Dividend Pay-out Policies of Listed Companies on the Ho Chi Minh City Stock Exchange

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Tung Nguyen
Student ID: 21102759

School of Computing
National College of Ireland

Supervisor: Noel Cosgrave

National College of Ireland

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School of Computing

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Dividend Pay-out Policies of Listed Companies on the Ho Chi Minh City Stock Exchange

Tung Nguyen
21102759

Abstract

This paper is a research project focuses on exploring how well machine learning can predict dividend policy of public companies listed on the Ho Chi Minh City Stock Exchange in Vietnam. As dividend payment is of great interest to investors and academics alike, and the number of available research on this topic is quite limited, this research hopes to contribute to the pool of knowledge regarding dividend policy on the stock market in Vietnam. The dataset used is collected from non-financial companies listed on the stock exchange from 2007 to 2021, upon which panel regression models were applied to predict dividend pay-out ratio. Overall, despite the error metrics that were used to evaluate the prediction returned relatively small values, the chosen statistical learning model did not perform well in predicting dividend policy of listed firms as the prediction's residuals plot was not randomly distributed, therefore violating the linearity assumption of the model. The paper's findings thus raise the need for future research with additional data as well as new variables to better predict the dividend policy of public companies in Vietnam.

1 Introduction

When talking about the health of the economy of a nation, the performance of that country's stock exchange is usually mentioned alongside other macroeconomic indices such as GDP growth or inflation. This highlights the importance of the stock market as an indispensable tool to provide needed capital for enterprises and in turn fuel the economy. Investors are drawn to spend their money on the stock market due to the prospect of realizing capital gain or receiving economic benefit in the form of dividend payment, which is considered more stable due to the volatility of stock prices (Wahjudi, 2020). Therefore, the need to understand dividend policy is essential not only for investors but also enterprise executives who wish to optimize their companies' financial performance as well as maximize their shareholders' wealth (Rój, 2019).

While there has been a huge amount of works that focus on the stock market, few have attempted to predict the dividend pay-out policies of listed firms. As a result, this research paper will try to fill in this gap by utilizing supervised learning technique to predict dividend payment of publicly traded companies on the stock exchange. Considering that nearly every country has a functioning stock market, the research will limit its scope to the public companies currently being listed on the Ho Chi Minh City Stock Exchange (HOSE) in Vietnam, one of the fastest developing economies in Asia.

The research question is “how well could machine learning predict dividend payment policies of publicly traded companies on the Ho Chi Minh City Stock Exchange”. The policies being studied are decisions made by public companies whether to pay out dividends or not. Also, they determine the type of dividend being paid to shareholders would be either cash or stock, and the amount of dividend paid per share. In addition, machine learning refers to the training of mathematical models to get familiar with the data and then utilizes these models to make prediction based on what they have learned. The predictions obtained could help to answer the questions stated above, which measures how well machine learning technique could predict dividend pay-out of listed firms.

For a developing market such as Vietnam where the legal framework is not as complete and effective as in developed countries, economic theories as well as findings from existing works carried out in other market may not hold true. Therefore, it is necessary to examine the characteristics of the dividend policies landscape in Vietnam and see if they can be predicted using knowledge gathered from studies undertaken in other countries. Should the results derived from this project succeed in answering the research question, it will help investors with better giving decisions on the stock exchange which in turn improve the market’s efficiency and predictability. Moreover, executives of listed firms on the HOSE could also benefit from these findings. Specifically, instead of deciding whether to pay out dividend and the amount per share on a yearly basis, the board of management could devise a long-term strategy, using relevant financial metrics discovered in this research to predict possible dividend payment based on their historical data.

The following sections and subsections will give a detailed description of the steps taken to answer the research question mentioned above. First, there will be an extensive critical review of existing works, beginning with an introduction regarding the dividend policy in Vietnam. This is followed by a review of various determinants of dividend policies across different stock markets around the world. Work related to predicting dividend payment will be thoroughly review at the end of this section. After the literature review, the next section will lay out the methodology being followed for this project, starting with the data collection. Next comes the data pre-processing and transformation of the data, which will be followed by a selection of variables and how to calculate them. Furthermore, a statistical learning model will be proposed for this research as well as relevant tests needed to choose the most suitable one for this dataset. The error metrics used for evaluating the prediction results will also be mentioned in this section as well.

After the methodology, an overview of the variables and the distribution of the dependent variable will be presented in the implementation. Next, the regression results from the proposed models will be detailed in the evaluation, along with a discussion on the prediction made by the most suitable model. The final section will conclude on the findings of this project and whether this paper has successfully answered the research question or not. The conclusion will also state the contributions of this paper to the existing pool of knowledge regarding the dividend policy on the stock market as well as proposals for further work needed to improve the research in the future.

2 Related Work

2.1 Background on Dividend Policy in Vietnam

For a developing economy such as Vietnam, the stock market is still on its way to becoming a more stable and trustworthy equity market. Established in the year 2000, the trade volume and value of the Ho Chi Minh City Stock Exchange (HOSE) has been increasing steadily win the last two decades, with the addition of new listed firms every year[1]. As in the case with any equity market, stockholders are concerned with the returns for their investment in the form of dividend payment or capital gain. While capital gain depends on the rise and fall of stock prices, dividend payment is determined by each company's policy which changes by period.

Specifically, dividend policy comprises of rules issued by a firm's board of management regarding the payment of dividend to their shareholders. This policy determines if dividend should be made in the form of cash or stock, and the amount paid per each outstanding share. Since the firm's financial performance changes from one period to the next, the dividend policy is not fixed but will be publicly announced by the management board after the end of each period. Nguyen et al (2021) found that the average dividend rate on the Vietnam stock market is around 10%, suggesting firms tend to retain profit to maintain their cashflow. They further conclude that dividend policy in Vietnam varies greatly between each listed firm, which indicate the payment of dividend largely depends on business strategy rather than economic theory.

