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Modernizing the Stock Pricing Mechanism: An Effective Path to Improve the Stock Market Efficiency

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Abstract

This study investigates whether regulating the stock pricing mechanism by adopting an agreed-upon efficient stock valuation model can enhance the stock market efficiency. The study involves a simulated stock market experiment with 65 traders who provide daily stock price predictions for a virtual company under unregulated and regulated scenarios. In the regulated scenario, traders agree on one of three valuation models to generate stock prices. Moreover, 20 evaluators acted as "Homo-Economicus" to determine a stock's fair value trend, serving as a benchmark to assess the information efficiency of the simulated market. The study finds that the NAPV-regulated market shows a strong linear relationship and high R-squared, indicating the highest level of information efficiency, while the DDM- and RIM-regulated markets show moderate correlations. The study suggests that modernizing the stock pricing mechanism, by regulating shareholders to mutually agree on one efficient stock valuation model to be used by the company to generate fair values alternative to market prices, could significantly enhance the stock market efficiency by focusing on fundamentals rather than irrational speculators. However, model choice matters, as NAPV explains more variation. The study suggests that appropriate regulation is crucial for realizing this potential. Although the results are promising, limitations like small evaluator samples, inability of models to always generate stock values, and trader biases should be considered. Future research with larger samples and more models could strengthen these insights.

JEL classification: G14; G18; C93

Keywords: stock valuation model, stock market efficiency, stock pricing mechanism, information efficiency, fundamentals

1. Introduction

The concept of stock market efficiency means that stock prices reflect all available information in a timely and accurate manner, eliminating opportunities for excess returns. Although the efficient market hypothesis suggests that stock markets are information efficient, evidence has raised doubts about this theory, leading to ongoing debates in the finance literature. This study aims to explore a new approach to improving stock market efficiency by regulating the stock pricing process, removing the influence of irrational speculators and emphasizing fundamental factors determined by an agreed-upon efficient valuation model overseen by the stock market regulator.

This study employs a simulated stock market experiment to explore whether the adoption of a mutually agreed-upon efficient stock valuation model can enhance the information efficiency of a company's stock market by generating stock values that are alternative to free market prices. The experiment aims to achieve two objectives. Firstly, it seeks to assess the information efficiency of the simulated stock market when left unregulated, with stock prices determined solely by the forces of supply and demand based on traders' individual predictions and valuation approaches. By analyzing the accuracy of the stock pricing in this free market scenario, we can gauge the market's efficiency when operating independently. Secondly, the experiment investigates the information efficiency of the same simulated stock market under a proposed new mechanism where traders, acting as shareholders in the virtual company, are regulated to agree on a single efficient stock valuation model

to be adopted by the company to periodically generate stock values that replace the free market prices.

The methodology of this experiment involves simulating a stock market with 65 traders, acting as shareholders in a virtual company, who provide daily stock price predictions under both an unregulated scenario and a regulated scenario assuming three different valuation models: The Net Asset Present Value (NAPV) model, the Constant-Growth Dividend Discount Model (DDM), and the Constant-Growth Residual Income Model (RIM). A group of 20 expert evaluators analyzes all information released about the virtual company to determine a benchmark "fair value" stock price trend. By comparing the stock price trends generated by the traders under each scenario to this benchmark, the experiment evaluates the information efficiency of the simulated stock market and the potential impact of the proposed regulated pricing mechanism on this information efficiency. Statistical analysis involves regression and ANOVA to quantify and compare market efficiency before and after adopting the regulated pricing mechanism.

This study is significant because it provides insights into whether regulating the stock pricing process through the adoption of an agreed-upon valuation model can enhance the functioning and efficiency of capital markets. However, selecting an appropriate and efficient valuation model to govern stock prices remains crucial to fully realizing this potential. The findings suggest that adopting a mutually agreed-upon efficient stock valuation model, specifically the NAPV model which was developed by Saad (2023), can significantly improve the information efficiency of a simulated stock market by generating stock price trends that more closely reflect the fair value benchmark trend set by the evaluators. The results provide a useful proof of concept, indicating regulated pricing holds promise for enhancing market functioning, stability, and efficiency, though follow-up studies are needed to further refine and strengthen these initial results.

The paper is organized as follows: introduction, literature review, methodology, results, discussion, and conclusion. The introduction sets the context and objectives. The literature review analyses previous studies. The methodology explains the research design. The results present the findings. The discussion interprets the results. The conclusion summarizes the study's contributions and provides recommendations.

