years, as the Vietnamese economy has become deeply integrated into the global economy, the operations of enterprises have experienced significant growth [1]. Following to the data from the General Statistics Office of Vietnam, the country's GDP growth rate has been consistently positive, indicating a thriving economy. In 2019, Vietnam's GDP increased by 7.02% [2]. This growth shows the expansion of different industries and the spread of Vietnamese enterprises in international trade and investment. Furthermore, the World Bank report on Vietnam's economic prospects supports the notion of significant growth in enterprise operations. The report highlighted the more important role of the private sector and foreign direct investment in driving Vietnamese economic growth [3]. This indicates that both domestic and foreign businesses have been actively expanding their operations in the country. As the Vietnamese economy continues to fit in the global economy and draw foreign investment's attention, the operations of enterprises are expected to get more growth and contribute to the overall development of the country.

Nowadays, the lion's share of businesses and economic institutions establish objectives focused on maximizing the firm value in both the short and long term. In the short term, the most important goal for enterprises is to maximize profits by efficiently using the resources at their disposal. Conversely, the long-term objective is to enhance the firm's value mixed with ensuring consistent and sustainable

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* Correspondence: trangdtv@hvnh.edu.vn

growth [4]. The requirement for achieving these objectives is that the enterprises have to have a plan for making appropriate and effective financial decisions: the investment decision, financing decision, and dividend decision. Some studies before have demonstrated the relationship between financial decisions and firm value. Authors Titman and Brooks [5] conducted research, which showed that investment in fixed assets has a positive impact on profitability and firm value, and highlights the importance of enterprises making rational investment decisions in fixed assets to enhance operational efficiency and increase firm value. A flexible capital structure helps enterprises adapt better to changes in the economic environment and diminish financial risks, thereby contributing to value creation. Denis and Wagenhofer [6] have concluded that enterprises that take on a transparent dividend policy, provide comprehensive information about their dividend payout policy to shareholders, typically have higher firm value than those with non-transparent dividend policies. Transparent dividend policies will raise the investor confidence, attract investment capital, and increase firm value. The rational and effective utilization and integration of the above financial decisions will not only build up the firm's value in the short term but also contribute to the enterprise's stability in development in the long term within the market economy.

With the advancement of technology, machine learning has become a crucial tool in addressing various challenges related to data, model complexity, and the relationships between variables across diverse domains. In the finance sector, these techniques have been widely applied in recent times to address data-related issues, tackle nonlinear relationships, and effectively handle complex problems, without being overly constrained by data limitations. The application of machine learning methods has demonstrated efficacy in forecasting financial issues, such as financial distress [7] financial risk [8] and firm value [9] among other financial domains. The influence of financial decisions on firm value has been conducted for many years by many authors, however, this study has been addressed on the application of machine learning in financial areas.

This study has focused on using machine learning models with data collected from 646 listed companies in Vietnam from 2012 to 2022. This study contributes to the financial literature by integrating machine learning with traditional statistical methods to analyze the impact of financial decisions on firm value in Vietnam. Unlike conventional econometric models, machine learning techniques improve predictive accuracy and capture complex financial patterns. Using these models, the research provides empirical insights into how financial decisions significantly impact firm value. Based on the findings, the study suggests recommendations for managers and stakeholders to make financial decisions in order to maximize the wealth of all stakeholders.

The article is structured in five parts, including an introduction, a literature review, the research methodology, a discussion of the research results, and a set of recommendations.

2. Literature Review and Research Hypothesis

2.1. Literature Review

2.1.1. Investment Decisions and Firm Value

Investment decisions are a crucial part of a firm's financial decision-making. Among these decisions, purchasing long-term assets to support the company's operations and provide future financial gains is the most important of these choices. Businesses must take into account utilization efficiency, reinvestment potential, and alignment with corporate strategy when making fixed asset investments [10]. However, investing in fixed assets also affects a company's worth over the long run [11]. A company's worth is determined by its capacity to produce steady and sustainable cash flows in the future in addition to its short-term profitability. Fixed assets effect corporate value, improve competitiveness, and provide the physical framework for production activities [12].