The current Vietnamese law doesn't require public companies on the stock market to pay dividend under any circumstances; however, dividend made by either cash or stock is taxed at a 5% rate. One empirical study found that more than 75% of listed firm in Vietnam choose to pay dividend by cash rather than stock due to Vietnamese investors prefer immediate cash benefit to capital gain (Nguyen, et al., 2020). Moreover, on a macroeconomic level, the government's monetary loosening policy has a positive effect on corporate dividend pay-out in Vietnam since it enables firms to access credit easier and lowers the cost of financing (Tran, et al., 2019). Overall, the works cited above provide some information on the particularities of dividend payment in Vietnam, with one notable point being the great variance between dividend payment of each listed companies on the stock market. This will present a challenge for building a statistical model that could fit with all of the companies in the dataset. The next subsection will review existing works on various financial indicators that determine dividend policy payment across different stock exchanges.

2.2 Determinants of Dividend Policy on the Stock Market

Building an effective model to predict dividend pay-out requires appropriate financial indicators to act as independent variables. Due to the differences of each stock exchange, there hasn't any consensus reached until now regarding what factors determine the dividend policy of publicly traded companies on the stock market. As a result, the researcher will try to

[1] https://ssc.gov.vn

provide a critical review of existing studies to act as a benchmark for the project's model calculation and evaluation.

Within the South East Asian region, a number of works have explored dividend policy of listed firms in countries with similar social and economic conditions as Vietnam. Lloren-Alcantara (2020) conducted a study on the impact of different factors on the dividend decisions of Philippine-listed firms in the period from 2014 to 2018. Utilizing logit regression to test whether the decisions to pay out dividend are influenced by these financial indicators, the author concluded that Profitability, Firm Size, Liquidity and Financial Leverage all have significant impact on the dividend policies in the Philippines. Furthermore, they applied the pooled OLS model to test the relationship between these indicators with the dividend pay-out amount. The results are different from the logit regression model as only Liquidity and Firm Size are the significant determinants of dividend pay-out ratio. From these findings, it can be inferred that the determinants of dividend policy may differ depending on the dependent variables and models being used, even if they are applied on the same dataset.

Besides the Philippines, Shafai et al. (2019) carried out a study using data taken from the Bursa Malaysia to investigate the relationship between different financial metrics and dividend policies of listed Malaysian firms. Using a panel dataset as input, the authors applied the Generalized Method of Moments (GMM) model with the results being reported for both Difference GMM estimators (One Step and Two Step). The final results show that a variety of metrics such as Profitability, Financial Leverage, Firm Size, Business Risk and Growth significantly affect the dividend pay-out ratio of publicly traded firms.

In another South East Asian country, Financial Leverage and Liquidity are also found to be of significant impact on Dividend pay-out ratio of listed firms on the Indonesian Stock Exchange (Nurchaqiqi & Suryarini, 2018). The authors chose to focus only on the real estate and construction sector, making their findings only valid for a limited number of firms. However, the dataset used for this model only consisted of 23 companies in the duration of 3 years, resulting in a small sample size of 69 observations. As a result, there needs to be further research using larger dataset to strengthen the findings of the authors. Tohri Muhamad et al. (2022) carried out another study in Indonesia to test the relationship between Liquidity and Financial Leverage on Dividend Policy of listed Indonesian firm. Using Partial Least Square (PLS) regression model, they came to the conclusion that these two financial indicators have no significant impact on the dividend policy of public companies in their dataset.

Under the similar approach, Heliani et al. (2021) conducted their dividend policy research on the transportation and infrastructure sector of the Indonesia Stock exchange. They concluded that common financial indicators such as Profitability, Asset Growth or Liquidity all have no significantly impact the dividend pay-out of listed firms within the transportation and infrastructure sector in Indonesia. However, this study also utilizes a very small sample of only 84 observations, thus requiring further research in the future using larger dataset to verify its findings. Overall, the contradictory findings from these three papers carried out in the same stock exchange, which stem from different datasets and methodologies being used by the papers' authors, highlight the impossibilities to find consensus on dividend policy's determinants on the stock market.

The Bombay Stock Exchange (BSE) where the shares of public companies based in India are traded is also used in a number of different papers. Kaur (2021) studied the determinants of dividend pay-out decisions of manufacturers within the Indian automobile industry. Applying random effects panel data regression model on the dataset, the author concluded that Profitability, Firm Size, Financial Leverage are among the financial indicators that determine the decision to pay-out dividends of these firms. However, one notable limitation of this paper is that its dataset only contains 180 observations from a small pool of 12 companies, making this work's findings not representative of public companies on the stock market.

Pahi & Yadav (2021), on the other hand, investigated the pattern of dividend payments using a large sample size of nearly 65.000 observations. Applying logit regression method on the dataset, the authors concluded that Firm Size and Profitability have a significant impact on the dividend payment decisions of listed Indian firms. When looking at a particular sector, empirical research carried out by Bhayani & Ajmera (2019) was done using data from publicly traded cement companies in India. They applied both the pooled OLS and random effect models on the dataset and concluded that Profitability and Liquidity have no significant impact on the dividend pay-out ratio. Once again, these studies show that different research carried out on the same stock market could produce radically different results, thus making the task of reviewing these papers all the more necessary.

In the West Asia and Middle East regions, academics have also undertaken similar studies to identify determinants of dividend policy from publicly traded companies on the stock exchanges. Kheirandish & Khyareh (2022) tested the relationship between the growth in firms' earnings with their cash dividend payments on the Tehran Stock Exchange in Iran. Unlike previously mentioned studies, in this paper, the researchers used dividend pay-out ratio as independent variable while earnings growth act as dependent variable. Using a large dataset with 131 companies spanning a duration of 13 years, the authors were able to conclude that cash dividend pay-out ratio and earnings growth have a positive significant impact on each other, which means an increase in revenue will likely results in an increase in dividend payment of public Iranian companies. Another study was conducted using data gathered from listed companies on the Bahrain Bourse to identify the determinants of their dividend policy (Ali & Kumaraswamy, 2021). The authors of this paper applied the Vector Auto Regression (VAR) model on the dataset, and the results show that among different financial indicators, only Firm Size is found to have a significant impact on the dividend per share. Meanwhile, other variables commonly associated with predicting dividend policies of listed firms such as Profitability, Liquidity, Financial Leverage or Growth in revenue all show no significant impact on the dividend policies of these Bahraini firms.

