Journal of Finance and Economics, 2023, Vol. 11, No. 2, 113-130
Available online at http://pubs.sciepub.com/jfe/11/2/5
Published by Science and Education Publishing
DOI:10.12691/jfe-11-2-5

How a Novel Stock Valuation Model Outperforms Traditional Models in Information Efficiency: Implications for Shareholders and Regulators

Mohamad Saad*

Department of Management, University of Tehran, Kish International Campus, 79416-55665, Kish Island, Islamic Republic of Iran
*Corresponding author: Mohamad Saad, saadmohamad313@gmail.com

Received June 03, 2023; Revised July 01, 2023; Accepted July 11, 2023

Abstract This study examines the information efficiency of eight stock valuation models, including a novel model called NAPV, to accurately estimate stock prices by reflecting all relevant information. An experiment was conducted with 65 traders, 20 evaluators, and a virtual company. The evaluators provided an informationally efficient benchmark. The stock price growth rates generated by each model were compared to this benchmark. The results indicate that NAPV was the most efficient model, accounting for 89% of the variation in the benchmark. Meanwhile, the Constant-Growth DDM, Adjusted Net Asset, and Constant-Growth RIM models explained approximately 30% of the variation. Other models showed no significant relationship. Income-based models were less efficient than other models, some generating no value at times. The two-stage model's sensitivity to estimated terminal value limits its efficiency. The findings suggest that NAPV is a promising tool for valuation, as it can decompose the stock value into key components of value. NAPV's full potential requires some regulatory measures and an updated stock pricing mechanism. Implications include shareholders carefully choosing a model, regulators enabling NAPV's potential, and developing new models addressing limitations. Future research could explore other influences on models' efficiency, study implementing regulatory measures' impact, and develop new models.

Keywords: *Stock valuation models, Information efficiency, NAPV model, Growth premium, Evaluators*

Cite This Article: Mohamad Saad, "How a Novel Stock Valuation Model Outperforms Traditional Models in Information Efficiency: Implications for Shareholders and Regulators." *Journal of Finance and Economics*, vol. 11, no. 2 (2023): 113-130. doi: 10.12691/jfe-11-2-5.

1. Introduction

This research paper examines the information efficiency of different stock valuation models in reflecting relevant information and estimating stock prices. The study aims to address the following research question: which stock valuation model is the most efficient in reflecting relevant information and estimating stock prices?

There is an ongoing debate about which stock valuation model is most effective and accurate in predicting stock prices and reflecting market information. While many valuation models are commonly used, such as the dividend discount model and discounted cash flow model, the accuracy and efficiency of these models are still questionable. The choice of valuation model is crucial, as it can significantly impact the estimation of a stock's intrinsic value and investment decisions. Therefore, there is a need to evaluate the information efficiency of different stock valuation models to determine which models are most suitable for stock valuation.

Further, this study proposes and examines a new stock valuation model called the Net Asset and Present Value (NAPV) model. The NAPV model aims to provide a comprehensive approach to stock valuation by combining net asset values, representing a company's past earnings, with net present values, representing the present value of future cash flows. This model decomposes a stock's value into different components, allowing investors and analysts to gain valuable insights into the stock's value composition and the proportion of growth premium. The study examines the NAPV model along with other major valuation models, including the dividend discount model, discounted cash flow model, and residual income model. An experiment was conducted with a simulated stock market to test the information efficiency of the different valuation models. The experiment involved a group of evaluators, assumed to behave rationally as "Homo Economicus" investors, and a group of market traders. The evaluators had full access to information and were asked to determine the correct stock price trends. These trends were then compared to the price trends formed by the different valuation models used by the traders to determine the relative efficiency of each model. Various statistical analyses, including correlation measurement, R-squared analysis, and ANOVA, were performed to evaluate the accuracy and efficiency of the valuation models in reflecting changes in stock values. Specifically, this study examined the linear relationship between the quarterly stock price growth rates generated by a group of evaluators and those generated by each of eight different stock valuation models. The null hypothesis was that there is no significant linear relationship between the two variables, indicating that the stock valuation model is not information efficient. The alternative hypothesis was that there is a significant linear relationship between the two variables, indicating that the stock valuation model is information efficient.

The findings of this study aim to provide valuable insights into stock valuation models and help investors and analysts make informed decisions when selecting a valuation model. The results suggest that the NAPV model is the most efficient model in reflecting all available information and estimating stock prices. However, the full benefits of the NAPV model cannot be achieved without regulatory changes, including a new stock pricing mechanism. A comprehensive framework is proposed in another complementary paper to implement these regulatory changes, which could significantly enhance market efficiency and stability. Overall, this study addresses an important issue in finance and provides recommendations to improve the stock valuation practices and theory.

2. Literature review

2.1. The Asset-based model

Asset-based valuation models give primary importance to the accounting information related to the book value of the assets when performing the valuation. According to the findings reported by Jan and Ou (2020) [1] on the information content of negative book value, the first instance of negative book value reporting is associated with a decline in stock prices, and this decline is in addition to any reaction the market may have had to earnings announcements. Asset-based valuations rely on accounting data such as book value, which may have limitations due to the arbitrary nature of accounting rules that may not accurately capture the true economic value of assets and therefore can result in mispricing of assets (Lev & Zarowin, 1999) [2]. Farooq and Thyagarajan (2014) [3] stated that the asset-based method doesn't require complex inputs to derive the asset value and therefore this characteristic renders the asset-based model a simple and easy to use valuation model. Damodaran (2012) [4] stated that the adjusted net asset valuation model assumes that the value of the business should not be higher than the cost of gathering all its individual assets and liabilities. The value of the business depends on both the net assets of the company and its ability and potential to generate economic profits in the future, so the value of the business is more than the value of its assets (Ghi -Mitrescu & Duhnea, 2016) [5]. The investment in marketing, research & development, and human resources will add a value to the business in the future that has not been captured by the net assets of the company (Farooq & Thyagarajan, 2014) [3]. Kirk and Wishing (2018) [6] argued that the asset-based valuation model does not necessarily conclude a liquidation value. They added that the asset-based valuation model assumes a going-concern transfer, and not liquidation, of the firm's assets. In addition, they recommended that the asset-based valuation model be used along with other valuation approaches such as the income-based model. Mohendroo and Mohindra (2017) [7] stated that it is difficult to generate the going-concern value and the true value of a company using the asset-based valuation approach especially if it has too many intangible assets rich in value. Further, they recommended investors to use the asset-based valuation approach to identify the downside value or the floor price of the company.

2.2. The Income-based models: DDM and FCF models

DDM model fails to fully capture the information contained in dividend changes, suggesting that the model is not information efficient (Lins, et al., 2017) [8]. This model, in its general form, is impractical because investors cannot estimate large number of dividends that the company might pay in the long run (Pinto, et al., 2017) [9]. Skinner (2008) [10] argued that dividend-paying companies are increasingly paying increases in earnings in the form of stock repurchase as an alternative to dividends. DDM relies on a number of unrealistic assumptions. By comparing the results from the CAPM and DDM, Lu, et al. (2021) [11] could compare the actual stock prices of Alibaba Group and Tencent to their fair values. The results show that the stock prices of both companies are overvalued indicating that DDM and CAPM are based on different assumptions, thus producing different fair value estimates. When applying the DDM, Williams (1938) [12] stated that each investor should use his or her own personal discount rate, known as the minimum required rated of return. In this case the DDM will produce different values for the same stock owned by different investors since each investor will require a distinct rate of return based on his or her own risk profile. Applying the constant growth model for many companies proved to be unrealistic, and alternatively investors assume three stages for dividends growth (Sharpe, et al., 1999). Pinto, et al. (2017) [13] argue that two-stage DDM and three-stage DDM have serious drawbacks. First, at least 75% of the stock value derived from such models belongs to the terminal value which represents the present value of dividends expected to be distributed during periods that will occur in the very far future which are hard to estimate. Second, any small error in estimating the inputs of such terminal value such as growth rate and required rate of return will strongly affect the terminal value and the resulting stock value today. Mayes and Shank (2012) [14] proved mathematically and numerically that the value generated by the constant growth model is equal to the value generated by the earnings model:

$$V_0 = \frac{D_1}{k-g} = \frac{EPS}{k} + \frac{RE_1\left(\frac{r}{k}-1\right)}{k-g} \qquad (1)$$

Therefore, the stock value generated by the constant growth DDM has the following two main components: the no growth value (NGV) and the present value of growth opportunities (PVGO). Anesten, et al. (2020) [15] tested the pricing accuracy of the dividend discount model, residual income model, and abnormal earnings growth model based on forecasts of company dividends, earnings, and book values. The dividend discount model proved to be the most accurate valuation model when given access to the true forecasted value drivers.