In contrast, according to Nyamasege, et al. [13] when fixed assets are used as efficiently as possible for managerial goals, a large investment in them raises the firm's worth. The article has highlighted that fixed assets play a crucial role in the business production activities of a firm. They enable the firm to generate products and services, thereby generating revenue and profit. According to Saleh [14] investing in fixed assets leads to a decrease in firm value. The author suggests that the reason behind

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this phenomenon is the high investment costs, which reduce the available profits for dividend payments to shareholders.

2.1.2. Financing Decisions and Firm Value

Financing decisions concern the use of debt and equity and the firm's performance. There is a wealth of research demonstrating the impact of capital structure on the value of a business resulting from financing decisions. According to Markus, et al. [15] leverage significantly mediates the effect of risk management on firm value. This finding concerning the mediating role of capital structure is in line with Gilje and Taillard [16] who state that corporate hedging especially adds value to the firm by lowering bankruptcy and underinvestment risks. The moderator analysis further confirms that these relationships gain importance over time. Overall, these findings imply that capital structure decisions and risk management should be jointly considered by managerial decision makers as important drivers for maximization of firm value.

2.1.3. Dividend Payout Decisions and Firm Value

The dividend policy plays an important role in the financial policies of businesses as it affects various aspects of their operations. In addition to being the sum of money given to shareholders, dividends also act as a reward for them, making up for the risks they take on by owning the company's stock and the value of their assets. Shareholders who own a specific percentage of the company's shares have substantial voting rights over decisions, including how dividends are paid out [17]. Because of this power, big investors can insist that businesses adopt dividend policies that benefit them, increasing the organization's efficiency and openness [18]. In addition to influencing the production of firm value, decisions about financing and dividend payments can also have a big impact on the business's value and operational effectiveness. According to Sualehkhattak and Hussain [17] these decisions can strongly influence the capital structure of the company, its ability to attract investments, and the importance of shareholders in shaping the financial strategy of the business.

The use of machine learning techniques in financial forecasting is thought to be a potential way to get beyond the drawbacks of conventional methodologies. Large datasets can be analyzed and trends found using machine learning models, which also offer useful information to decision-makers in a variety of industries, including banking. Furthermore, machine learning models offer better application and flexibility than traditional statistical methods since they are less dependent on rigid data circumstances and the correlations between independent and dependent variables. Sujith [19] suggests that independent variables such as cash management and risk management using machine learning are highly useful in making financial decisions. Managers can predict financial requirements and make the best business decisions by using machine learning models. Iman, et al. [20] highlights that through more precise and thorough data analysis, machine learning models assist businesses in better understanding market trends, which benefits investors looking for market insights and assessing the efficacy of investments.

2.2. Research Hypothesis

The influence of investment decisions on firm value: The research by Nyamasege, et al. [13] found that businesses with more fixed assets are often worth more than those with less assets. Similarly, the research by Listiani and Supramono [21] identified a positive impact of fixed asset growth on firm value, where higher growth rates lead to increased firm value. However, the findings of Nurlela, et al. [22] presented contrasting results. They discovered that firm value was negatively impacted by the ratio of fixed assets to total assets. This inverse link may be caused by the higher cost of capital that comes with greater fixed asset investments, which lowers firm value. Saleh [14] also indicated a substantial detrimental impact of fixed asset investments on manufacturing companies' worth, which lowers the firm's value. Based on these reasons, the authors propose the hypothesis:

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H_1: *The investment decisions have a positive impact on business value.*