For stock markets situated in Africa, there have also been a few studies relating to the study of determinants of dividend policy. Marobhe & Hembe (2019) embarked on a study to test the relationship between Financial Leverage ratio and dividend pay-out of listed companies on the Dar-es-Salam Stock Exchange in Tanzania. Applying generalized linear regression analysis to the dataset, the authors concluded that companies with high dividend pay-out ratio tends to have lower financial debt (or leverage). In other words, there exists a negative relationship between Leverage and dividend policy of listed non-financial Tanzanian firms on the stock exchange. In another study conducted by Nyere & Wesson

(2019), financial data of publicly traded companies on the Johanessburg Stock Exchange in South Africa are studied to identify which factors exert a significant impact on their dividend pay-out policies. The researchers selected both dividend paying and non-paying companies for their dataset, which also include delisted firm during the period of the study. Applying fixed effects panel regression method, they came to a conclusion that among different metrics used in the model, Profitability and Firm Size have a positive and significant affect on the dividend pay-out ratio, while Growth in revenue and Free Cash Flow exert a significant yet negative influence on the dividend policy of South African firms.

After looking at various stock markets in developing countires across Asia and Africa, studies on dividend policy of developped economies in Europe and North America will be explored. Taking data from the Warsaw Stock Exchange, Rój (2019) examined the financial metrics that affect the dividend decisions of public companies operating outside of the financial industry in Poland. Applying a Tobit Regression model on a dataset with 900 observations, the author identified key determinants of dividend policy of listed Polish firms, which include Profitability, Financial Leverage and Firm Size. Another study with similar goal was conducted to examine cash dividends payment of public companies within the Travel & Leisure sector on the London Stock Exchange (Erhan & Sercan, 2021). Testing both the determinants of dividend decisions and dividend pay-out ratio using logit and tobit regression model respectively on the panel dataset, the authors were able to conclude that Profitability, Financial Leverage and Firm Size all significantly affect the dividend policies of the studied firms in both the decision and the amount being paid. These findings stand in contrast to the study realized in the Philippines mentioned earlier in which two models used to identify the determinants of dividend decisions and pay-out ratio applied on the same dataset produced different results. Moreover, the studies on dividend policies from the UK and Poland returned similar results, which set them apart from previously mentioned papers where research being done in the same region or even the same countries produce vastly different outcomes.

In the United States, researchers have also carried out empirical studies on the determinants of dividend policy of public American companies. Anwer et al. (2021) focused their study on the Shariah-compliant firms taken from the Dow Jones Islamic Market Index, which denote American companies who follow the Islamic rullings. While these firms face certain constrains due to their religious background, the authors of this paper were able to identify key financial factors that significantly affect their dividend payment decicions. These include Profitability, Growth in Asset, Equity to Asset ratio and Market to Asset Book Value. Sheikh (2022) studied the relationship between public companies whose CEOs are considered to be powerful and their dividend payment policies. Applying Linear Probability Model (LPM) regression on a large dataset, the author came to a conclusion that Profitability and Free Cash Fow significantly impact the dividend policies of these firms in the sample. As the studies conducted in the US focused on unique groups of listed firms, their results differ from previously reviewed papers as well as from each other.

While each of the above-mentioned studies were done within the boundary of a single stock market, there also exist other works where the studies into the determinants of dividend policy are being done across multiple different stock exchanges. These studies are often carried out for countries belonging to a certain economic group, such as the study into the

drivers of dividend policy of publicly traded companies in BRICS countries (Mrzygłód, et al., 2021). Using data gathered from listed firms across 5 nations in 4 different continents, the authors identified the financial factors that drive dividend pay-out policy in these developping economies, which include Firm Size, Financial Leverage, Growth, Liquidity and Risk. If the BRICS is a group of five most powerful emerging economies, Heba (2022) focused their study on corporate dividend policy of public companies from the G-12 countries, a group of industrially advanced nations who regulate the international financial system. Applying logit regression model on a large dataset with nearly 9000 companies within a duration of 5 years, the financial metrics that are found to have significant impact on the dividend decisions of these firms include Profitability, Firm Size and Financial Leverage. These findings show that there exist common drivers of dividend policy even if the studies utilize data gathered from different stock exchanges with different socio-economics condition.

Besides these group-based studies, a few cross-border research focus only on a pair of countries to identify any notable difference between them. Lixia (2020) compared the dividend policies of publicly traded logistic and transportation companies operating in China and Thailand. Applying the Pooled OLS model on the dataset comprise of listed firms from both countries, the author concluded that the financial factors that significantly affect the dividend pay-out of firms on the two stock exchanges are nearly similar, which include Profitability, Growth in revenue, Financial Leverage as well as Liquidity for both countries. In another study which was also carried out in two Asian markets, Basharat et al. (2022) highlights the difference in dividend policies of public firms in Japan and South Korea, two major developped economies in the same geographical region. Applying both the Least Square Dummy Variable and Error Component models on the dataset collected from both countries, the authors identified common and distinct drivers of dividend policies between these two nations' listed firms. Specifically, Firm Size and Profitability are found to have significant impact on dividend pay-out in both Japan and South Korea; however, Free Cash Flow is found to be a determinant of dividend policy in South Korea but not in Japan.

Besides studies focused on stock markets belonging to certain economy groups or neighboring countries, some reserchers based their work on data collected from many different countries without a grouping criterium. Neves et al. (2020) chose to look at the financial metrics that affect dividends per share of listed firms in the telecommunications sector across countries in Europe, the US and Canada. The results from applying panel regression model on the dataset show that financial factors such as Financial Leverage and Free Cash Flow significantly affect the dividend pay-out of telecommunications firms in Europe and North America. Looking at the dividend policy practice of a large sample of public companies across 18 different countries, the work of Rajesh & Ranjan Das (2021) revealed the inconsistency of financial metrics as determinants of dividend policy between different countries. While Liquidity proved to be a consistently significant metric for predicting dividend payment in every countries studied, Firm Size on the other hand changed its significance status depending on the countries. The authors concluded that for countries that have strong legal principles, advanced economic development as well as high level of protection for investors, the financial metrics that impact dividend pay-out tend to be similar.

Therefore, studies carried out in developping stock markets such as those mentioned in previous paragraphs produced different and sometimes contrasting results with each other.