2. Literature Review

2.1 The Ongoing Debate on Stock Market Efficiency

Degutis and Novickytė (2014) defined an efficient stock market as a market where fundamental information about corporations are clearly reflected into prices of the stocks traded in such market. Statman (2019) defines three levels of efficiency: directionally where fair value and market price move up together, proportionally where their changes are equal, and value-efficient where value and price are identical. Previous studies show that investors exhibit irrational behaviors like overconfidence (Barber & Odean, 2001), overreaction (De Bondt & Thaler, 1985), loss aversion (Kai-Ineman & Tversky, 1979) and regret (Bell, 1983), which prevents markets from fully reflecting all information, causing historical financial crises (2015) and contradicting the assumptions of EMH. Even though interesting and attractive, EMH stands on unrealistic assumptions about investor behavior and the pricing process and functions in the financial markets (Baltussen, 2009). EMH, even in its weak form, is violated in emerging stock markets such as the Korean and Taiwanese markets (Cheung, Wong, & Ho, 1993), in addition to the Indian stock market (Poshakwale, 1996). The weak form EMH is also violated in less developed stock markets such as the Bahrain stock market (Hawaldar, Rohit, & Pinto, 2017) and the Dhaka Stock Exchange (Alam, Yasmin, Rahman, & SalahUddin, 2011). Even in developed countries, research on the semi-strong form of efficiency produces mixed results while research on the strong form suggests that stock markets are not efficient at that level (Mishkin & Eakins, 2011). Studies provide strong evidence that stock markets are inefficient, with some researchers further finding that stock markets are becoming platforms for gambling activities. Using data from 38 countries, the study by Kumar, et al. (2021) found that the scale of gambling in stock markets was 3.5 times larger than gambling through lotteries and casinos. The debate over market efficiency remains unresolved, with some evidence supporting EMH but more evidence rejecting it. I propose replacing "efficient market hypothesis" with "efficient market objective" and reframing the discussion from "is the market efficient?" to "how can we improve stock market efficiency?" to accomplish that objective. G-20 stock market is efficient in their weak form (Zebende, Dias, & de Aguiar, 2022). information security (ISec) breach announcements have a significant negative impact on long-term investor confidence, leading to decreased abnormal returns and increased equity risk. This supports the relevance of the Efficient Market Hypothesis, highlighting the importance of information security for market efficiency. Firms must address ISec challenges proactively, implement preventive measures, and consider information security as part of their corporate social responsibility for sustainable growth (Ali, Lai, Hassan, & Shad, 2021).

2.2 Ways to Improve Stock Market Efficiency: A Review

Without investor trust and confidence that markets are efficient and can fairly value stocks, markets cannot grow and develop (Hamedinia, Raei, Bajalan, & Rouhani, 2022). Improving market efficiency aids market development but primarily depends on regulatory measures taken by the stock market regulator, who is responsible for achieving this goal, so reviewing ways to improve efficiency implies reviewing those regulatory actions. Several studies researched several regulatory measures like trading halts, price limits and taxes which can potentially improve stock market efficiency. Kim, et al. (2008) and Bildik (2004) argue that trading halts help reflect relevant information into stock prices and improve efficiency. Dong (2019) found that price limits decrease volatility and improve firm value in China, though they delay price discovery. Meanwhile, Lehmann (1989) and Bao, et al. (2020) argue that price limits have limited benefits and can delay price discovery. Chang and Chang and Chang (2021) agree that relaxing price limits could reduce volatility in Taiwan. In response to the GameStop case, Duggan (2021) proposed a transaction tax on speculators. However, Saret (2014) and Miller and Tyger (2020) argue that financial transaction taxes reduce efficiency by lowering trading and liquidity. Conversely, Stiglitz (1989), Eichfelder and Lau (2017) found that transaction taxes can reduce volatility and improve efficiency. Veryzhenko, et al. (2022) propose a Non-Value-Added Tax that taxes profitable transactions not supported by fundamentals, which they claim could enhance market efficiency. In summary, while certain measures show potential, the evidence is mixed on whether and how regulations like trading halts, price limits and taxes ultimately improve stock market efficiency.