The influence of financing decisions on firm value: According to financial analysts, a company's worth will rise if its financial leverage is increased up to a specific point. Beyond that point, though, any financial leverage will increase the company's cost of capital and lower the firm's value. The theory proposed by Modigliani and Miller [23] argues that the value of a firm is independent of the choice of capital structure under the assumption of efficient markets. Carpentier, et al. [24] and their colleagues (2012) also suggest that there is no evidence to support the impact of capital structure on firm value. However, previous research on capital structure, such as Durkheim [25] has proposed that due to the lower cost of debt compared to the cost of equity, firms tend to increase their use of debt to enhance firm value. Based on these reasons, the authors propose the hypothesis:

H_2: *The financing decisions have a positive impact on firm value.*

The influence of dividend payout decisions on firm value: Gharaibeh and Qader [26] in a study of 40 firms from various industries, concluded that dividend policy and leverage have an inverse relationship with firm value. According to the M&M theory, dividends are unrelated to stock prices, and therefore, cash dividend policy does not affect firm value. However, authors Lintner [27] and Gordon [28] argue that investors tend to prefer companies that have the ability to pay dividends in cash rather than retaining earnings for reinvestment, as it reduces risk for investors and can potentially increase firm value. In Vietnam, Dang, et al. [29] found significant effects of dividend policy on firm value, especially for companies that implement higher dividend payout ratios. Additionally, Baker, et al. [30] concluded that increasing dividend payout ratios are positive signals for the future profit growth of a firm, thus positively influencing stock prices. Based on these reasons, the authors propose the hypothesis:

H_3: *The dividend payout decisions have a positive impact on corporate value.*

3. Methodology

This study evaluates the effectiveness of employing traditional statistical methods and six different machine learning methods in predicting the firm value of listed companies on the Vietnam Stock Exchange from 2012 to 2022. After data processing, there were 6018 observations used in the analysis.

For the traditional method, the article conducts descriptive statistical analysis to present the most general overview of the research sample. Additionally, the article performs regressions such as pooled OLS, REM, and FEM, along with tests including F, LM, and Hausman tests for heteroscedasticity, multicollinearity, and autocorrelation, ensuring the model's reliability and accuracy.

3.1. Machine Learning Model

This study employs two categories of machine learning models to examine the impact of financial decisions on firm value: (1) traditional machine learning models and (2) modern machine learning models, including Random Forests (RF) and Deep Neural Networks (DNN).

The traditional machine learning model group includes the following models: (1) Linear Regression (LR), (2) LASSO, and (3) Generalized additive model (GAM). Linear regression is considered the simplest model for predicting regression problems, so it is used as the first baseline model in this study. However, the drawback of LR is its high sensitivity to multicollinearity and overfitting. To overcome these disadvantages, the article applied the LASSO model. The strength of LASSO is that it can select a reduced set of variables in the model to predict outcomes. However, the LR and LASSO models are not suitable for accurately modeling nonlinear relationships between covariates and the dependent variable without prior intervention. Therefore, the GAM has employed a non-parametric model that can handle potential nonlinear relationships.

The modern machine learning model includes the following models: (1) Random Forests (RF), (2) Gradient Boosting Regression Trees (GBRT), and (3) Deep Neural Network (DNN). These models excel in capturing nonlinear relationships between dependent and independent variables. RF, widely used for regression and classification, enhances performance by aggregating multiple decision trees,

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reducing overfitting, and handling large datasets with high-dimensional attributes. In contrast, GBRT constructs decision trees sequentially, where each tree corrects the errors of the previous one, resulting in a more refined predictive model. Lastly, the study incorporates a single-layer neural network (NN), in which neurons are directly connected to input features without hidden layers. While simpler in architecture, NN effectively models complex nonlinear relationships, offering advantages over traditional machine learning methods.