Overall, it can be seen from the academic works reviewed herein that there cannot be a consensus on what financial factors determine dividend pay-out policy. However, common indicators such as Profitablity, Liquidity or Financial Leverage could be used to build a statistical learning model as they appear frequently within the empirical studies on dividend pay-out. Furthermore, despite the difference between each research paper in choosing the variables, the source of data or the research model, common features can be found among them. One of the notable similarities in most of these studies is the criterium for choosing the public companies to be included in the dataset, which are non-financial. Due to the special regulations for firms working in banking, insurance and other finacial-related industries, they are usually not included in the scope of research on the general dividend policy of public companies. Besides, all of the dataset being used in these studies is of panel data format. As a result, the algorithms chosen to analyse these data are often panel regression techniques such as Pooled OLS or Random Effects models.

2.3 Predicting dividend payment using machine learning method

Even though there has been a fair amount of works being done on the dividend policy of public companies listed on national stock exchanges, most these studies explore the financial factors that determine dividend pay-out. Empirical studies on predicting dividend payment of listed firms remain scarce, with a notable example being the study by Lee & Hsu (2021) in which these authors tried to predict cash dividend payment of the Formosa Plastic Corporation in Taiwan. The input data for this model includes monthly opening and closing stock prices, along with the highest and lowest trading prices. The model also utilizes other internal financial metrics such as Earnings Per Share to represent Profitability and Price-To-Earnings to represent Stock Valuation, along with the monthly revenue. To evaluate the performance of the model's prediction, the authors employed different measurements such as Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE) and Root Mean Square Error (RMSE).

In the end, they concluded that their model produced an excellent outcome as the prediction values returned a relatively low MAPE at only 3%. However, there exists a few limitations to this study. One of its shortcoming is the fact that the researchers only use data taken from one unique corporation, the dataset being used is relatively small and not being representative of the public companies on the stock market. Moreover, while dividend policy is affected by a lot of different financial metrics as discussed in the previous subsection, the supervise learning model in this study relies upon stock price fluctuation and only employs three financial metrics. For these reasons, the model may not work well with predicting cash dividend payment of listed firms. As a result, further studies with larger dataset need to be taken to prove the model's effectiveness in predicing cash dividend payment.

Overall, the existing scientific studies into the dividend payment of public companies on the stock exchanges have helped the author with a comprehensive understanding of the financial factors that determine dividend policy. These factors can be used to build up the statistical model, which will be laid out in the Research Methodology section below.

3 Research Methodology

After reviewing relevant scientific journal articles relating to the dividend policy in Vietnam and its determining factors across different stock markets in the world, this paper will now give a detail description of the methodology being followed. Among existing commonly used methodologies, the KDD (Knowledge Discovery in Database) is deemed the most suitable for this project as this research doesn't have any business objective. Following the KDD approach, the author performed the below steps to answer the research question stated at the beginning of this paper.

3.1 Data Collection

Since the focus of this study is the dividend policy of listed companies on the Ho Chi Minh Stock Exchange (HOSE) in Vietnam, data taken from the financial reports of public companies on the HOSE needs to be collected. In Vietnam, publicly traded companies are required by law to publish their audited financial report every quarter to the general public; therefore, all the data was collected from websites[2,3] specialised in providing stock market information and no primary data was used.

As the HOSE was only founded in 2000, the number of firms listed on the stock exchange increased over time. To create a sufficiently large dataset that can be used as input for the model, quarterly data of listed companies starting from the year 2007 until 2021 was selected which results in a time interval of 60 periods per company. Moreover, as highlighted in the Related Work, most of the existing studies into dividend policy exclude firms operating within the finance industry since they are subject to financial regulations and requirements which are different from other non-financial firms. Therefore, this research chose to filter out public companies working in banking, insurance, and financial securities industries on the HOSE. With the criteria on time period and industry, the sample consists of quarterly data of 63 public and non-financial Vietnamese companies for a duration of 15 years.

3.2 Data Pre-Processing and Transformation

After downloading the financial reports from the chosen companies, there needs to be further processing and transformation to make the data suitable for analytics purpose. The downloaded data comes directly from the selected companies' financial reports, including balance sheets, income statements and stock price movement reports that indicate basic information such as total asset, total equity, net profit, etc. Since previous empirical studies utilize panel dataset as input for their statistical model, downloaded data were also re-organized into panel data type, in which the companies' financial performance are observed over quarterly period for a duration of 15 years. This results in a master dataset with a column representing company's name and a column detailing time period with a total of 3,780 observations.

[2] https://www.cophieu68.vn/
[3] https://finance.vietstock.vn/

Having assembled all the data into a single file, the data was checked for missing value. Next, the data type of each column was checked to see if all the data point in the same column belongs to similar type. For a dataset that contain financial information, the data type of each column is expected to be of numeric type. Moreover, new features are engineered for the statistical learning model from existing data to represent different variables. The next subsection will give a detailed explanation of what variables were chosen for this research and how to calculate them.

3.3 Selected variables for the model

Based on the insights garnered from reviewing relevant scientific journals and conference proceedings, seven financial indicators were selected to be used as independent variables. The first metric is Profitability, which is mentioned as a determinant of dividend policy in nearly every reviewed paper. Depending on the research, Profitability is either represented by the Return on Asset (ROA) such as in the works of Lloren-Alcantara (2020), Kheirandish & Khyareh (2022) Heba (2022) or Return on Equity (ROE) such as in the work of Rój (2019). The common view on the impact of Profitability on dividend policy is that the more profit a company generates, the more dividend it will pay to the shareholders. The ROA ratio was selected as a representation of Profitability of listed firms on the HOSE, calculating by dividing the Net Income over the Total Asset as shown in equation 1 below.

$$ROA = \frac{Net\ Income\ of\ Company}{Total\ Asset\ of\ Company} \quad (1)$$

The next independent variable being selected is the Growth Opportunities, representing the expectation of investors on the potential for growth of the public companies. For companies experiencing high growth rate, the common belief is that they tend to withhold their earnings to finance for future operation and investment, resulting in low or no dividend being paid. Previous studies such as Shafai et al. (2019) or Kheirandish & Khyareh (2022), however, concluded that Growth Oppoprtunities in fact has a positive relationship with dividend pay-out, contradicting the theory above. While there exists a number of different ratio to represent Growth Opportunities, the Market-to-book ratio (P/B) as shown in equation 2 below was selected, similar to the approach taken by Emeka (2020). This ratio shows how much money the investors are willing to pay for a particular stock compared with its intrinsic value and thus captures the prospect for growth of this company.