3. Methodology

3.1 Experiment

3.1.1 Objectives of the Experiment

The objective of this experiment is twofold. First, it aims to evaluate the efficiency of a simulated stock market when left unregulated, with stock prices determined by the forces of supply and demand based on traders' own predictions and valuation approaches. By analyzing the accuracy of the stock pricing in this free market scenario, we can assess the market's information efficiency when operating independently, as is the case in the real-world stock market. Second, the experiment seeks to examine the information efficiency of the same simulated stock market under a new proposed mechanism where the traders agree on a single and efficient stock valuation model to be supervised by the stock market regulator and to be used by the company to periodically generate stock values independent of free market forces. By comparing the market's information efficiency and stock pricing accuracy before and after the introduction of this new regulated stock pricing mechanism, we can determine whether it can improve the stock market efficiency.

3.1.2 Structure of the Experiment

3.1.2.1 The Group of Traders

The experiment aims to simulate the real stock market as closely as possible. It will involve one virtual company whose stock will be traded and priced by a sample of 65 potential traders, representing finance students in both undergraduate and graduate programs. These traders will have access to all available information about the virtual company, similar to real market conditions. They will be asked to provide daily stock price predictions and estimations under two scenarios: before and after adopting the new stock pricing mechanism proposed by the regulator.

Specifically, the traders will be tasked with pricing the virtual company's stock on a daily basis from Monday to Thursday for five consecutive weeks. Each day in the experiment will represent one quarter in the lifespan of the virtual company, simulating a total of five years. The traders will compete for a monetary prize based on pricing performance, simulating factors like greed and fear of loss that influence real market traders.

To further simulate real market conditions, the traders will receive a daily package of news and information about the virtual company and market, including rumors, exaggerations and misinformation. Using a Google Form, each trader will submit their predicted daily price growth and resulting estimated stock price. The average of all traders' prices will determine the virtual stock's daily market price.

By utilizing a sample of traders and simulating the informational and emotional factors of the real stock market, the experiment aims to provide insights into how the simulated stock market's information efficiency may change with and without the proposed new regulatory measures.

3.1.2.2 The Group of Evaluators

In addition to the group of market traders, there will be an assemblage of analysts or evaluators comprised of 20 experts in the finance field, inclusive of CFA certificate holders and PhD degree holders. This group will take the

sufficient and essential time to analyze and evaluate every single piece of new information released into the simulated stock market about the company to determine the exact stock price trends far away from any subjective or emotional factor. The prediction of this group is speculated to be the precise prediction forming the appropriate trend, which will be compared with the prediction of the first group of traders. By comparing the predictions of the two groups before and after adopting the new stock pricing mechanism the experiment will furnish insights into the information efficiency of the market from one side and into the potential impact the new stock pricing mechanism has on the stock market efficiency from another side.

Specifically, the second group consisting of evaluators in the experiment is assumed to comport like a "Homo-Economicus," a term employed by Baltussen (2009) to characterize a rational investor. The Homo-Economicus investor is characterized by various key attributes, inclusive of the capability to correctly apply the laws of probability to form beliefs and expectations, have limitless capacity to process information whenever needed, solve complex problems, possess high computational capabilities, have no constraints with reference to attention capacity and time, comport in a consistent way free of emotions, and efficiently administer preferences and choose to act accordingly. To represent the Homo-Economicus investor, the group of evaluators in the experiment is intended to meet all of these criteria. They are given access to all pertinent information relevant to the stock of the virtual company, devoid of rumors and fake data. In addition, they are proffered the information piece by piece, rather than receiving a package of diverse news and contradictory 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 accomplish this objective, each evaluator is asked to take sufficient time to assess and analyze each piece of pertinent information and to divulge his or her price range prediction, via Google Forms, regarding the effect of such piece of pertinent 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 estimated for a stock at the beginning of each period.

3.1.2.3 The Virtual Company

For this experiment, Whirlpool Company served as the virtual company. Whirlpool is a well-known manufacturer of home appliances operating around the globe. The decision to select Whirlpool for the experiment involved transferring all its financials, fundamentals, history, and achievements to a new company called Ahoo Co. to ensure participants did not recognize it as Whirlpool. All of Whirlpool's data up to December 31, 2021 was considered, after which a new future for the company was designed.

This allows participants to work with real-life company data and make real-world decisions. Using a virtual company enables the researcher testing different strategies, regulations, approaches, and valuations with no real consequences. Overall, it provides a unique chance to gain practical experience in decision-making and analysis in a simulated business setting.

The virtual company incorporates Ahoo's past performance matching Whirlpool's up to December 31, 2021. This includes Whirlpool's 2021 annual report adjusted for Ahoo's assumptions. Participants have Ahoo's financial statements for the past five years, enabling analysis of its performance over time. They also see key fundamentals like DPS, WACC, Beta, cost of equity, and FCF, plus other needed financial data for analysis and valuation. Participants also have Ahoo's historical stock price chart for technical analysis.