2.3. The Residual Income Model (RIM): an asset-plus-income based model

The Residual Income Model (RIM) stands out from other valuation methods in the literature due to its comprehensive nature, as it integrates both the income-based and asset-based approaches (Yeh, 2023) [16]. In the study described in the previous section, Anesten, et al. (2020) [15] found that the residual income valuation model generated the best pricing accuracy when the value drivers had to be predicted based on historical financial numbers, rather than the true forecasts used for DDM. This suggests that the residual income model may be more robust in practice when analysts must infer value drivers from past financial data rather than having access to true future forecasts Pinochi, Fais, and Corsiglia (2019) [17], after investigating the predictability of the RIM in US and Europe from 1995 to 2018, concluded that the residual income model is strongly effective in identifying stocks that are overvalued relative to the market and therefore is able to produce relatively higher returns. From a perspective of simplicity, it may not be necessary to estimate future earnings potential since the current book value of equity has likely already captured sufficient value, indicating that future earnings projections carry negligible value (Shrieves & Wachowicz, 2001) [18]. Lee, Myers, and Swaminathan (1999) [19] assumes an RIM with two stages. The first stage is for 3 years during ROE is forecasted to revert to the industry average of ROE. The terminal value at the end of year 3 equals RI of the third year divided by the cost of equity, which means earning RI in perpetuity assuming earnings growth in the second stage has neutral effect on the value. The validity and forecasting ability of stock valuation theories were examined by Leong, et al. (2023) [20] through an empirical study. The study utilized 19 years' worth of market data from banking firms and tested the four most commonly used theories. The results indicated that the P/E model had the strongest predictive power, followed by the RIM, DDM, and FCFE models in descending order. Cziglerné Erb (2020) [21] found that, by using specific business examples, the risks of under or overestimation can be minimized by utilizing the Residual Income Model (RIM). Although the discounted cash flow (DCF) method remains a popular choice for valuation in literature and international practice, it can produce flawed results in certain scenarios. The primary advantage of the RIM over the DCF method is that, rather than relying solely on future projections, it places greater emphasis on the known book value, while the speculative value based on accounting income plays a smaller role in the valuation process.

3. Methodology

3.1. Developing Current Valuation Models into an Efficient Stock Valuation Model

First of all, a stock valuation model, in order to be classified as an efficient stock valuation model, is assumed to meet the following three basic criteria:

1. The efficient stock valuation model is a model that can generate the intrinsic value of the stock issued by a going-concern company.
2. The efficient stock valuation model, while generating the intrinsic value of a stock, should reflect all available information relevant to the stock
3. The efficient stock valuation model should estimate the intrinsic value of the stock with the lowest possible estimation errors

3.1.1. The No-Growth Basic Value of the Stock

Theoretically, almost all stock valuation models first reflect a basic value of the stock that is considered as the starting point in the valuation model. The income-based models generate a fair value for the stock that can be divided into two components: the no-growth value, and the present of the future growth opportunities. For example, the stock value generated by the constant growth DDM reflects the following two main components of the formula explained before:

$$V_0 = No\ Growth\ Value\ Per\ Share + PVGO \quad (2)$$

The first component represents the no-growth value of the stock which represents the value of a no-growth company without earnings reinvestment and without positive NPV expected to be generated from new projects, and such no-growth stock value is calculated as EPS paid in perpetuity divided by the cost of equity required by shareholders. In addition, the residual income models (RIM) states that the fair value of the stock is equal to the accounting book value of equity plus the present value of the abnormal profits expected to be earned by the company in the future. So, the first component, the book value per share (BVPS), reflects a basic value of the stock as well. Similarly, the asset-based model generates a basic value of the stock as reflected by the book value of equity per share. This book value per share (BVPS), after adjusting the assets and liabilities to reflect their market values, is considered the fair value of the stock according to the adjusted net asset method.

Based on this, the efficient stock valuation model should incorporate this basic value along with other elements to be discussed later. However, what is the difference between the no-growth value per share and the book value per share? The no-growth value per share is calculated using the formula stated below:

$$No\ Growth\ value\ per\ share = \frac{EPS}{k} \quad (3)$$

(EPS) is the earnings per share and (k) is the cost of equity or the required return on equity. This no-growth value assumes that the company distributes all of its earnings as dividends and therefore dividends are constant and are paid in perpetuity. On the other hand, the book value per share can be calculated using a formula that resembles the above formula used for no-growth value per share. The return on equity (ROE) is calculated as net income divided by total equity. On a per share basis, it can be stated as the earnings per share (EPS) divided by the book value of equity per share (BVPS) with the latter being equal to total equity divided by the number of shares:

$$ROE = \frac{EPS}{BVPS} \quad (4)$$

This implies that the book value per share (BVPS) is equal to:

$$BVPS = \frac{EPS}{ROE} \quad (5)$$

In the case that the required return on equity (k) is equal to the return on equity (ROE) realized by the company, therefore we can state that the book value per share is equal to the no-growth value per share as shown below:

$$\frac{EPS}{k} = \frac{EPS}{ROE} \quad (6)$$

In the case that the company is able to generate an ROE from its current running projects greater than the required return on equity (k), then the no-growth value per share will exceed the book value per share:

$$\frac{EPS}{k} > \frac{EPS}{ROE} \quad (7)$$

In the above case, the ROE exceeds the cost of equity which implies that the company is generating a residual income. However, we are talking about a no-growth value where no new projects and no new growth opportunities are available, so where does this residual income come from? Actually, this residual income is generated from the projects that are already running in the company and that are generating constant earnings and return that exceed the required return. In conclusion the difference between the no-growth value per share and the book value per share is an amount that reflects the present value of the constant economic profit, or residual income, generated by those running projects in the company. From now on, I will call this amount of difference between the no-growth value per share and the book value per share as the present value of running projects (PVRP):

$$PVRP = No\ growth\ value\ per\ share - book\ value\ per\ share \quad (8)$$

The present value of running projects (PVRP) represents the present value of the residual income generated from the current and running projects. It can be calculated using the following new formula that is derived from the above formulas:

$$PVRP = EPS \times \left(\frac{ROE - k}{ROE \times k}\right) \quad (9)$$

So the basic value, or the no-growth value per share, in the efficient stock valuation model is divided into two main components. The first component is the real basic value which represents the book value per share to be called from now on the basic net asset value per share (Basic NAV). The second component is the present value of running projects (PVRP):

$$No\ Growth\ value\ per\ share = Basic\ NAV + PVRP \quad (10)$$

The Basic NAV is the book value per share in the no-growth company. Such no-growth company will generate a constant EPS and ROE in the future from its running projects. For this reason, by assuming the number of shares is constant we can say that the basic NAV is expected to stay constant in all cases except when the EPS is negative, where the book value of equity will decrease. Unless EPS is negative, changes in the ROE measure will be offset by changes in the EPS measure that is directly affected by the realized ROE. Therefore, the Basic NAV is a constant book value per share measure unless the number of shares increases or decreases. PVRP is the present value of the economic profits expected to be generated by the current projects in the no-growth company. Since EPS, ROE, and k are going to be constant in a no-growth company, as a result PVRP is constant as well. EPS and ROE represent the constant earnings and returns that can be generated by the no-growth company from its available and running projects without undertaking new projects. The basic EPS is the key element here since it affects the ROE. If such EPS generated by the no-growth company changes up or down, then PVRP will change as well. The updated PVRP based on the new level of the EPS will be taking into consideration new projects that the company has undertaken and added to its current running projects. The new level of EPS won't affect the basic NAV since it will be offset by the changing ROE. Therefore, the key element needed to calculate the two components of the no-growth value per share or to update them in the future is to know how much EPS can the company generate constantly each year from its running projects without undertaking new investments. Unless the financial manager in the company has different projections, the last EPS generated by the company is considered the basic EPS. In addition to the basic EPS, the level of the required return on equity (k) affects directly the PVRP value. If the financial manager is expecting that the ROE generated from the current and running projects will revert to the required return on equity (k) over time, this implies that PVRP should be assumed to revert to zero over time and as a result the no-growth value per share should revert to the basic NAV as well.

Up until now, the efficient model has captured the basic value of equity via the Basic NAV and the economic profit from current projects via the PVRP measure. One of the criteria assumed for the efficient stock valuation model is that it reflects all available and relevant information about the stock being valued. However, the Basic NAV is an accounting measure that reflects the historical costs of the assets and liabilities reported on the balance sheets of the company and therefore the market value of net assets is not reflected in the model. To meet this efficiency criterion, the model should reflect the difference between the cost of net assets reported by the Basic NAV and the fair or market values of these net assets. This difference will be called the revaluation per share (RPS) and will be calculated as follows:

$$RPS = Fair\ NAV - Basic\ NAV \quad (11)$$

Assuming the company is providing all information related to the fair value accounting, the fair NAV is calculated using the market value of assets and the market value of liabilities reported by the company. As the assets would be sold at market prices, and book value uses the historical costs of assets, market value is considered a better floor price than book value for a company. Such mark-to-market practice is known as fair value accounting, whereby certain assets and liabilities are recorded at their market value. The following is a common definition for the fair value that is found in both IFRS and US GAAP: "the fair value is the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date.". This means that when the market prices of the assets and liabilities change, the value of an asset or liability as reported in the balance sheet will be revalued or devalued to match their fair values. In fact, stocks are financial assets and claims over the assets of the company, and the fact that the company should know the fair value of its assets is a prerequisite for investors to know the fair value of their stocks which are considered financial claims over the assets reported by the company.

In conclusion, the efficient model is capturing now, through the no-growth value per share, three components of value: the basic value, the inflation value, and the economic value.

$$No\ Growth\ value\ per\ share = Basic\ NAV + RPS + PVRP \quad (12)$$

The investor or the shareholder can clearly see how much each component contributes to the comprehensive no-growth value per share. For example, if the PVRP contributes the largest portion in this no-growth value, then this indicates that such value is more speculative than basic. In fact, this decomposition will enhance the valuation process where each component should be estimated and identified aside which in turn decreases the estimation errors that might be caused by the stock valuation model, an important criterion in an efficient stock valuation model.