$$GROWTH = \frac{Market\ price\ of\ Stock}{Book\ price\ of\ Stock} \quad (2)$$

The third independent variable is Financial Leverage, which was found to exert a significant impact on dividend policy of listed firms in the studies of Kaur (2021), Ali & Kumaraswamy (2021) and Marobhe & Hembe (2019). The conventional view regarding Financial Leverage's impact on dividend pay-out is a negative relationship between the two factors, which means when a company has a higher level of debt, it will reduce the diviend paid out to investors and use the retained earnings to fulfill its debt obligation. The Debt to

Equity ratio calculated in equation 3 was selected to represent the leverage ratio, similar to the approach taken by Kaur (2021)

$$LEVERAGE = \frac{Total\ Debt\ of\ Company}{Total\ Equity\ of\ Company} \quad (3)$$

Another important financial metric to be included in the model is Risk, a factor which every business faces no matter how large they are or how well their business perform due to the ever changing nature of our living environment leading to uncertainties outside of human control. The commonly accepted theory relating to Risk is that for companies that are perceived to be risky, its board of management will tend to withold dividend payment to save the available cash to lessen the risk of insolvency. Even though this view is challenged by findings from a lot of existing studies, Risk was found to be of significant impact on diviend pay-out. In order to calculate this financial factor, researchers applied different ratio such as liquidity ratio in the study by Mrzygłód et al. (2021) or the beta in the study by Shafai et al. (2019). For this research, the Price per Earning ratio (PER) was chosen to represent the Risk factor as was done by Sharma & Bakshi (2019). This ratio reveals the perception of the market regarding a particular stock, with a low PER indicates that investors are not willing to pay more for this stock and thus it is deemed riskier to invest. The calculation of this ratio can be found in equation 4 below.

$$RISK = \frac{Price\ per\ Stock}{Earnings\ per\ Share} \quad (4)$$

The next independent variable to be included in the model is Size of the listed firm, a commonly found financial metric in the studies relating to dividend policy. Public companies with bigger size normally have a large reserve of cash, plus they have more power to negotiate a better loan term on the debt market. Therefore, these companies could theoretically pay more dividend to shareholders as they do not have to worry too much about reserving cash for future operation and investment. The Size factor was found to be an important determinant of dividend pay-out in the previously reviewed papers such as Pahi & Yadav (2021) and Ali & Kumaraswamy (2021). The size of a company in this model was calculated using the natural logarithm of the company's total asset, as shown in equation 5 below. This is the most common stand-in for size when studying the determinants of dividend policy and was also applied in the works of Shafai et al. (2019) and Tinungki et al. (2022).

$$SIZE = LN(TOTAL\ ASSET) \quad (5)$$

One more internal financial indicator to be included in the model is Liquidity, which indicates how easy it is for public firms to convert their asset into cash or cash equivalents. Liquidity was found to exert a significant impact on dividend decisions and payment amount of public firms, such as in the studies conducted by Lixia (2020) and Rajesh & Ranjan Das (2021). A firm that is perceived to have greater liquidity is believed to be more willing to pay out dividend to shareholders as they are able to generate cash quickly to fulfill their debt obligation, thus reducing the need to withold their retained earnings. The current ratio

calculated in equation 6 below was used to measure the liquidity for this model, equivalent to current asset divided by current liability which was also applied in the study of Lixia (2020).

$$LIQUIDITY = \frac{Current\ Asset}{Current\ Liabilities} \quad (6)$$

The final independent variable selected for the statistical learning model is a macroeconomic factor, which is the Gross Domestic Product (GDP) growth rate. While it does not commonly appear in studies relating to dividend policy, the GDP growth rate is one of most popular indicator being used to evaluate the health of an economy and consequently it will impact the stock market. Lotto & McMillan (2020) did incorporate the GDP per capita amount into their study and concluded that it had a significant impact on the dividend pay-out of publicly traded companies in Tanzania. However, the GDP growth rate was selected in lieu of per capita value to represent the year on year growth in the value of gross domestic production of the economy. This ratio can be calculated as in equation 7 below.

$$GDP = \frac{GDP\ Current\ Period}{GDP\ Previous\ Period} - 1 \quad (7)$$

Finally, to complete the model, the dependent variable was selected, which acts as a stand-in for dividend policy of listed firms. Previous studies used a variety of different measurements for dividend payment, from Dividend Per Share (the dividend amount paid to shareholder per one share), Dividend Pay-out Ratio (the ratio between Total dividend pay-out and net income of the company) to Dividend Yield (the ratio between DPS and the company's share price). For this research, the Dividend Pay-out Ratio calculated in equation 8 was chosen to represent the dividend policy and acts as the dependent variable in the model.

$$DPR = \frac{Total\ Dividend\ paid}{Net\ Income} \quad (8)$$

The final dataset can be obtained after calculating all of these variables for each company in each time period. Before the dataset can be used, a correlation plot was drawn to check if there's autocorrelation between any of the independent variables. Furthermore, all of the variables were normalized using the min-max normalization technique to ensure that they are on the same scale before they can be used to run the model.

3.4 Building the Machine Learning Models

Once all the necessary variables are identified, the model was constructed as in equation 9 below:

$$DPR_{i,t} = \beta_0 + \sum_{j=1}^{7} \beta_j X_{j,i,t} + \varepsilon \quad (9)$$

In which: i represents a particular listed firm in the dataset

t represents a particular quarter in a particular year
ε represents the error of the model
X represents each independent variable summarized below

Variables	Name
X_1	ROA
X_2	GROWTH
X_3	LEVERAGE
X_4	RISK
X_5	SIZE
X_6	LIQUIDITY
X_7	GDP

The regresion models to be used include the Pooled OLS Model, the Fixed Effects Model and the Random Effects Model, all of whom have been applied in previous works on dividend policy, such as studies by Kaur (2021), Lixia (2020) and Nyere & Wesson (2019). The sample data were split into train and test partitions, with data from 2007 to 2017 used for training and those from 2018 to 2021 used for testing. Among these models, the Pooled OLS does not consider the effects of time and space within the panel dataset and its parameters are determined through the Ordinary Least Square method. For Fixed Effects model, the individual effects of the independent variables are taken into account; however, these effects are assumed to be fixed over time. Random Effects model, on the other hand, acknowledges the individual effects of the independent variables as random through time.