By incorporating Whirlpool's real history, the experiment ensures real-life conditions while applying new factors and studies to this virtual company with a real past and designed future. This approach provides a unique chance to analyze and evaluate a virtual company in a simulated business environment while allowing participants to gain practical experience in decision-making and analysis.

The first step in valuing Ahoo Company is to identify all necessary data to estimate the net present value (NPV) of each project, which will then be used to decompose the company's value into its no-growth and growth components. Assumptions will be made for the no-growth segment, including quarterly sales of $5,502, a net profit margin (NPM) of 7.91%, and a return on equity (ROE) of 35.87% per year for running projects. The dividend policy will change, with no DPR assumed for earnings generated by projects in 2022, and a 25% DPR from 2023 onwards. All projects are assumed to be average-risk and will have an average WACC to discount cash flows, as well as a 5-year average maturity. A capital structure policy will be adopted with a 40% debt and

60% equity target weight for financing each project, with debt being repaid upon project completion. The experiment assumes that NPV-negative projects will not be closed, as closing them would be more expensive than continuing with them. Each project will have 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 December 31, 2021, is $400, which will be used as the starting value in the experiment. The ratio of this stock price to Whirlpool Company's stock price will be used to adjust Ahoo Company's historical stock prices. The experiment will simulate the virtual future of Ahoo Company from January 1, 2022, to December 31, 2026, with news, analysis, announcements, rumors, accidents, and other factors impacting the financial markets released in different quarters. Positive and negative news, as well as accurate and fake information, will be included. The development plan for Ahoo Company will identify profitable projects resulting from the capital budgeting process and analysis, with all project specifications included. Each year, the company will undertake a new project that will mature after five years. The valuation process and information structure is designed to set the ending value of the stock to be $400 by making the ending values of the no-growth and growth components equal to their beginning values. This will allow for the analysis of the performance of the group of traders and comparison with other valuation models. The group of evaluators will act as fully rational investors with complete access to relevant information about the virtual company, while the group of traders will not receive the decomposition of the company's value into no-growth and growth value, as this is not the case in real financial markets.

3.1.3 The Proposed Stock Pricing Mechanism

Stock market efficiency can be improved rather than debating whether the market is efficient or not. According to current literature, regulatory measures taken to enhance efficiency are largely ineffective, and their cost-benefit analysis yields conflicting results.

The current regulatory measures are not integrated, resulting in inefficacy. Stock price limits are not effective as the fair value of the stock often lies outside the imposed limits meant to protect it. Additionally, a financial transaction tax impedes the free pricing mechanism that the market is structured around. Before implementing such new regulations, the free pricing mechanism should be updated and regulated.

Unlike goods and products, stocks should not be subject to the traditional laws of supply and demand. While supply and demand dictate the price of goods and products, the stock market operates differently. Stocks represent ownership in a business, rather than a consumable item. More sellers in the stock market signify that shareholders are choosing to no longer share in the business, which is not always beneficial for a profitable company. Therefore, determining the price of stocks using the law of supply and demand is not necessarily appropriate for a financial asset that is purchased for ownership or speculation.

Applying the economic law of supply and demand to stock pricing implies that market traders' irrational behaviors and psychological factors affect stock prices. It also implies that the price is determined by the free float; however, long-term shareholders who hold the remaining shares may have differing opinions about the stock's value.

The proposal is to improve market efficiency by updating and regulating the pricing mechanism in the stock market. Currently, stock pricing is performed by the market itself, through demand and supply forces. However, given the evidence of the market's inefficiency, it is proposed that the main problem is delegating the pricing task to irrational speculators and short-term traders. Instead, the proposal suggests assigning this task to the company that issued the stock, through a regulated valuation process that is performed off the market, away from the psychological forces of the speculative market. Shareholders in each company will agree on a common and efficient stock valuation model that will be used by the company and supervised by the stock market regulator. Investors will then buy and sell at this fair value, which will increase or decrease based on the fundamentals reflected in the stock valuation model agreed upon by shareholders. This proposal aims to increase market efficiency by removing the influence of irrational speculators and short-term traders from the pricing mechanism and bringing the focus back to fundamental factors.