3.1.2. The Growth Premium of the Stock

The company is virtually composed of two different personalities. The first personality is represented by the no-growth company which is assumed to have a zero growth and no new investments as a result of distributing all current earnings as dividends. A no-growth company is a company that does not seek to increase its size or expand its operations. Instead, it focuses on maintaining its current level of operations and profitability. This type of company may be content with its current market share and may not see the need to invest in new products or services, expand into new markets, or acquire other companies. The value of this personality, the no-growth value of the company, is reflected by the efficient stock valuation model as was explained in the previous section. The second personality is represented by the growth company which is a company that seeks to expand its size and operations by investing in new products or services, expanding into new markets, or acquiring other companies. The value of this second personality is represented by the present value of these future investments, in other words by the present value of growth opportunities (PVGO) of the company. The present value of growth opportunities (PVGO) in a company is the value of its future growth opportunities or potential for future earnings growth that is not reflected in its no-growth value. It represents the additional value that investors are willing to pay for a company's stock based on its potential for future growth.

Practically speaking, the PVGO is calculated by subtracting the no-growth value per share from the market value per share, where the latter reflects both the company's current earnings and the present value of future earnings growth expected to be generated by this company. The formula for PVGO is as follows:

$$PVGO = Market\ Stock\ Price - No\ Growth\ value\ per\ share \quad (13)$$

However, an overvalued or undervalued stock price in the market may lead to incorrect values for the PVGO as calculated in this formula. Theoretically speaking, when the company is expected to grow at a constant rate in the future, the PVGO is reflected in the Dividend Discount Model (DDM) using the following formula which was explained in previous sections:

$$PVGO = \frac{RE_1\left(\frac{r}{k}-1\right)}{k-g} \quad (14)$$

However, this method assumes a constant growth in the company forever which is not the true case in practice. In addition, the PVGO in this formula is highly sensitive to changes in the cost of equity and growth rate estimations. Moreover, estimating these measures such as cost of equity and growth rates is complex and can differ from an investor to another. In the same framework, the Residual Income Model (RIM) reflects this PVGO by discounting the stream of residual incomes expected to be generated in the future into the present at the cost of equity. Similarly, the present value of the future residual incomes, the PVGO, in this formula is highly sensitive to changes in the cost of equity and growth rate estimations which can vary from an analyst to another.

The constant generation of new ideas about new products and projects or about how to develop old products or projects is the main determinant of the growth of the company in the future. Good ideas are translated into profitable projects that will define and boost the company's growth in the future, so the present value of those projects that are expected to be taken in the future is considered the present value of the growth opportunities of a firm. Net Present Value (NPV) is a financial metric used to determine the value of an investment or project by comparing the present value of its expected cash inflows to the present value of its expected cash outflows. The NPV calculation involves discounting the expected cash inflows and outflows of the project to their present value using the appropriate discount rate which is usually the weighted average cost of capital (WACC). If the NPV is positive, it means that the project is expected to generate more cash inflows than outflows, and therefore, it is considered a profitable investment. If the NPV is negative, it means that the project is expected to generate more cash outflows than inflows, and therefore, it is considered a loss-making investment. NPV is a useful technique used by companies in the capital budgeting process for evaluating the profitability of investments by accepting positive NPV projects and rejecting negative NPV projects. Is the sum of all NPVs of all projects expected to be undertaken by a company equal to the present value of growth opportunities (PVGO) this company has? The PVGO is a concept that provides a different approach to equity valuation that includes a combination of fundamentals and expectations, where the fundamentals are reflected in the no-growth value assuming no earnings are reinvested while the expectations are reflected into the present value of growth opportunities (PVGO). From this point, we should note that such PVGO is not a fundamental value that you will get now from selling the company or its stock, rather it just reflects the growth prospects and expectations about the company. In other words, it is just a premium (or discount) paid over (or under) the no-growth value per share to reflect the present value of the expected future earnings growth expected to be generated by the company in the future. Therefore, the premium/discount component in this case is not a principle determinant for the intrinsic value of the stock, rather it is just a variable that reflects how investors weigh and value the prospects and the future profitability of the relevant company. Since this growth premium is based on expectations, it can vary from an investor to another or from an analyst to another. For example, an investor using the residual income model (RIM) will be reflecting such growth premium or discount by calculating the present value of all residual incomes, economic profits, expected to be generated by the company in the future. The residual income model (RIM) and the net present value (NPV) technique capture this growth premium in a very similar way and approach. Donnelly (2013) [22] proved that the net present value (NPV) of a project is in fact equal to the present value of the residual income (RI) generated by the project throughout its life. Although the NPV of the project is usually calculated by discounting future net cash flows of the project under a capital budgeting process, the NPV can be calculated as a function of the economic profit expected to be generated by the project in the future. Therefore, if we use the weighted average cost of capital (WACC) to discount those future economic profits, which represent the economic value added (EVA) of the projects, we will get the NPV or the market value added (MVA) of the project as shown in the below formula, where EP is equal to the net operating profit after tax minus the dollar cost of capital (Stowe & Gagné, 2017) [23]:

$$NPV = MVA = \sum_{t=1}^{\infty} \frac{EP_t}{(1+WACC)^t} \qquad (15)$$

Moreover, by using the rate of return required by equity shareholders as a discount rate instead of the WACC rate, we can replace the economic profit in the numerator with the residual income in order to calculate the NPV of the project (Stowe & Gagné, 2017):

$$NPV = \sum_{t=1}^{\infty} \frac{RI_t}{(1+r_e)^t} \qquad (16)$$

Where RI, the residual income, is equal to net profit minus the dollar cost of equity, and (r_e) is required rate of return on the equity capital.

The principles behind valuing a company are similar to the principles used in valuing a project because a collection of projects constitutes a business or a company Donnelly (2013) [22]. The value of a project is the initial book value of the debt and equity used in this project, plus the net present value NPV of this project (Stowe & Gagné, 2017) [23]. In the same framework, we can say that the value of the business, which is a collection of different projects, is the book value of the company's debt and equity plus the NPV of all future projects the company is expected to undertake. Finally, the debt value should be subtracted from this derived value in order to calculate the shareholders' equity value. The net present value (NPV) method indicates the amount of the shareholders' wealth created by a specific project. In addition, the NPV reflects indirectly the possible effect that a project may have on the stock price. This can be done by dividing the total NPV of the profitable project by the number of shares, which will theoretically give the potential per share increase or decrease in the stock price (Brigham & Houston, 2018) [24]. In conclusion, the sum of all NPVs of all projects expected to be undertaken by a company is equal to the present value of all expected and attainable growth opportunities (PVGO) this company has, and based on this, such NPV technique should be considered as an efficient method to estimate the growth premium of the stock.

3.1.3. The equation of the NAPV model

The efficient stock valuation model is assumed to reflect all available and relevant information about the company. Therefore, it should reflect this growth premium by incorporating the sum of all net present values per share of all projects expected to be undertaken by a company, to be called from now on the NPV. Assuming that the financial management of the company will provide its shareholders with all information related to its capital budgeting process and plan that includes all planned projects along with their NPVs, the efficient stock valuation model can now estimate the intrinsic value of the stock using the following formula:

$$Stock's\ Intrinsic\ Value = Basic\ NAV + RPS + PVRP + NPV \qquad (17)$$

Based on this formula, the efficient model has the potential to capture and reflect four components of value per share: the basic value (NAV), the inflation value (RPS), the economic profit value (PVRP), and the growth value (NPV). By taking into consideration that the RPS is an added value over the basic NAV and that the PVRP is the NPV of current and running projects in the no-growth company and that future projects, whose NPVs are included, will generate new equity value and new NAV, therefore we can reduce the formula of the efficient stock valuation model as follows:

$$Stock's\ Intrinsic\ Value = Net\ Asset\ Values + Net\ Present\ Values \qquad (18)$$

$$Stock's\ Intrinsic\ Value = NAVs_{\ (Basic\ +new\ NAV)} + NPVs_{\ (PVRP\ +new\ NPV)} \qquad (19)$$

Where the NAVs includes the old Basic NAV and the new NAV expected to be generated from future projects, both adjusted for inflation (RPS). On the other hand, the NPVs includes both the PVRP, which is the old NPV of current projects, and the NPV of new projects expected to be taken in the future. By taking the letters "N" and "V" as common letters between NAV and NPV, this efficient stock valuation model will be called from now on the "NAPV" model which stands for Net Asset and Present Value model.

NAPV model has its own assumptions as listed below where some of them are critical to its functioning, while others may have only a minor impact on its performance or validity.

Primary Assumptions:

- The NAPV model is used by the company's management with the authorization of its shareholders to determine the fair value of their stock, while being supervised by the stock market regulator.
- In order to utilize the NAPV model, the model assumes that the financial statements presented by the company have undergone a thorough audit, are accurate, and have not been manipulated.
- For the NAPV model to be applicable, it is assumed that the company is obligated to regularly provide the stock market regulator with any relevant data necessary for its capital budgeting analysis.
- To utilize the NAPV model for fair value accounting, it is assumed that the company is required to disclose any necessary data related to it to the stock market regulator on a regular basis.

Secondary Assumptions:

- The NAPV model assumes that any distant projects that the company may undertake after completing its strategic plan will have no impact on the stock's value today, and their NPV is assumed to be zero.
- The NAPV model assumes that the company calculates the weighted average cost of capital (WACC) for each project based on the project's risk profile.
- The NAPV model assumes that the company uses scenario analysis to estimate future cash flows for each project based on different potential outcomes or scenarios, considering the fundamentals of the project.
- The NAPV model assumes that intangible assets, specifically goodwill, are already reflected in the NPV of future projects and can be excluded from fair value accounting.

A common definition of the intrinsic value of a stock is that it represents the value of a stock by someone who has complete understanding of the characteristics of that stock or the issuing firm. Based on this, the most critical assumption in the NAPV model is that the company itself is authorized by its shareholders to calculate the fair value of the stock under the supervision of the stock market regulator. Nobody knows more about the company and its businesses than the company itself. Therefore, the company is the best in understanding the business and forecasting its performance.