3.2. Training and Evaluating Models

The research team implemented machine learning models using the scikit-learn library in Python version 3.11, utilizing default parameters. The dataset was split into two subsets: 70% for training and 30% for testing. Each candidate model was trained using the entire training set and then used to generate yearly predictions. Model performance was assessed using two key metrics: Mean Squared Forecast Error ($MSFE$) and Out-of-Sample R-squared (R^2_{OS}), which are defined as follows:

$$MSFE = \frac{1}{N}\sum_{i=1}^{N} (y_i - \hat{y}_i)^2$$

$$R^2_{OS} = 1 - \frac{\sum_{i=1}^{N} (y_i - \hat{y}_i)^2}{\sum_{i=1}^{N} (y_i - \underline{y}_i)^2}$$

where N is the total number of observations, y_i represents the actual response, $\hat{y}_i$ is the predicted value based on the selected model, and $\underline{y}_i$ is the average response value.

3.3. Research Data

Dependent variable: This study employs Tobin's Q ratio as a proxy for firm value, as it integrates both market value and accounting book value, offering a more comprehensive measure. Unlike other financial metrics such as Earnings per Share (EPS), Return on Equity (ROE), and Return on Assets (ROA)—which primarily reflect past performance—Tobin's Q captures investor expectations for future firm value. This makes it particularly valuable for assessing long-term growth potential, especially given the inherent challenges in forecasting firm value over short time horizons [31].

Independent variables: Besides, the paper has considered a number of control variables in the model to better explain the changes in the company's value. The independent variables are included:

(i) The variable representing financial decisions, including fixed assets' ratio (TANG) for investment decisions, the debt-to-asset ratio (DE) for financing decisions, and the dividend payout ratio (DPR) for dividend payment decisions.

(ii) The group of variables related to the characteristics of the company includes: company age (AGE), return on assets (ROA), pre-tax and interest profit margin (QUALITY), company size (SIZE), liquidity ratio (LQD), total asset turnover (ATR), and asset growth rate (AGR).

(iii) The group of variables related to the macroeconomic situation in Vietnam includes: interest rate (IR), inflation rate (INFLATION), and GDP growth rate (GR).

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Table 1.
The list of variables included in this study.

Independent variable	Formula	Source
FV	(Book value of debt + Market capitalization of common stock) / Book value of total assets.	Cheng, et al. [31]; (2012); Dang, et al. [29] and Dang and Do [32]
Dependent variables		
TANG (Investment decision)	$\frac{Total\ Fixed\ Assets_{i,t}}{Total\ Assets_{i,t}}$	Nyamasege, et al. [13] and Listiani and Supramono [21]
DE (Financing decision)	$\frac{Total\ Debt_{i,t}}{Total\ Equity_{i,t}}$	Dang and Do [32]
DPR (Dividend payment decision)	$\frac{Total\ Dividend_{i,t}}{Net\ Income_{i,t}}$	Baker, et al. [30]
ROA	$\frac{Net\ Income_{i,t}}{Total\ Assets_{i,t}}$	Kuzey, et al. [9]; Singh and Bansal [33]; Juca and Fishlow [34]; Aggarwal and Padhan [35]; Dang, et al. [29] and Dang and Do [32]
QUALITY	$\frac{EBIT_{i,t}}{Total\ Assets_{i,t}}$	Kuzey, et al. [9]; Singh and Bansal [33]; Juca and Fishlow [34]; Aggarwal and Padhan [35]; Dang, et al. [29] and Dang and Do [32]
SIZE	$Ln(Total\ Assets_{i,t})$	Singh and Bansal [33]; Kuzey, et al. [9]; Aggarwal and Padhan [35]; Juca and Fishlow [34]; Dang, et al. [29] and Dang and Do [32]
LQD	$\frac{Total\ Current\ Assets_{i,t}}{Total\ Current\ Liabilities_{i,t}}$	Juca and Fishlow [34] and Dang and Do [32]
ATR	$\frac{Total\ Revenue\ Assets_{i,t}}{(Total\ Assets_{i,t} + Total\ Assets_{i,t-1})/2}$	Cheng, et al. [31]; Singh and Bansal [33]; Kuzey, et al. [9]; Dang and Do [32]; Senan, et al. [36] and Juca and Fishlow [34]
AGR	$\frac{Total\ Assets_{i,t}}{Total\ Assets_{i,t-1}}$	Kuzey, et al. [9]; Aggarwal and Padhan [35]; Dang and Do [32]; Senan et al. (2022)
GR	Vietnam's GDP growth rate in the year t.	Aggarwal and Padhan [35]; Dang and Do [32] and Senan, et al. [36]
IR	Operating interest rate in the year t.	Cheng, et al. [31] and Dang and Do [32]
INFLATION	Inflation rate in the year t.	Cheng, et al. [31]; Aggarwal and Padhan [35]; Dang and Do [32] and Senan, et al. [36];