As these models are based on different assumptions, relevant statistical tests are performed to determine which one of these three models is the most suitable for this dataset. First, the F-Test is conducted to compare between the Fixed Effects model and the Pooled OLS model. Should the null hypothesis be rejected, which states that the unobserved and observed fixed effects are equal to zero, it can be concluded that the Fixed Effects model is more suitable than the Pooled OLS model. Depending on the outcome of the F-test, either the Breusch-Pagan Lagrange multiplier (LM) test or the Hausman test is conducted. If the Breusch-Pagan test is performed and its null hypothesis is rejected, it can be concluded that the Random Effects model is the most suitable model. On the other hand, should the null hypothesis of the Hausman test is rejected, the Fixed Effects model will be considered the most suitable model for this dataset.

3.5 Evaluation

After the most suitable regression model was identified, it was then applied on the test partition to generate dividend pay-out ratio. The obtained prediction values are compared against the actual ratio in this dataset by calculating three measurements of prediction accuracy. The results from these calculations will help answer this paper's research question of how well machine learning could predict the dividend pay-out policies of publicly traded firms on the HOSE. The first measurement to be used is the Mean Absolute Error, which

shows the average of difference between the predicted and actual value as shown in equation 10 as below.

$$MAE = \frac{1}{n}\sum_{t=1}^{n}|\hat{y}_t - y_t| \quad (10)$$

The second evaluation measure to be used in this paper is the Symmetric Mean Absolute Percentage Error (SMAPE) which reveals the percentage of error between the forecast and actual values and is calculated in equation 11. An advantage of this measure is that it can calculate the error percentage in case either the forecast or actual value equals to 0 (but not when both of them are 0). This would be useful for this research since there are many periods where companies do not pay dividend, resulting in value of 0 for the actual data.

$$SMAPE = \frac{1}{n}\sum_{t=1}^{n}\frac{|F_t - A_t|}{(F_t + A_t)/2} \quad (11)$$

The final evaluation metric used is the Root Mean Square Error (RMSE), which returns the standard deviation of the forecast errors. As the effect of each error on the RMSE is proportional to the square error, the RMSE is heavily impacted by outliers, especially when compared with other measurements such as MAE or SMAPE. The calculation of the RMSE can be found in equation 12.

$$RMSE = \sqrt{\sum_{t=1}^{n}\frac{(\hat{y}_t - y_t)^2}{n}} \quad (12)$$

As these three measurements evaluate the forecast performance based on the difference between the actual and predicted values, it can be inferred that the smaller these measurements are, the more accurate the predictions would be. These measures were used by Lee & Hsu (2021) in their study on predicting cash dividend payment in Taiwan, with the authors concluding that their predictions performed excellently with an MAPE of 2.95%, an MAE at 0.16 and RMSE at 0.2. These values will act as a benchmark for the researcher to evaluate this paper's results.

4 Implementation

Before arriving at the final results, data transformation was performed as described in the Methodology. First, the *Period* column, which was originally of character type, was transformed into year-quarter type so that it can be used in the regression models later. Then, the correlation table is drawn to check if there's multicollinearity between the independent variables in the dataset.

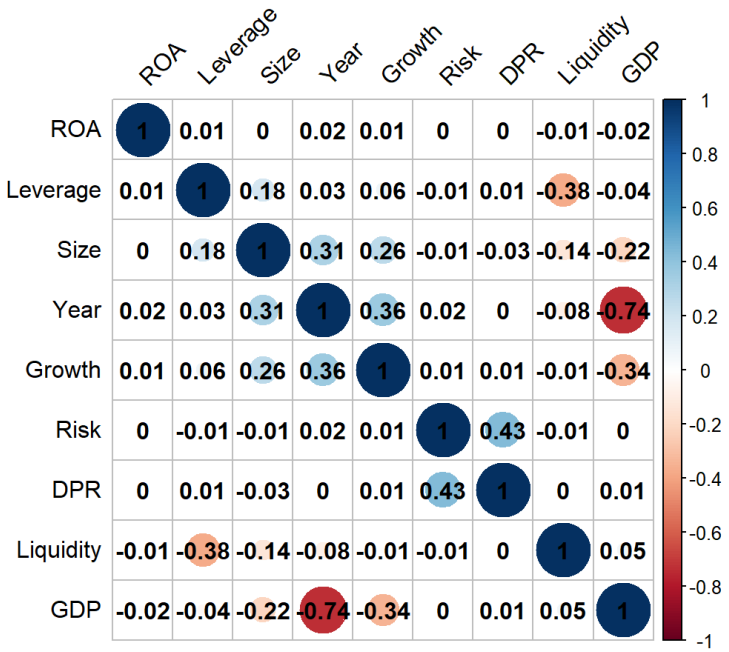

Figure 1. Correlation Table

Figure 1 shows that there is no inherent correlation between any of the independent variables in the model. However, the GDP and Year variables have strong correlation, which could create the problem of multicollinearity for Fixed Effects and Random Effects models with time period dummy variables. Therefore, time effect was left out when running these two models on the training and test partitions to prevent the problem of multicollinearity. Moreover, it can be seen from this table that apart from Risk, all other independent variables virtually have no correlation with the DPR. This could potentially result in these variables not being statistically significant against the dependent variable in the regression models. Next, the distribution plot for the DPR was drawn to check if there is any outlier present in the dataset.