3.2. Experiment

3.2.1. Objectives of the experiment

The objectives of the experiment are threefold. Firstly, it aims to test the efficiency of a simulated stock market by analyzing the accuracy of its predictions and stock pricing. Secondly, it aims to test the information efficiency of major stock valuation models, such as the dividend discount model and the discounted cash flow model. This will help to determine which model(s) are most effective and efficient at predicting stock prices and providing valuable insights into market trends. Finally, the experiment aims to test the information efficiency of a new proposed stock valuation model (NAPV), which will be compared to the existing models to determine its effectiveness. By achieving these objectives, the experiment will provide valuable insights into the information efficiency and accuracy of the new proposed stock valuation model relative to other stock valuation models. It will also provide insights into the accuracy of stock market predictions.

3.2.2. Structure of the experiment

This experiment involves four main components: a group of traders, a group of evaluators, stock valuation models, and a virtual company.

3.2.2.1. The group of traders:

The experiment will be structured to simulate the real stock market as closely as possible. It will include one company whose stock will be traded and priced by a sample of potential traders. These potential traders will be given access to all available and designed information about the company, including financial statements, news releases, rumors, and other market data, and will be asked to make predictions about the stock's future price movements based on this information.

Specifically, the experiment will involve a group of 65 traders, consisting of finance university students in both BA and Master classes, with some having experience in trading financial markets. The traders will be asked to trade and price the stock of the virtual company on a daily basis from Monday to Thursday in each week for five weeks, which corresponds to five years in the lifetime of the virtual company assuming each day in the experiment represents a quarter in the lifetime of the company. The traders will be competing to win a prize of money compensation based on their pricing performance, which will play a role in simulating emotional factors affecting stock market traders, such as greed to win and fear of losing the prize. To simulate the real stock market, the traders will receive a daily package of different news and information about the virtual company, the stock market, and the country where the company is operating. This package of news will include rumors, fake news, overestimations, and estimations, as in the real market. Using the Google Form platform, each trader will send his or her price growth estimation and the resulting price estimation for the stock at the end of each trading day based on the released package of daily news and information. The average price of all traders in this sample will form the daily market price of the stock of the virtual company. By using a sample of traders and simulating the emotional and informational factors that affect the real stock market, the experiment aims to provide valuable insights into the efficiency and accuracy of the simulated stock market and the accuracy of different prediction models. The use of a controlled sample of traders and the manipulation of different variables, such as the daily news package and the prize compensation, will help to isolate the effects of these factors on the traders' pricing performance.

3.2.2.2. The group of evaluators:

In addition to the group of market traders, there will be a group of analysts or evaluators consisting of 20 experts in the finance field, including CFA holders and PhD holders. This group will take the enough and needed time to analyze and evaluate every piece of new information released into the simulated stock market about the company to determine the correct stock price trends far from any emotional factor. The prediction of this group is assumed to be the correct prediction forming the correct trend, which will be compared with the prediction of the first group of traders. By comparing the predictions of the two groups, the experiment will provide insights into the information efficiency and accuracy of the simulated stock market.

Specifically, the second group consisting of evaluators in the experiment is assumed to behave like a "Homo-Economicus," a term used by Baltussen (2009) [25] to describe a rational investor. The Homo-Economicus investor is characterized by several key attributes, including the ability to correctly apply the laws of probability to form beliefs and expectations, have unlimited capacity to process information whenever needed, solve complex problems, possess high computational capabilities, have no constraints with respect to attention capacity and time, behave in a consistent way free of emotions, and efficiently control preferences and decide and act accordingly. To represent the Homo-Economicus investor, the group of evaluators in the experiment is designed to meet all of these criteria. They are given access to all relevant information about the stock of the virtual company, free of rumors and fake data. In addition, they are given the information piece by piece, rather than receiving a package of different news and contradicting information and indicators, as in the real stock market. The objective is to form the correct stock price trend based on the correct information trend that serves as the benchmark formed by this group. To achieve this objective, each evaluator is asked to take enough time to assess and analyze each piece of relevant information and to give his or her price range prediction, via Google Forms, about the effect of such piece of relevant information on the stock price. For each trading day corresponding to a quarter in the lifespan of the virtual company, the individual growth rate predictions from each evaluator, reflecting all pieces of news and information released on that day, are summed to give the overall daily growth rate estimation submitted by each evaluator. Then, the daily growth rate estimations submitted by all evaluators are averaged to determine the final daily growth rate estimate for the stock price. This will form the average percentage change in stock price on a daily basis, which will ultimately form the benchmark of the correct growth estimation and the fair information trend that can be applied to any starting price assumed for a stock at the beginning of each period.

3.2.2.3. The stock valuation models:

In addition, by introducing the major stock valuation models, including NAPV, into the simulated stock market, the experiment will also help to determine the information efficiency of these models. Throughout the experiment, the group of market traders will be asked to delegate the pricing role to each of the studied valuation models, including the new proposed one. This will allow the stock price trend to be formed by the prices generated from the valuation models. The newly formed price trends will then be compared to the price trend of the group of evaluators and analysts to conclude the information efficiency of each valuation model, assuming the price trend formed by the group of evaluators is the correct one and serves as the benchmark. By comparing the accuracy of the different valuation models, the experiment will provide valuable insights into the information efficiency and effectiveness of each model in predicting stock prices and providing valuable insights into market trends.

The proposed experiment aims to apply a new model called NAPV to calculate the fair value of a virtual company's stock based on relevant news and information released over a quarter. The purpose is to determine the intrinsic value of the stock and break it down into its components. Specifically, the experiment seeks to understand how each piece of information released affects the different components of value present in the model, including basic NAV, RVS, new NAV, PVRP, and NPV. The results of this analysis will be used to generate a trend of prices that will be compared to the trend set by group evaluators to test the efficiency and accuracy of the model. The ultimate goal is to determine what would happen to the stock market if all shareholders agreed to use this model to derive stock values for buying and selling or to delegate the pricing role to the company.

The proposed experiment seeks to expand the analysis of the virtual company's stock value by incorporating other valuation models in addition to the NAPV model. Specifically, the experiment will use seven other valuation models, including the Constant-Growth DDM, Two-Stage DDM, Constant-Growth FCFE, Two-Stage FCFE, Adjusted Net Asset, Constant-Growth RIM, and Two-Stage RIM, to calculate the fair value of the stock on a periodic basis. The prices generated by each model will form a trend that will be compared to the trend set by the group evaluators. More specifically, the periodic growth rates of each price trend are compared to the equivalent periodic growth rates of the information trend set by the group of evaluators. To determine the information efficiency of each model, statistical analyses will be conducted, including correlation measurement and testing, R-squared analysis, and Analysis of Variance (ANOVA). These analyses will help to identify which models are most accurate and efficient in reflecting changes in the market. By using multiple models and statistical analyses, this experiment aims to provide a comprehensive understanding of the virtual company's stock value and the efficiency of different valuation models. The results of this experiment could have significant implications for investors seeking to make informed decisions about stock valuation and pricing.

3.2.2.4. The virtual company:

For the experiment, the Whirlpool Company was chosen as the virtual company. Whirlpool is a well-known manufacturing company operating in the home appliances industry across the world. The decision to select this company as the virtual company in the experiment involved transferring all of its financial, fundamental, historical data, and achievements to a new company with a new name. The virtual company was renamed Ahoo Co. to ensure that participants in the experiment did not recognize it as Whirlpool. All of Whirlpool's historical data was taken into account up to December 31, 2021, after which a new future for the company was designed. This experiment allows the participants to work with data from a real-life company and make decisions based on real-world scenarios. The use of a virtual company allows for the testing of different strategies, regulations, approaches, and valuations without any real-world consequences. Overall, this experiment provides a unique opportunity to gain practical experience in decision-making and analysis in a simulated business environment. The virtual company in the experiment will incorporate all of the past performance of the Whirlpool company. This will include the annual report published by Whirlpool at the end of 2021, adjusted to fit the specific assumptions made for the new company, Ahoo. The participants in the experiment will have access to the financial statements of the company for the past five years, allowing them to analyze the company's performance over time. Additionally, they will be able to see key fundamental data about the company, such as DPS, WACC, Beta, Cost of equity, and FCF, among other important financial data necessary for analysis and valuation. Moreover, participants in the experiment will also have access to the historical stock price chart of the company, allowing for technical analysis to help with pricing. By incorporating real historical data about Whirlpool, the experiment ensures that real-life conditions are preserved, while applying new factors and studies to this virtual company with a real history along with a newly designed future. This approach provides a unique opportunity to analyze and evaluate a virtual company in a simulated business environment, allowing participants in the same time to gain practical experience in decision-making and analysis. As of December 31, 2021, Ahoo Company was operating in the same geographical and business segments as Whirlpool Company. However, Ahoo Company has been virtually divided into two sub-companies: the no-growth company and the growth company. The no-growth segment assumes that the company will generate constant EPS that will be fully distributed as dividends, leading to zero retained earnings and zero growth. The growth segment assumes that the company will undertake new profitable projects in the future. Financial statements will be prepared for both segments, the no-growth segment and the growth segment which implies preparing the financial statements for each project that the company undertakes. A consolidated financial statement will be prepared by combining the statements of the no growth company and the statements of the projects undertaken by the company. All data necessary to estimate the net present value of each project will be identified, which will help in valuing the company by decomposing its value into no-growth value and growth value. Some specific assumptions will be made starting from 2022, such as quarterly sales of $5,502 for the no-growth company, a NPM of 7.91%, and a ROE of 35.87% per year from the company's running projects. The dividend policy will also change, with the DPR for the earnings generated by each project assumed to be zero in 2022 to meet financing needs of new projects and 25% starting from 2023. All projects are assumed to be average-risk projects so that the average WACC can be used to discount cash flows, and all projects have an average maturity of 5 years. The capital structure policy adopts 40% debt and 60% equity target weights to finance each project, with debts raised to finance projects repaid just after the project completion. It is assumed that closing the projects after their start is not possible, even if their NPV turns negative, since closing is assumed to cost more than continuing a negative NPV project. Each project has its own estimations for starting annual sales, growth rate per year, gross profit margin, SG&A as a % of sales, and total assets turnover. After applying the NAPV model, the stock value of Ahoo Company as of Dec 31, 2021, is $400, composed of Basic NAV, RPS, PVRP, and NPV components. This $400 stock value will be assumed as the starting stock value in the experiment and will be adopted by both the group of traders and group of evaluators. The ratio of this calculated stock price over the actual stock price of Whirlpool Company as of this date will be used to adjust the historical stock prices for Ahoo Company to make the price trend adjusted and consistent. The group of evaluators will act as fully rational investors with complete access to relevant information about the virtual company and will receive the main figures and results, while the group of traders will not receive the decomposition of the company's value into no-growth value and growth value because that is not the case in real financial markets. The experiment is designed to simulate a virtual future of the Ahoo Company from January 1, 2022, to December 31, 2026, covering a period of five years. To create a realistic trading environment, information will be released in different quarters of this period, containing news, analysis, announcements, rumors, accidents, and other factors that impact the financial markets. Some news will be positive, while others will be negative, and some will be relevant, while others will be irrelevant. Furthermore, some information will be accurate, while others will be fake as it is the case in real financial markets. In addition to designing news and information, a development plan for the Ahoo Company is also designed to identify profitable projects resulting from the capital budgeting process and analysis. All specifications about each project to be launched each year in this five-year virtual future are included in the development plan. At the beginning of each year, the company will undertake a new project that will mature after five years from its start. At the end of the experiment, the valuation process and information structure are designed to force the ending value of the stock to close at $400, the same as the starting value adopted at the beginning of the experiment. This will be achieved by making the ending values of the no-growth and growth components of the company equal to their beginning values. This approach will allow for the analysis of the performance of the group of traders and for the comparison with other valuation models.