4. Research Results and Discussion

4.1. Descriptive Statistics

The descriptive statistics results, presented in Table 3, provide an overview of the variables used in this study. Notably, some financial capability indicators, such as ROA and QUALITY, exhibit minimum values below zero, suggesting that certain firms experienced negative profitability or operational inefficiencies. Additionally, most independent variables display a relatively high standard deviation compared to their mean, indicating significant variation across firms. This variability reflects the diverse financial structures and performance levels within the dataset, highlighting the complexity of financial decision-making among listed companies.

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Table 2.
Results of descriptive statistical analysis.

Variable	Obs.	Mean	Std. Dev.	Min	Max
FV	5585	1.6885	23.0780	0.0626	1192.7782
TANG	5585	0.3159	1.1179	0	29.2248
DE	5585	0.8856	0.3875	0	9.0394
DPR	5585	0.6738	0.4135	0	1
ROA	5585	0.1107	1.7490	-2.5412	104.1584
QUALITY	5585	0.1575	2.3042	-2.3815	122.3491
SIZE	5585	13.6254	1.6005	9.5149	20.1741
LQD	5585	2.9444	10.1577	0.0124	562.3809
ATR	5585	0.3004	0.9495	0	23.7572
AGR	5585	1.5657	16.1408	0.0017	1132.7619
GR	5585	6.0430	1.8903	2.5600	8.0200
IR	5585	4.7501	0.9556	3.3700	7.1400
INFLATION	5585	3.1063	1.3739	0.6300	6.5900

4.2. The Traditional Approach

The multicollinearity test results, presented in Table 3, indicate that the Variance Inflation Factor (VIF) for all variables is below 10, confirming the absence of multicollinearity. This suggests that the independent variables in the model are not highly correlated, ensuring the reliability and stability of the regression estimates.

Table 3.
Results of testing multicollinearity.

Variables	VIF	1/VIF
TANG	5.62	0.1780
ATR	5.43	0.1834
DPR	4.19	0.2387
DE	3.76	0.2659
ROA	3.16	0.3165
QUALITY	2.94	0.3401
IR	1.16	0.8615
GR	1.11	0.9018
INFLATION	2.15	0.4659
SIZE	1.07	0.9345
LQD	1.03	0.9731
AGR	1.01	0.9940

TThe regression analysis results, summarized in Table 4, indicate that the Fixed Effects Model (FEM) is the most appropriate specification. This selection is supported by the F-test, which is statistically significant at the 1% level, and the Hausman test ($chi^2(12) = 0.000$), also significant at 1%, confirming the preference for FEM over the Random Effects Model (REM). Additionally, the Wooldridge test for autocorrelation yields a p-value of 0.7864, indicating that the model does not suffer from autocorrelation, ensuring the robustness of the regression estimates.

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Table 4.
Results of regression analysis of traditional models.