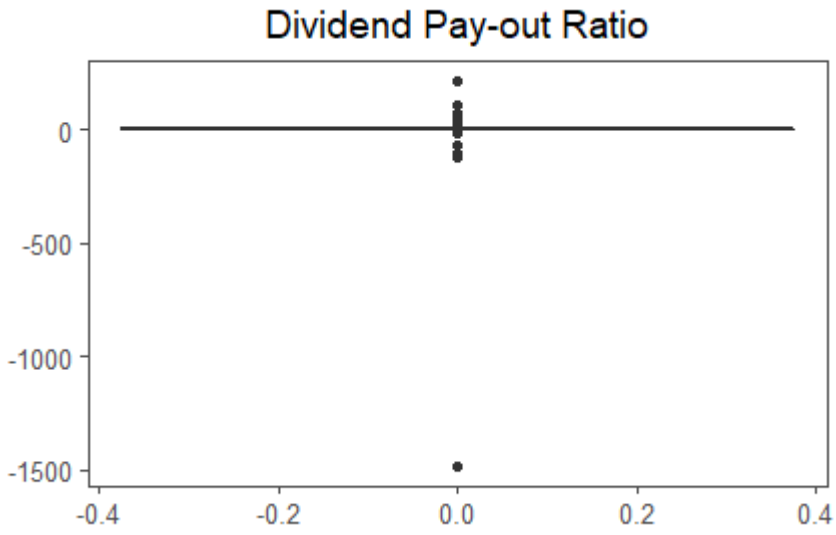

Figure 2. Distribution of Dividend Pay-out Ratio

It can be seen in Figure 2 that while the majority of the Dividend Pay-out Ratio is close to 0, there exist a few outliers with extreme values compared to the rest of the DPR. This may impact the prediction results later, especially on the RMSE as it is impacted heavily by the square errors. After checking the variables, the dataset was used as input for the three models as specified in the Methodology and the results will be discussed in the Evaluation.

5 Evaluation

As stated in the Methodology, three types of panel regression models were applied on the training dataset, whose results are detailed in the first three subsections below. These are followed by a presentation of prediction results and discussion of the findings in relation to the research question.

5.1 Pooled OLS Model

The statistical results from running the Pooled OLS Model on the training dataset are presented in the table 1 below.

Table 1. Pooled OLS Regression results

Coefficients	Estimates for Pooled OLS	p-value
β_0 (Intercept)	0.68706	
β_1 (ROA)	0.00070	0.967
β_2 (Growth)	0.00444	0.2482
β_3 (Leverage)	0.00556	0.3182
β_4 (Risk)	0.42269	<2e-16***
β_5 (Size)	-0.00275	0.1092
β_6 (Liquidity)	0.00201	0.6963
β_7 (GDP)	-0.00004	0.9767
R-Squared	0.21554	
Adjusted R-Squared	0.21355	
F-Statistic	108.489	
p-value	<2.22e-16	

From Table 1, it can be seen that the Pooled OLS regression model has a rather low R-Squared and Adjusted R-Squared value at only around 21%, which means the model can only explain for 21% of the variability of the dividend pay-out ratio. Furthermore, the p-values of the independent variables in this model show that only one factor (Risk) has a significant impact on the dividend pay-out. Its coefficient indicates that dividend payment is positively impacted by Risk, which means perceived riskier firms tend to pay more dividend to their shareholders. This result is similar to the finding from the work of Sharma & Bakshi (2019) carried out in India. All other financial metrics does not appear to be of significance to the dependent variable, which could partly explain for the low value of R-Squared.

5.2 Fixed Effects Model

After running the Pooled OLS model, the researcher then applies the training dataset on the Fixed Effects model with individual effect only, collecting the statistical results in the table below.

Table 2. Fixed Effects Regression Results

Coefficients	Estimates for Fixed Effects	p-value
β_0 (Intercept)	0.00973	
β_1 (ROA)	-0.00100	0.95490
β_2 (Growth)	0.00336	0.48710
β_3 (Leverage)	0.00088	0.91890
β_4 (Risk)	0.42295	<2e-16***
β_5 (Size)	-0.00032	0.94660
β_6 (Liquidity)	0.00162	0.78700
β_7 (GDP)	0.00007	0.96090
R-Squared	0.21375	
Adjusted R-Squared	0.19368	
F-Statistic	104.94	
p-value	<2.22e-16	

The results from the Fixed Effects regression model with individual effects are quite similar compared to the Pooled OLS model. Specifically, the R-Squared and Adjusted R-Squared value are around 20%, and only the Risk factor is proved to have a significant impact on the dividend pay-out ratio.

5.3 Random Effects Model

Finally, the training dataset is applied on the Random Effects model, whose regression results are detailed in table 3 below.

Table 3. Random Effects Regression Results

Coefficients	Estimates for Random Effects	p-value
β_0 (Intercept)	0.00937	
β_1 (ROA)	0.01705	0.967
β_2 (Growth)	0.00384	0.2481
β_3 (Leverage)	0.00557	0.3181
β_4 (Risk)	0.01540	<2e-16***
β_5 (Size)	0.00171	0.1091
β_6 (Liquidity)	0.00516	0.6963
β_7 (GDP)	0.00136	0.9767
R-Squared	0.21554	
Adjusted R-Squared	0.21355	
F-Statistic	759.424	
p-value	<2.22e-16	

Once again, the regression results from the Random Effects model show similarities with the results from the previous two models. It can be inferred from these results that most of chosen variables for this project do not determine the dividend policy of listed firms on the HOSE and resulting in low-fit models. In order to choose which model is the most suitable one, three statistical tests were carried out, namely the F-Test, the Hausman Test and the Breusch-Pagan Test. The results of these tests are summarized in the table 4 below.

Table 4. Statistical Test Results

Statistical Test	F-Test	Hausman	Breusch-Pagan
Probability	0.6645	0.992	0.5565

The p-values taken from performing the three types of statistical tests show that the null hypotheses of these tests cannot be rejected. In other words, the F-Test fails to conclude that the fixed factor term significantly affects the response, meaning the Pooled OLS model is more suitable than the Fixed Effects model. Similarly, the Hausman test shows that the Random Effects model is more suitable than the Fixed Effects model. In the end, the Breusch-Pagan's null hypothesis cannot be rejected, resulting in a conclusion that among the three types of regression model, the Pooled OLS is the most suitable of all. As such, this model was then applied on the test partition to predict the dividend pay-out ratio and evaluate the prediction results.

5.4 Prediction

The test dataset is used to evaluate the quality of predicting dividend pay-out ratio using the Pooled OLS Regression model. As stated in the Methodology, this project utilizes three measurements, namely MAE, SMAPE and RMSE to evaluate the prediction results. The table below summarizes these measures after running the model on the dataset and calculate the error between the actual and predicted values.