3.2.3. The uses of this experiment in this paper and beyond

The focus of this paper is to analyze the information efficiency of the proposed NAPV model compared to other major stock valuation models. In order to answer the research questions raised in this paper, we conducted an experiment that will also be used to answer many other research questions beyond the scope of this paper. More specifically, our aim in this paper is to see how each model reflects all available and relevant information about the stock of the virtual company. By analyzing the information efficiency of each model, we can determine which model is most effective in providing reliable and accurate information about the stock. In a complementary paper, we will analyze the information efficiency of the market in two scenarios. In the first scenario, the market is left free to use any suitable approach to analyze all released information in order to give its price estimation about the stock. In the other scenario, the market is assumed to be regulated in a form that they agree to vote on or use one and only one stock valuation model to generate the stock prices to be adopted for trading in the market. Assuming that the agreed upon model is any tested efficient model suggested in this paper, the aim in the complementary paper will be to analyze how such new stock pricing mechanism imposed by the stock market regulator will affect and improve the stock market efficiency and stability. This analysis will provide valuable insights into how the stock market can be made more efficient and stable through regulatory interventions. In conclusion, the use and the benefit of this experiment in this paper is that it establishes the first important step toward ensuring stock market stability and efficiency.

3.3. Statistical analysis methodology

To analyze the information efficiency of different stock valuation models in reflecting all relevant information about the virtual company, we will transform the responses from the group of evaluators into an average price growth rate in each quarter of the virtual company's life. Assuming that this group is fully rational and behaves like the Homo-Economicus investor, each growth rate in the stock price estimated by this group at the end of each quarter is considered the fair and correct growth rate that reflects all available and relevant information released in this quarter about the company and its stock. This quarterly series of fair growth rates will constitute the benchmark to be compared with other price trends generated from different stock valuation models used in the same periods of study. We will use the NAPV model, developed in this paper, along with other models, such as Constant-Growth DDM, Two-Stage DDM, Constant-Growth FCFE, Two-Stage FCFE, Adjusted Net Asset, Constant-Growth RIM, and Two-Stage RIM, to generate separate stock price trends to be compared with the benchmark in the life of the virtual company. It is assumed that the assumptions relevant to each valuation model are put in a way that the best possible R-squared measure of each model is achieved. Thus, during comparison, we will be comparing each model's best information efficiency possible.

The second main assumption is that the analyst adopting each model for valuation can forecast the future cash flows with zero estimation errors. Since we designed the experiment, we know the future of the virtual company in a confident way. Therefore, we can make the future real cash flows and dividends available when adopting the valuation models that need to discount such cash flows. For periods with missing data, where the company is not generating or paying dividends for example, we assume that such dividends needed for the model are estimated based on the approach of the model itself. This way, the estimated values replace the missing actual value to avoid high variation and volatility in the prices generated by the model. Overall, by using these different stock valuation models and assumptions, we can compare the information efficiency of each model in reflecting relevant information about the virtual company's stock price.

In this study, we aim to evaluate various stock valuation models by applying the following statistical analysis steps taken to analyze the growth rates data. Firstly, we will compare the quarterly stock price growth rates generated by the group of evaluators with those generated by the stock valuation model under study. This will be achieved by placing the two series of growth rates data next to each other and conducting a linear regression analysis between them. The null hypothesis that there is no linear relationship between the two variables will be tested by analyzing and testing the confidence interval of the beta variable. If the interval includes zero, the null hypothesis cannot be rejected, indicating that the valuation model is not significantly correlated with the benchmark set by the group of evaluators and is therefore not information efficient. If the null hypothesis is rejected at the significance level, then a regression analysis of the linear relationship will be conducted using the ANOVA table. Therefore, such analysis of variance is performed to analyze only the valuation models that have a significant positive linear relationship with the group of evaluators.

Further, we will test the efficiency of each valuation model by focusing on the three efficiency criteria assumed for the efficient stock valuation model. The first and second criteria assume that the model, while generating the intrinsic value of a stock, should reflect all available information relevant to the stock. This implies that the model should statistically show the highest regression sum of squares (SSR) as a percent of total sum of squares or R-squared that represents the explained variation in the dependent variable. The third criterion is that the model should estimate the intrinsic value of the stock with the lowest possible estimation errors. This implies that the model should statistically show the lowest error sum of squares (SSE) that represents the unexplained variation in the dependent variable in the regression. All statistical tests will be performed using a 95% level, although higher significant levels may be used when needed to confirm and increase confidence in the results. Overall, this statistical analysis approach will allow us to evaluate the effectiveness and efficiency of various stock valuation models and determine which models are the most suitable for accurately estimating the intrinsic value of a stock based on available information.

4. Results

4.1. Main results of the experiment

4.1.1. The group of evaluators

For the experiment conducted, each evaluator was placed in an environment that was specifically designed to facilitate the digestion and analysis of all relevant information about the virtual company, Ahoo. This environment was intended to encourage rational thinking and enable evaluators to make well-informed decisions about the company's performance. Each evaluator was asked to provide a quarterly growth rate estimate for the stock price of Ahoo, based on the information they had available to them. These individual growth rate estimations were collected and used to compute the arithmetic average of all growth rate estimations submitted by all evaluators for each quarter. By doing so, a comprehensive table summarizing the observations of all evaluators was obtained. The following table provides a clear summary of the collective observations of the evaluators, and can be used to draw insights and conclusions about the performance of Ahoo during the period under review.

Based on the quarterly growth rate estimates provided by the group of evaluators, it is possible to estimate the equivalent stock prices for Ahoo company in each quarter of the experiment. Assuming a starting stock price of $400 for Ahoo company at the beginning of the experiment (i.e. as of January 1, 2022), the table also provides a clear picture of the estimated stock prices for each subsequent quarter, based on the average growth rate estimated by the group of evaluators.

By providing this additional context, the following table becomes an even more valuable tool for understanding the dynamics of Ahoo's stock price during the period under review.

Table 1. Quarterly Ahoo Stock Values as Estimated by the Group of Evaluators from Dec. 31, 2021 to Dec. 31, 2026

Period	2021				2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Stock Value $	N/A	N/A	N/A	400.00	450.20	500.31	675.66	905.46
Growth Rates	**N/A**	**N/A**	**N/A**	**N/A**	**12.55%**	**11.13%**	**35.05%**	**34.01%**
Period	**2023**				**2024**			
	Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Stock Value $	817.36	992.76	1,217.62	1,447.15	1,779.41	1,581.36	1,781.40	1,606.11
Growth Rates	**-9.73%**	**21.46%**	**22.65%**	**18.85%**	**22.96%**	**-11.13%**	**12.65%**	**-9.84%**
Period	**2025**				**2026**			
	Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Stock Value $	1,396.35	1,169.73	1,034.74	1,350.34	1,060.55	705.90	582.87	430.15
Growth Rates	**-13.06%**	**-16.23%**	**-11.54%**	**30.50%**	**-21.46%**	**-33.44%**	**-17.43%**	**-26.20%**

4.1.2. NAPV model

At the beginning of the experiment, a NAPV (Net Asset Present Value) model was applied to estimate the stock price of Ahoo company as of December 31, 2021. The initial estimate generated by the model was $400. As the experiment progressed, the NAPV model was used to generate updated stock price estimates for Ahoo company at the end of each subsequent quarter. The NAPV model was able to do this by tracking the changing fundamentals and financials of the company, taking into account relevant information and developments released in the market.