	OLS		FEM		REM	
	coef.	**std. err.**	**coef.**	**std. err.**	**coef.**	**std. err.**
TANG	3.5472***	0.1608	3.1489***	0.1657	3.5239***	0.1558
DE	0.4770	0.3798	1.7048***	0.5139	1.0920**	0.4412
DPR	2.0167***	0.3760	1.0356**	0.4769	1.6358***	0.4202
ROA	6.6094***	0.1573	6.0229***	0.1597	6.1700***	0.1544
QUALITY	4.2924***	0.1184	4.7749***	0.1230	4.6456***	0.1175
SIZE	0.0499	0.0491	-1.2013***	0.1776	-0.0896	0.0759
LQD	-0.0045	0.0076	-0.0014	0.0091	-0.0030	0.0078
ATR	-2.0075***	0.1863	-3.0559***	0.1818	-3.0970***	0.1774
AGR	0.0005	0.0047	0.0044	0.0051	0.0021	0.0046
GR	-0.0229	0.0429	-0.0148	0.0390	-0.0254	0.0391
IR	-0.0213	0.1239	-0.3315***	0.1262	-0.0234	0.1163
INFLATION	0.0243	0.0809	0.0982	0.0751	0.0172	0.0741
_cons	-2.2238***	0.8641	15.7111***	2.6875	-0.5143***	1.1282
Hausman	p-value = 0.0000					
F	p-value = 0.0000					

According to the results from the FEM model in Table 4, the article states that (1) the variables TANG, DE, DPR, ROA, and QLT have a positive impact on firm value, whereas the variables SIZE, ATR, and IR have a negative impact on firm value; and (3) the variables LQD, AGR, GR, and INFLATION are not statistically significant in the regression model with p-values greater than 0.1. Based on these results, all three hypotheses H_1, H_2, and H_3 are accepted with confidence levels of 1%, 1%, and 5%, respectively. These results can be interpreted as follows:

Investment Decision: The fixed asset ratio (TANG), representing investment decisions, has a positive correlation with firm value which aligns with previous research on investment decisions [13, 21].

Financing Decision: Relying on debt can enhance a firm's value, as leveraging debt financing may lead to higher returns. However, 100% debt financing is impractical, as excessive reliance on debt increases financial risk. Miller [37] argued that the debt tax shield diminishes when personal income taxes are considered, reducing its benefits. Moreover, excessive debt raises bankruptcy risks and costs, making it essential for firms to maintain an optimal debt-to-equity ratio. According to Ross, et al. [38] an increase in debt signals positive prospects, while a decrease may indicate financial distress. Similarly, Myers [39] in his capital structure puzzle, suggested that firms can maximize profits by strategically increasing leverage, balancing the benefits of debt financing with the risks of financial instability.

Dividend Payment Decision: The dividend payout ratio (DPR), representing dividend payment decisions, has a positive correlation with firm value. This research finding aligns with prior studies such as Lintner [27] Gordon [28]; Baker, et al. [30] and Dang, et al. [40]. These studies have shown that high dividend payouts are often associated with higher firm values. This may be because high dividend payouts reflect a company's stable financial situation, strong profitability, and bright future. This can create confidence in future stability and profitability, leading to an increase in firm value [30]. Furthermore, paying dividends can help attract investors who prioritize cash returns, boosting demand for the company's stock and, thus, contributing to an increase in the firm's market value.

4.3. The Machine Learning Approach

Table 5 compares the results of using machine learning models to analyze the impact of financial decisions on firm value. The metrics used to assess model accuracy include R-squared (R^2) and root mean square error (RMSE). The R^2 index values range from 0 to 1. A higher R^2 value indicates a more accurate predictive model. Conversely, RMSE represents the average error value on the dataset after model training. Therefore, a lower RMSE indicates more accurate model predictions.

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As shown in Table 5, all models demonstrate good predictive ability with the research dataset. Among them, the GBRT model exhibits the highest accuracy, with R^2 and RMSE values of 0.6791 and 0.000046, respectively. Compared to the R^2 value of 0.3765 for the FEM, the machine learning models demonstrate a significantly higher level of accuracy than traditional statistical models.

Table 5.
Accuracy of machine learning models.