Table 5. Evaluation measurement

MAE	SMAPE	RMSE
0.00152	0.00172	0.00632

Furthermore, as this project utilizes the Pooled OLS regression model to make prediction, a residual plot was drawn to check the assumption of the linear regression model. As can be seen in Figure 3 below, the residuals of the prediction from a distinct pattern, which violate the linearity assumption of the regression model.

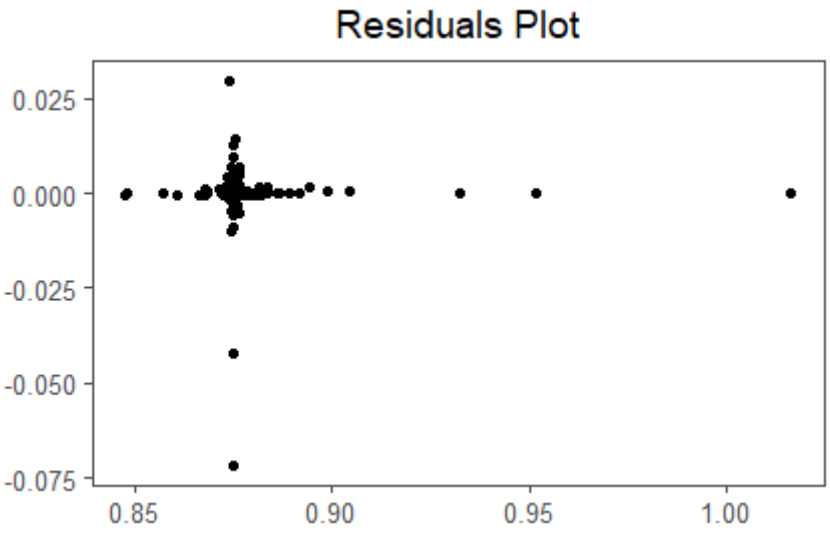

Figure 3. Residuals Plot

5.5 Discussion

As seen from the regression models' results, the R-Squared and Adjusted R-Squared obtained from after running these models on the training dataset are rather low, which means the independent variables cannot explain much for the variances in the dependent variable. Furthermore, only one out of seven independent variables is found to have significant impact on the dividend pay-out ratio, thus reducing the predicting capability of these financial metrics on dividend policy. While the evaluation measures are found to be low (under 1%), the residuals plot in Figure 3 shows that its distribution is not random, which means they are not normally distributed and thus violate the assumption of linearity in the models. Therefore, it can be concluded that the regression models applied on this panel dataset are not able to predict well the dividend policy of listed firms on the HOSE.

The existence of outliers in the dependent variable seems to have affected the regression model's results. In order to test whether the Pooled OLS regression could produce a better result on a more suitable dataset, the researcher filtered out the data point with the dependent variable between the interquartile range to exclude outliers. However, this results in a rather small sample size of only 113 observations (close to 3% of the original dataset). This new dataset is then split into a new training set to train the Pooled OLS model; then this model is applied on the new test set to evaluate the prediction. Overall, the MAE, SMAPE and RMSE of the prediction is extremely low and close to 0, with the residual plot of the new prediction is as below. As can be seen in Figure 4, the residuals in the new prediction are randomly distributed and thus satisfy the linearity assumption of the regression model. While the new results are statistically better than the results obtained from the original dataset, they are from a very small sample size selected based on specific criteria. As a result, the Pooled OLS regression model cannot be deemed suitable for predicting the dividend policy of public companies listed on the HOSE.

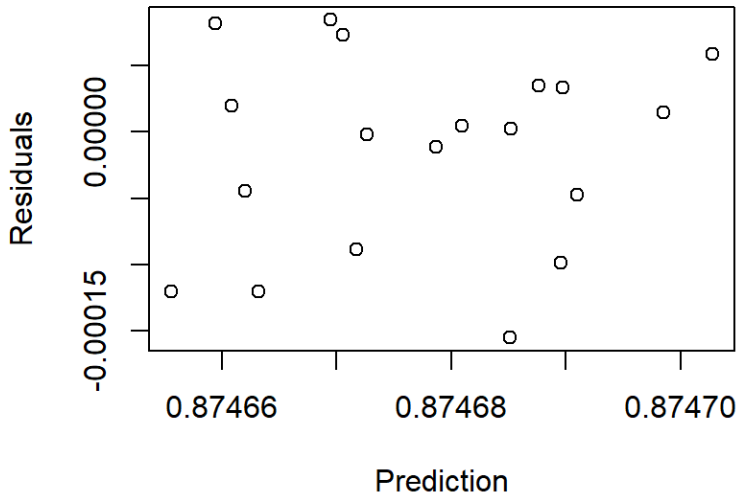

Figure 4. Residuals Plot (New dataset)

6 Conclusion and Future Work

This research paper was carried out with the aim of finding out how well machine learning could predict the dividend policy of publicly traded companies on the Ho Chi Minh City Stock Exchange. Using data collected from non-financial companies for a duration of 15 years, three types of regression models were applied and relevant statistical tests were performed on the dataset. In the end, the Pooled OLS regression model was found to be the most suitable, and this model was chosen to predict the dividend pay-out ratio on a test dataset. While the evaluation measurements that compare the actual value against the predict value were rather low at around 1%, the residuals plot invalidated the linearity assumption of the model since the residuals are not normally distributed. The model was re-applied on a much smaller sample, which yielded better results in terms of residual's distribution; however, the prediction results stemmed from such a limited dataset cannot be said to represent the dividend policies of listed companies on the HOSE.

After studying the statistical results and distribution plot of the predictions made by the Pooled OLS Regression, the researcher found that this model cannot predict well the dividend pay-out policy for non-financial companies on the Ho Chi Minh City Stock Exchange. This is due to the particularities of the dividend pay-out ratio which could be better suited for other types of learning model so as to produce better results. Consequently, future research on this subject could focus on identifying a more effective statistical learning model as well as a more inclusive dataset. Moreover, different financial indicators from the ones used in this paper should be explored and applied in future research, which could help with building a more effective model and thus returning better results.

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