The quarterly stock value generated by the model was composed of several main components of value, which included the basic value called net asset value (NAV), the inflation value called revaluation per share (RPS), the economic profit value called present value of running projects (PVRP), and the growth value called net present values (NPV). Additionally, a new equity value or new net asset value (New NAV) was generated from new projects undertaken by Ahoo company. This new NAV adjusted the estimations given by the NPV component. The following table provides a detailed breakdown of the NAPV model's stock price estimates for each quarter, and can be used to gain insights into the factors driving the stock price of Ahoo company during the experiment:

Table 2. Quarterly Ahoo Stock Values (In US Dollars) as Estimated by the NAPV Model from Dec. 31, 2021 to Dec. 31, 2026

PERIOD	2021				2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
BASIC NAV	N/A	N/A	N/A	82.25	75.95	75.95	75.95	75.95
RPS	N/A	N/A	N/A	67.00	61.87	61.87	61.87	61.87
PVRP	N/A	N/A	N/A	143.65	132.65	132.65	132.65	132.65
NEW NAV	N/A	N/A	N/A	-	38.85	46.23	68.68	87.24
NPV	N/A	N/A	N/A	107.09	162.68	217.72	321.70	537.59
STOCK VALUE	**N/A**	**N/A**	**N/A**	**400.00**	**472.01**	**534.43**	**660.86**	**895.30**
Growth Rates	**N/A**	**N/A**	**N/A**	**N/A**	**18.00%**	**13.23%**	**23.66%**	**35.48%**
PERIOD	**2023**				**2024**			
	Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
BASIC NAV	75.95	75.95	75.95	75.95	75.95	75.95	75.95	75.95
RPS	61.87	61.87	61.87	61.87	61.87	61.87	155.78	155.78
PVRP	132.65	132.65	132.65	132.65	132.65	132.65	132.65	8.84
NEW NAV	104.89	134.12	175.53	232.91	284.67	347.29	430.27	424.40
NPV	470.50	639.16	825.12	1,032.91	1,237.24	970.09	998.71	917.55
STOCK VALUE	**845.86**	**1,043.76**	**1,271.12**	**1,536.30**	**1,792.39**	**1,587.86**	**1,793.36**	**1,582.52**
Growth Rates	**-5.52%**	**23.40%**	**21.78%**	**20.86%**	**16.67%**	**-11.41%**	**12.94%**	**-11.76%**
PERIOD	**2025**				**2026**			
	Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
BASIC NAV	75.95	75.95	75.95	75.95	75.95	75.95	75.95	75.95
RPS	155.78	155.78	155.78	155.78	155.78	61.87	61.87	61.87
PVRP	8.84	8.84	8.84	8.84	132.65	132.65	132.65	132.65
NEW NAV	457.24	476.04	493.26	490.69	557.04	362.63	388.97	22.43
NPV	700.05	483.42	344.59	521.53	143.71	206.59	56.17	107.09
STOCK VALUE	**1,397.86**	**1,200.02**	**1,078.42**	**1,252.79**	**1,065.13**	**839.70**	**715.61**	**400.00**
Growth Rates	**-11.67%**	**-14.15%**	**-10.13%**	**16.17%**	**-14.98%**	**-21.16%**	**-14.78%**	**-44.10%**

4.1.3. Other stock valuation models

The experiment utilized seven additional valuation models, apart from the NAPV model, which belonged to the following different categories of valuation models:

Income-Based model:

1. The Constant-Growth DDM assumes that the constant growth rate is the sustainable growth rate, which is determined by the long-term ROE and long-run retention ratio observed in Whirlpool company. The cost of equity used in the valuation is based on the return observed in the key financial metrics applicable for Whirlpool company. This model is not applicable during 2022, as Ahoo has announced that it will not pay any dividends in this year.
2. The Two-Stage DDM consists of a first stage, which spans four quarters (equivalent to the time lag between each two projects), during which actual dividends are discounted. The second stage is assumed to be a constant stage after the fourth quarter.
3. The Constant-Growth FCFE model assumes that the constant growth rate is the sustainable growth rate, which is determined by the long-term ROE and long-run retention ratio observed in Whirlpool company. The WACC rate used in the valuation is based on the key financial metrics applicable for Whirlpool company.
4. The Two-Stage FCFE model consists of a first stage, which spans four quarters, during which actual FCFE figures are discounted. The second stage is assumed to be a constant stage after the fourth quarter.

Asset-Based model:

1. The Adjusted Net Asset model involved estimating the book value per share for Ahoo company at the end of each quarter, which was

adjusted to reflect the market values of assets and liabilities as reported by the company.

Asset-Plus-Income Based model:

1. The Constant-Growth RIM model utilized the long-term ROE and g, along with the same cost of equity used in the income-based models. Furthermore, the initial book value per share was taken from the quarterly balance sheet reported by Ahoo company.
2. The Two-Stage RIM model assumed that the actual residual income to be generated next quarter would remain constant for four periods (i.e., four quarters) in the first stage. In the second stage, the ROE is assumed to equal its long-term average, and residual income is assumed to grow at the long-run constant growth rate generated from the long-run ROE, and the present value of this continuing residual income is calculated. The initial book value per share in each period was also taken from the quarterly balance sheet reported by Ahoo company.

These common valuation models were used during the same study period used for the NAPV model, wherever possible, to calculate the quarterly values. The quarterly growth rates obtained using these different models were summarized in a table for ease of comparison.

Table 3. Quarterly Ahoo Stock Values (In US Dollars) as Estimated by the Selected Valuation Models from Dec. 31, 2021 to Dec. 31, 2026

Model	Constant-Growth DDM		Two-Stage DDM		Constant-Growth FCFE		Two-Stage FCFE		Adjusted Net Asset		Constant-Growth RIM		Two-Stage RIM	
TIME	Stock price	% rate	Stock price	% rate	Stock price	% rate	Stock price	% rate	Stock price	% rate	Stock price	% rate	Stock price	% rate
2021 (Q4)	N/A	N/A	499	N/A	691	N/A	1,272	N/A	149	N/A	163	N/A	244	N/A
2022 (Q1)	N/A	N/A	832	67%	1,060	53%	3,902	207%	177	18%	228	40%	285	17%
2022 (Q2)	N/A	N/A	1,184	42%	2,513	137%	5,308	36%	184	4%	242	6%	372	31%
2022 (Q3)	N/A	N/A	1,649	39%	1,391	-45%	6,489	22%	207	12%	287	18%	413	11%
2022 (Q4)	568	N/A	1,508	-9%	1,422	2%	6,686	3%	225	9%	324	13%	498	20%
2023 (Q1)	940	66%	1,825	21%	4,447	213%	8,164	22%	243	8%	359	11%	615	24%
2023 (Q2)	1,331	42%	2,411	32%	6,012	35%	10,507	29%	272	12%	417	16%	755	23%
2023 (Q3)	1,845	39%	2,476	3%	7,321	22%	10,787	3%	313	15%	499	20%	942	25%
2023 (Q4)	1,664	-10%	990	-60%	7,484	2%	793	-93%	371	18%	613	23%	959	2%
2024 (Q1)	2,013	21%	639	-35%	9,114	22%	3,347	322%	423	14%	715	17%	1,087	13%
2024 (Q2)	2,668	33%	530	-17%	11,731	29%	3,063	-9%	485	15%	840	17%	1,258	16%
2024 (Q3)	2,727	2%	519	-2%	11,993	2%	528	-83%	662	36%	1,004	20%	919	-27%
2024 (Q4)	1,056	-61%	2,063	297%	715	-94%	556	5%	656	-1%	993	-1%	1,092	19%
2025 (Q1)	663	-37%	2,119	3%	3,576	400%	492	-11%	689	5%	1,058	7%	1,111	2%
2025 (Q2)	554	-17%	838	-60%	3,315	-7%	4,047	722%	708	3%	1,095	4%	950	-15%
2025 (Q3)	566	2%	860	3%	531	-84%	4,145	2%	725	2%	1,129	3%	893	-6%
2025 (Q4)	2,320	310%	935	9%	543	2%	4,045	-2%	722	0%	1,124	0%	917	3%
2026 (Q1)	2,372	2%	N/A	N/A	555	2%	N/A	N/A	789	9%	1,256	12%	N/A	N/A
2026 (Q2)	922	-61%	N/A	N/A	4,820	768%	N/A	N/A	500	-37%	870	-31%	N/A	N/A
2026 (Q3)	943	2%	N/A	N/A	4,927	2%	N/A	N/A	527	5%	922	6%	N/A	N/A
2026 (Q4)	1,027	9%	N/A	N/A	5,037	2%	N/A	N/A	160	-70%	195	-79%	N/A	N/A

4.2. ANOVA results

The table presented below summarizes the key statistical measures that were observed during the analysis of variance between each of the studied valuation models and the group of evaluators. These measures were used to determine the information efficiency of each model represented in the table that was used in the experiment.