Model	R^2	RMSE
LR	0.5557	0.000064
LASSO	0.4774	0.000075
GAM	0.4494	0.000079
RF	0.6337	0.000052
GBRT	0.6791	0.000046
NN	0.1697	0.000119

To analyze the impact of independent variables on the model's predictive ability, the study proceeds with an analysis of variable importance. Each model has its own set of weights, depending on the structure and characteristics of the model. The importance of variables is determined by calculating the sum of the weights assigned to them. Then, the results are normalized on a scale from 0 to 100, with 100 being the highest value, representing the importance of the variables.

For the model with the highest accuracy, the GBRT, the variables with the greatest impact on firm value in descending order of importance are ROA, QUALITY, TANG, LQD, GR, IR, SIZE, ATR, DPR, AGR, INFLATION, and DE. However, the importance of the ROA and QUALITY variables is distinctly different from the other variables. In the GBRT model, variable importance is measured using the mean and standard deviation of the accumulation of impurity decrease within each decision tree. This shows that ROA and QUALITY play vital roles in determining firm value, and the GBRT model uses these measures to optimize model performance in predicting firm value. However, overemphasizing these two variables may lead to a lack of generalization in the model, resulting in poorer predictive performance when applied to new or different cases.

Table 5 presents the results of the analysis of the importance of independent variables used in the models. For each model, the variables are ranked in descending order of importance from top to bottom. Additionally, it can be observed that ROA is rated as the most important variable in four models, except for QUALITY and GAM. The LR, LASSO, RF, and GBRT models tend to remove variables more quickly than the remaining models, with only one or two independent variables having importance greater than 20% in these models. The fairest weight distribution is most evident in the neural network model, where all variables have importance greater than 80%. This can be explained by the network structure with hidden layers in the neural network. This allows independent variables to be connected with intermediary nodes in the network and contribute to the model's prediction results.

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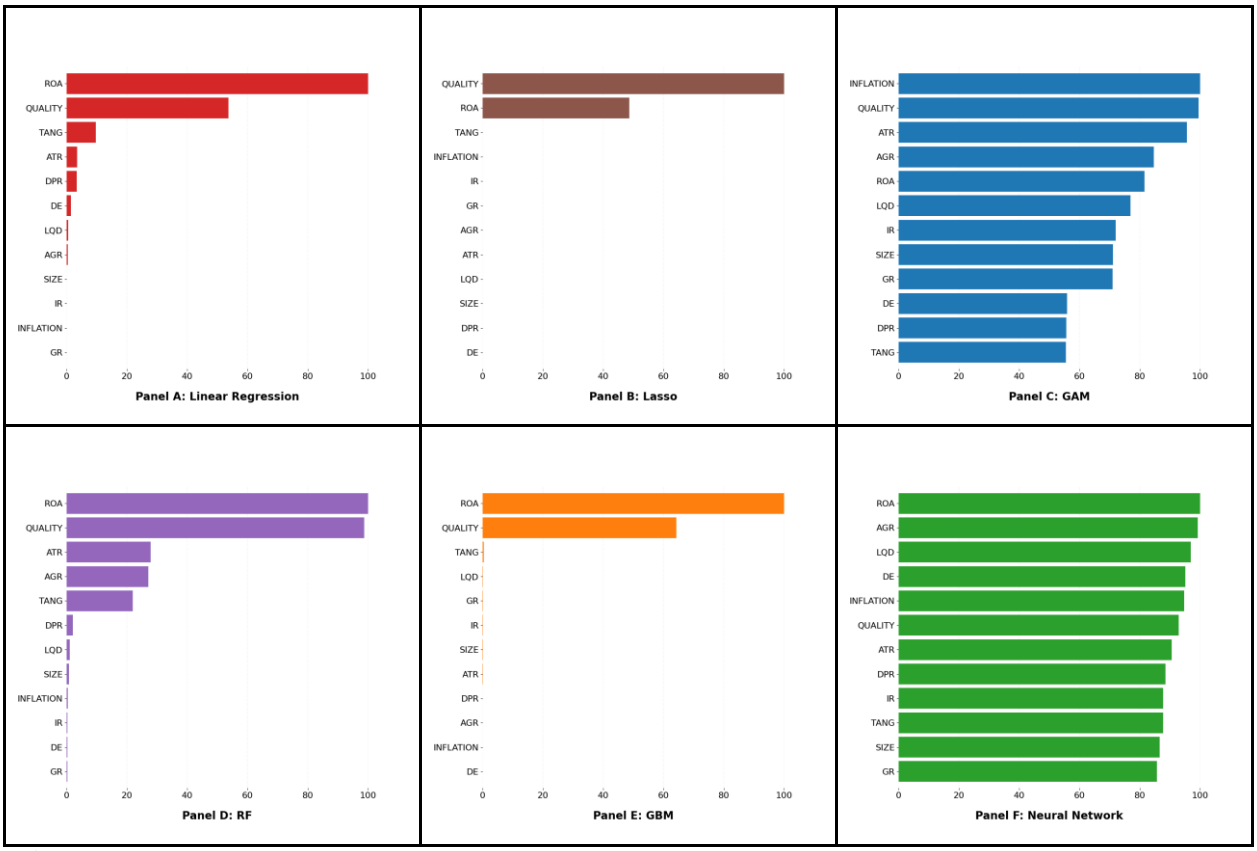