Table 4. Results of ANOVA Analysis of Valuation Models Vs. Evaluators

Key Statistics		NAPV	CONSTANT-GROWTH DDM	TWO-STAGE DDM	CONSTANT-GROWTH FCFE	TWO-STAGE FCFE	ADJUSTED NET ASSET	CONSTANT-GROWTH RIM	TWO-STAGE RIM
CORRELATION COEFFICIENT		0.94	0.56	-0.16	-0.40	-0.25	0.54	0.55	0.23
SLOPE COEFFICIENT		0.89	2.30	-0.73	-3.65	-2.70	0.55	0.61	0.19
REGRESSION SUM OF SQUARES (SSR)		0.71	3.33	0.27	11.91	3.71	0.27	0.33	0.02
ERROR SUM OF SQUARES (SSR)		0.09	7.38	9.70	61.10	56.30	0.64	0.77	0.35
R-SQUARED		0.89	0.31	0.03	0.16	0.06	0.30	0.30	0.05
SLOPE CONFIDENCE INTERVAL I	*Lower 95%*	0.74	0.34	-3.23	-7.75	-8.73	0.13	0.15	-0.28
	Upper 95%	1.05	4.26	1.77	0.44	3.33	0.97	1.07	0.67
SLOPE CONFIDENCE INTERVAL II	*Lower 99%*	0.68	-0.43	-4.20	-9.26	-11.07	-0.03	-0.02	-0.47
	Upper 99%	1.10	5.03	2.75	1.96	5.67	1.12	1.24	0.85
SLOPE P-VALUE		0.00	0.02	0.54	0.08	0.35	0.01	0.01	0.40

By analyzing the statistical measures, we will be able to gain insight into how effective each valuation model was at providing accurate and reliable information, and how well it performed compared to the group of evaluators.

5. Discussion

5.1. Analyzing the findings of the experiment: addressing the research question and comparing with previous research

This study examined the linear relationship between the quarterly stock price growth rates generated by a group of evaluators and those generated by each of eight different stock valuation models. A linear regression analysis was conducted with a null hypothesis that assumed no linear relationship between the two variables. The results showed that Two-Stage DDM, Constant-Growth FCFE, and Two-Stage FCFE models had a negative correlation with the group of evaluators. Meanwhile, Constant-Growth DDM, Adjusted Net Asset, Constant-Growth RIM, and NAPV models had a strong correlation with the group. The Two-Stage RIM model had a weak positive correlation. The null hypothesis could not be rejected for Two-Stage DDM, Constant-Growth FCFE, Two-Stage FCFE, and Two-Stage RIM models since the confidence intervals at a 95% significance level included a zero beta coefficient. However, the null hypothesis was rejected for Constant-Growth DDM, Adjusted Net Asset, Constant-Growth RIM, and NAPV models since their confidence intervals at a 95% significance level did not include a zero beta coefficient. P-value analysis confirmed these results. At a 99% significance level, the null hypothesis was only rejected for the NAPV model. For the models with rejected null hypotheses, the SSR as a percent of SST, as measured by R-squared, was 0.89 for the NAPV model and approximately 0.30 for Constant-Growth DDM, Adjusted Net Asset, and Constant-Growth RIM models.

The findings of this study suggest that there is no significant relationship between Two-Stage DDM, Constant-Growth FCFE, Two-Stage FCFE, and Two-Stage RIM models and the group of evaluators. This implies that these models were not able to explain the variation seen in the group of evaluators during the experiment, and therefore, they are not informationally efficient. Conversely, there is a statistically significant linear relationship between Constant-Growth DDM, Adjusted Net Asset, Constant-Growth RIM, and NAPV models and the group of evaluators, indicating that these models were able to explain the variation observed in the group of evaluators, and therefore, they can be informationally efficient by reflecting relevant information into stock prices. However, the degree of information efficiency matters and can be measured by R-squared, which shows how much variation observed in the group of evaluators was reflected in the valuation model. The R-squared for Constant-Growth DDM, Adjusted Net Asset, and Constant-Growth RIM models was approximately 0.30, while the R-squared for the NAPV model was 0.89. The NAPV model had the highest R-squared, indicating that it was the most efficient in reflecting all relevant information and estimating the stock price during the experiment. Furthermore, higher R-squared implies lower estimation error when estimating the stock value, which is another efficiency criterion. The research question posed in the introduction of this paper was answered by the results of the experiment, which showed that the NAPV model was the most efficient among the valuation models studied. This conclusion was based on several factors, including the highest R-squared value and the lowest estimation error. These findings suggest that the NAPV model is a reliable and effective tool for valuing stocks, and may be particularly useful for investors and analysts seeking to make informed decisions about stock valuation and investment strategies.

The results of the ANOVA analysis provide valuable insights into the stock valuation models used in the experiment. However, there are additional findings that are worth highlighting. One significant weakness of some of the valuation models is the inability to generate stock values during certain periods. For example, the DDM model could not generate stock values when the company was not paying dividends, while the FCF model was inefficient when the company was experiencing negative FCF figures, which aligns with previous research in the literature review. Regression analysis indicated that income-based valuation models were less information-efficient than other categories of valuation models which is consistent with the findings of prior studies discussed in the literature review. The asset-based model, on the other hand, generated the floor price for the stock by excluding the growth premium which confirms some of the results from previous studies. However, in this experiment, the asset-based model was found to have higher information efficiency than the two-stage income-based models and almost the same level of efficiency as the constant growth DDM income-based model. These results are in contrast to what previous studies in the literature review had concluded about the asset-based model's inferiority in terms of information efficiency relative to other valuation models. The influence of macroeconomic variables like inflation, interest rates, and exchange rates on stock prices has been observed in some studies (Anh, et al., 2020) [26]. Other studies have observed the impact of variables such as foreign direct investment (FDI), technological innovation, and financial development on stock prices (Hanh, et al., 2020) [27]. However, it is not necessary to incorporate these factors into an efficient stock valuation model that focuses on the main components, the internal factors, indirectly impacted by such external factors. However, weakness in corporate governance, risk management, and audit systems as indicated by other research (Huy, 2015) [28] poses a significant obstacle to the efficient reflection of macroeconomic factors in the model components.

The stock value in the two-stage model was found to be too sensitive to the terminal value, which is an estimated figure based on a constant growth model and constitutes the largest proportion of the stock value today. As a result, adjusting the valuation model such as DDM, FCF, or RIM to be multiple stages rather than constant stage was not increasing the efficiency of the model. The NAPV model was found to be the most efficient valuation model in the experiment. One of the key strengths of this model is its ability to decompose the stock value on a periodic basis. Specifically, the NAPV model generates the no-growth value per share in addition to the net present value of the growth. Through further decomposition, the no-growth value can be broken down into other components, such as basic net asset value adjusted to reflect market values and the present value of the economic profit generated by the company's current projects. This breakdown allows investors and analysts to monitor the proportion of the growth premium represented by the NPV portion of the stock value in each period. Such a breakdown provides insight into the riskiness of the stock and whether it is a growth or value stock. Furthermore, the NAPV model reflects both the past and the future of the company. It combines NAV, which represents the future value of past earnings, with NPV, which represents the present value of future cash flow or earnings. This combination allows for a more comprehensive approach to valuing stocks, which can inform investment decisions.

5.2. Implications for practice

The findings of this study have significant implications for practice in the field of stock valuation. It is clear that the choice of stock valuation model is crucial in accurately reflecting the relevant information and estimating the stock price. Therefore, investors and analysts should be careful when selecting a stock valuation model, ensuring that it is efficient and able to explain the variation seen in the market. The NAPV model, in particular, shows great promise in the real-world setting. It can be used by regulators and companies for stock valuation, allowing financial managers to identify the real stock value and investors to decompose the stock value to know the floor level and the real breakdown of the stock value. However, the full applicability and utility of this model cannot be achieved without taking new regulatory measures. A comprehensive framework and a new stock pricing mechanism are needed to achieve the full applicability of the NAPV model and enhance financial stability and market efficiency. Therefore, it is recommended that regulators and policymakers take action to implement these measures and ensure that the benefits of the NAPV model are fully realized.

A research paper complementary to this paper proposes a comprehensive regulatory framework for stock valuation that could have significant implications for practice. The framework suggests that shareholders in each company should be regulated to agree on a common and efficient stock valuation model that will be used by the company and regulated by the stock market regulator. This will help to derive the fair value of the stocks periodically, and investors will then buy and sell at this discovered fair value, which will be updated based on the updated fundamentals reflected into the stock valuation models agreed upon it. The framework also proposes that the role of stock price limits becomes important after knowing and agreeing on a single fair value. The price limits will be placed on a fixed interval around the intrinsic value derived from the common stock valuation model agreed upon it. This will protect the intrinsic value and give the market a regulated way to give their discounts or premiums within this price range without causing bubbles and crashes. The proposed framework also includes a transaction tax based on maturity to make speculation costly and a losing strategy, which will help the stock market regulator to curb speculation and promote long-term investment. Such a regulatory framework could be very fruitful for the stock market regulator, whose main mission is to maintain stock market efficiency and ensure stock market stability. In addition, if the NAPV model were the model used in this framework, the stock value would reflect the basic real value, the inflation value, the economic profit value, the growth value, and the market premium value.

5.3. Limitations of the study

There are several limitations to consider when interpreting the findings of this study. One possible limitation is the sample size used in the experiment for the group of evaluators. This sample size may be too small to be representative of the population being studied, which could limit the generalizability of the findings. Another limitation is the missing stock values generated by some stock valuation models in some periods. This can affect the accuracy and reliability of the findings studied for such valuation models. Additionally, the NAPV model may not be fully applicable in the absence of new regulatory measures, which could render the findings of such model externally invalid. These limitations suggest that caution should be taken when interpreting the results of this study. However, it is worth noting that the assumptions for the NAPV model are relatively lenient compared to the very theoretical assumptions held for other stock valuation models such as the DDM. Although these assumptions may seem strange, they can be turned into practical ones if the stock market regulator takes the necessary actions to complete its mission concerning ensuring stock market efficiency and stability. Overall, these limitations should be considered when interpreting the findings of our study and future research should aim to address these limitations to improve the accuracy and generalizability of the results.

6. Conclusion

The main objective of the study was to examine the information efficiency of different stock valuation models in reflecting relevant information and estimating stock prices. The study aimed to address the following research question: which stock valuation model is the most efficient in reflecting relevant information and estimating stock prices?

The study aimed to analyze the efficiency of different stock valuation models in reflecting relevant information and estimating stock prices. The findings revealed that there was no significant relationship between Two-Stage DDM, Constant-Growth FCFE, Two-Stage FCFE, and Two-Stage RIM models and the group of evaluators, indicating that these models were not informationally efficient. Conversely, Constant-Growth DDM, Adjusted Net Asset, Constant-Growth RIM, and NAPV models showed a statistically significant linear relationship with the group of evaluators, suggesting that these models were more efficient in reflecting relevant information into stock prices. The NAPV model was found to be the most efficient valuation model, with the highest R-squared value of 0.89 and the lowest estimation error. This model was able to decompose the stock value into different components, allowing investors and analysts to monitor the proportion of growth premium represented by the NPV portion of the stock value in each period. The findings also indicated that income-based valuation models were less information-efficient than other categories of valuation models. The study highlighted the limitations of some of the valuation models, such as the inability to generate stock values during certain periods, and the sensitivity of the stock value in the two-stage model to the terminal value.

The findings of the research paper have significant implications for practice in the field of stock valuation. The study highlights the importance of selecting an efficient stock valuation model that can accurately reflect relevant information and estimate stock prices. The NAPV model is identified as a promising tool for stock valuation, but its full applicability and utility require new regulatory measures, including a comprehensive framework and a new stock pricing mechanism. A complementary research paper proposes a regulatory framework for stock valuation that could have significant implications for practice. The framework suggests that shareholders should agree on a common and efficient stock valuation model that will be used by the company and regulated by the stock market regulator. This will help to derive the fair value of the stocks periodically and provide a regulated way for investors to buy and sell at the discovered fair value. The proposed framework also includes price limits, a transaction tax, and other measures to promote long-term investment and curb speculation. Such a regulatory framework could be fruitful for the stock market regulator in maintaining stock market efficiency and stability. If the NAPV model were the model used in this framework, the stock value would reflect the basic real value, the inflation value, the economic profit value, the growth value, and the market premium value, providing a comprehensive approach to stock valuation. In conclusion, the study has successfully addressed the research question and provided valuable insights into the efficiency of different stock valuation models. The NAPV model was found to be the most efficient among the models studied in reflecting relevant information and estimating stock prices accurately. The findings of the study have important implications for practice, as investors and analysts should be careful when selecting a stock valuation model and consider the efficiency and ability of the model to explain market variation. Future research could address the limitations of the study and further improve the accuracy and generalizability of the results. The study also suggests that new regulatory measures are needed to fully realize the potential of the NAPV model and enhance financial stability and market efficiency.

There are several areas for future research related to the study on the efficiency of stock valuation models. Future research could explore other factors that may influence the efficiency of stock valuation models, such as changes in market conditions or company-specific factors. Firstly, while the NAPV model was found to be the most efficient, further validation of its effectiveness could be conducted with a larger sample size or in different markets and time periods. Secondly, future research could examine how different valuation models perform across various industries, which could have unique characteristics that affect the accuracy of these models. Thirdly, the study suggests that new regulatory measures are needed to fully realize the potential of the NAPV model and enhance financial stability and market efficiency. Future research could investigate the impact of implementing these measures on stock valuation and market performance. Lastly, the study highlights the limitations of existing valuation models and suggests developing new models that address these limitations and provide greater accuracy in estimating stock prices.

Author Contributions: The author's contributions to the paper include developing the model that was tested in the experiment, designing the experiment and its elements, such as the company and information, supervising and managing the experiment and the simulated stock market. Finally, the author has read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Informed Consent Statement: Not applicable.

Data Availability Statement: The information pertaining to the experiment, including details about the company, traders, evaluators, information, and simulated stock market, is available upon request.

Acknowledgements: I would like to express my sincere gratitude to Dr. Saeed Bajalan and Professor Dr. Reza Tehrani for their invaluable support and guidance throughout my research journey. Their insightful feedback and fruitful ideas have been instrumental in shaping the direction of my thesis. I am also deeply grateful to all the students who participated as traders in my experiments and to all the instructors and professors who participated as evaluators. Their willingness to engage with my research and provide thoughtful feedback has been essential to the success of this project. Thank you all for your contributions to this work.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of Interest: The author declare no conflict of interest.

References

[1] Jan, C.-L. & Ou, J. A., 2020. The Information Content of Negative Book Value. *Journal of Accounting & Finance,* 20(6), pp. 125-142.

[2] Lev, B. & Zarowin, P., 1999. The boundaries of financial reporting and how to extend them. *Journal of Accounting research,* 37(2), pp. 353-385.

[3] Farooq, M. S. & Thyagarajan, V., 2014. Valuation of Firm, Methods & Practices: An Evaluation. *International Journal of Research in Business Management,* 2(10), pp. 7-14.

[4] Damodaran, A., 2012. *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset.* 3rd ed. Hoboken, NJ: John Wiley & Co..

[5] Ghi ă-Mitrescu, S. & Duhnea, C., 2016. The adjusted net asset valuation method: Connecting the dots between theory and practice. *Ovidius University Annals, Economic Sciences Series,* 16(1), pp. 521-526.

[6] Kirk , W. & Wishing, K., 2018. Fundamentals of the Asset-Based Business Valuation Approach. *Business Valuation Thought Leadership,* pp. 3-14.

[7] Mohendroo, M. & Mohindra, V., 2017. *The merits of an asset-based approach to valuing businesses,* s.l.: Deloitte Middle East Point of View.

[8] Lins, K. V., Servaes, H. & Tamayo, A., 2017. Social capital, trust, and firm performance: The value of corporate social responsibility during the financial crisis. *The Journal of Finance,* 72(4), pp. 1785-1824.

[9] Pinto, J., Henry, E., Robinson, T. & Stowe, J., 2017. Discounted Dividend Valuation. In: *Equity.* Charlottesville: Wiley, pp. 197-247.

[10] Skinner, D., 2008. The Evolving Relation between Earnings, Dividends, and Stock Repurchases. *Journal of Financial Economics,* 87(3), pp. 582-609.

[11] Lu, S., Li, X., Qi, Y. & Zheng, Z., 2021. *Comparison of Different Asset Pricing Models Based on Alibaba and Tencent Stocks.* s.l., Atlantis Press.

[12] Williams, J. B., 1938. *The Theory Of Investment Value.* Amsterdam: North-Holland Publishing Company.

[13] Sharpe, W., Alexander, G. & Bailey, J., 1999. *Investments.* Upper Saddle River, NJ: Prentice Hall Incorporated.

[14] Mayes, T. & Shank, T., 2012. *Financial Analysis with Microsoft Excel.* 3rd ed. Mason: South-Western, Cengage Learning.

[15] Anesten, S., Möller, N., Skogsvik, K. & Skogsvik, S., 2020. The pricing accuracy of alternative equity valuation models: Scandinavian evidence. *Journal of International Financial Management & Accounting,* 31(1), pp. 5-34.

[16] Yeh, I.-C., 2023. Comparisons of residual income model and growth value model. *Applied Economics,* pp. 1-19.

[17] Pinochi, M., Fais, F. & Corsiglia, M., 2019. Residual Income Model and abnormal returns: a comparison to factor styles and sell-side analysts. *Business Valuation OIV Journal Spring,* pp. 91-110.

[18] Shrieves, R. & Wachowicz, J., 2001. Free Cash Flow (FCF), Economic Value Added (EVA™), and Net Present Value (NPV): A Reconciliation of Variations of Discounted-Cash-Flow (DCF) Valuation. *The engineering economist*, 46(1), pp. 33-52.

[19] Lee, C., Myers, J. & Swaminatha, B., 1999. What is the intrinsic value of the Dow?. *Journal of Finance,* 54(5), pp. 1693-1741.

[20] Leong, K.-Y., Ariff, M., Alireza, Z. & Bhatti, M. I., 2023. Bank stock valuation theories: do they explain prices based on theories?. *International Journal of Managerial Finance,* 19(2), pp. 331-350.

[21] Cziglerné Erb, E., 2020. The re-emergence of the residual income model in the valuation of firms and investment projects. *PÉNZÜGYI SZEMLE/PUBLIC FINANCE QUARTERLY,* 65(3), pp. 430-442.

[22] Donnelly, R., 2013. *Accounting Income, Residual Income and Valuation,* Ireland: CPA IRELAND.

[23] Stowe, J. & Gagné, J., 2017. Capital budgeting. In: *Corporate Finance.* Charlottesville: Wiley, pp. 5-92.

[24] Brigham, E. & Houston, J., 2018. *Fundamentals of Financial Management.* 15th ed. Natorp Boulevard: Cengage Learning.

[25] Baltussen, G., 2009. Behavioral Finance: an introduction. *Available at SSRN 1488110* .

[26] Anh, P. T., Huy, D. T. N. & Loan, B. T. T., 2020. Analysis of a Financial Model for Converting Industrial Waste Tires into Clean Energy for Environment Protection-A Model in Developing Countries. *Wseas Transactions on Environment and Development,* Volume 15, pp. 447-454.

[27] Hanh, H. T., Huy, D. T. N., Phuong, N. T. T. & Anh, P. T., 2020. Impact of macro economic factors and financial development on energy projects-case in ASEAN countries. *Management,* 24(2), pp. 146-157.

[28] Huy, D. T. N., 2015. The critical analysis of limited south asian corporate governance standards after financial crisis. *International Journal for Quality Research,* 9(4), p. 741.