Figure 1.
The importance of variables.

5. Conclusion

This study employs both traditional statistical models and six modern machine learning models to analyze the impact of financial decisions on firm value of 646 listed companies on the Vietnam Stock Exchange from 2012 to 2022. The results of the traditional model indicate a positive correlation between investment decisions, financing decisions, dividend payout decisions, and the value of the companies during the research period. The machine learning methods were carefully selected to overcome the limitations of traditional methods and previous machine learning approaches, such as overfitting or addressing non-linear relationships between variables. Thus, the study demonstrates the compatibility between the results of the traditional approach and the modern machine learning models used in the study.

Based on the research findings, the article proposes the following issues:

Regarding investment decisions, Vietnamese companies can increase the value of their businesses by investing in fixed assets and expanding their business scale. Investing in fixed assets not only allows companies to increase production and business capacity but also contributes to improving business efficiency, generating stable, and sustainable development for the company - the main source of business value growth. Moreover, firms should ensure that their existing fixed assets are being utilized efficiently and to their full potential before considering new investments, which involve optimizing production schedules, maintaining assets effectively, or exploring ways to enhance asset productivity. Moreover, firms should focus their fixed asset investments on assets that are strategically important for their core business operations, such as production facilities, specialized equipment, or infrastructure that can provide a competitive advantage. For financing decisions, financial managers need to determine the

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appropriate ratio between debt and equity to maximize business value and minimize financial risk. The capital structure is not fixed but needs to be flexibly adjusted over time to suit business conditions and new investment opportunities. With dividend payout decisions, financial managers need to assess the financial situation of the company that includes examining financial indicators such as profitability, cash flow, debt, and assets in order to maximize the firm value.

Finally, besides applying the traditional statistical methods, applying the learning machine could be considered as a useful technique while predicting the firm value. It means that the learning machine might bring more benefits in financial areas for forecasting purposes.

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Transparency:
The authors confirm that the manuscript is an honest, accurate and transparent account of the study that no vital features of the study have been omitted and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Authors' Contributions:
Writing –review & editing, writing –original draft, visualization, validation, supervision, software, resources, project administration, methodology, investigation, funding acquisition, formal analysis, data curation, conceptualization, T.D.T.V. and T.D.V.; writing –review & editing, writing –original draft, methodology, formal analysis, D.T.V.T.; writing –review & editing, writing –original draft, methodology, formal analysis, M.N.T.X. All authors have read and agreed to the published version of the manuscript.

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