Gibson (1889) compared the stock valuation process to a voting campaign, where each trader and investor votes on the trend of the stock price. If the majority vote for an upward trend, the stock price will increase. However, if the majority is irrational, the stock market movement will be inefficient. Given the evidence of irrational traders contributing significantly to stock price movements, the proposal is to use this voting campaign to select and agree on a common stock valuation model to determine the stock price and future trends. The aim is to divert market forces used in stock pricing to voting and agreeing on an efficient stock valuation model.

Imposing taxes, trading halts, price limits, or other measures in isolation may appear ineffective. The proposal is to introduce an integrated regulatory framework that includes all of these measures together. The proposed stock pricing mechanism, combined with price limits set around the fair value derived from the agreed common stock valuation model, is expected to ensure and protect stock market efficiency. The maturity tax is expected to encourage long-term investment and to protect shareholders from the risks associated with speculative behaviors, such as greed, fear, and overconfidence.

To establish a fair and efficient stock pricing mechanism, it is proposed that a list of approved stock valuation models be identified by the stock market regulator. Shareholders in each company can then select a model from this list based on the risk-return profile of the company. One of the recommended models to be used in this new stock pricing mechanism is the Net Asset Present Value (NAPV) valuation model. Developed by Saad (2023), NAPV has undergone rigorous testing for information efficiency through simulated stock market experiment. By adopting NAPV, companies can ensure a reliable and accurate valuation of their stock prices. The NAPV valuation model has shown great potential for accurate stock valuation by outperforming traditional models in information efficiency. Its ability to decompose intrinsic value into key components has been identified as a major strength. However, to fully realize its potential, some regulatory measures and an updated stock pricing mechanism, similar to the one proposed in this paper, are necessary. The NAPV model captures four main components of value per share, including basic net asset value (Basic NAV), revaluation per share (RPS), present value of running projects (PVRP), and net present value (NPV). These components reflect basic book value, inflation value, current economic profit value, and expected growth value, respectively. By incorporating these factors, NAPV provides a more comprehensive and accurate valuation of stock prices using the following equation:

Equation 1: $$Stock's\ Intrinsic\ Value = Basic\ NAV + RPS + PVRP + NPV$$

Once the fair value of a stock has been determined using an efficient stock valuation model, price limits can be established as a protective, instead of a restrictive, tool by protecting the stock's fair value from overvaluation and undervaluation. The price range between the lower and upper limits will provide a space for stock market participants to express their opinions by charging a premium or granting a discount around the fair stock value. The intrinsic value of the stock generated by the NAPV model should be adjusted for the market premium or discount since the stock market may reach its equilibrium above or below the fair value of the stock. The equilibrium stock value within the price limits will reflect and capture the basic value, inflation premium, economic profit value, growth premium, and market premium. The first four components of value are generated from the NAPV model, while the fifth component, the stock market premium, reflects the opinions and expectations of the market participants concerning the first four components of value.

The experiment aims to assess the effectiveness of an unregulated simulated stock market, where stock prices are determined by the forces of supply and demand based on traders' own predictions and valuation approaches. The study then aims to investigate the information efficiency of the same simulated stock market under a proposed new pricing mechanism, where traders agree on a single efficient stock valuation model. The study assumes three different models, namely the NAPV model, Constant-Growth DDM, and Constant-Growth RIM, in three different scenarios. By answering the research question, "Can the adoption of a mutually agreed-upon efficient stock valuation model by a company improve its stock market efficiency by generating periodic stock prices alternative to market prices?" the experiment attempts to shed light on the potential benefits of adopting an agreed-upon efficient stock valuation model.

3.2 Statistical Analysis Methodology

To determine if the proposed stock pricing mechanism can improve the information efficiency of the simulated stock market, the experiment will use the responses from a group of evaluators to calculate an average price growth rate for each quarter of the virtual company's life. Assuming that the evaluators are fully rational and behave like Homo-Economicus investors, the 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 that quarter about the company and its stock. This quarterly series of fair growth rates will serve as a benchmark to be compared with other price trends. On one hand, the benchmark will be compared with the price trend generated by the unregulated and free market. On the other hand, the benchmark will be compared with the price trend generated under the new proposed stock pricing mechanism, where shareholders agree on one efficient stock valuation model to be used by the company to generate quarterly stock values. Under three different scenarios, the experiment assumes three different valuation models to be used in the new stock pricing mechanism: NAPV model, constant-growth DDM, and constant-growth RIM. By comparing the benchmark with

the price trends generated under each model, the experiment aims to determine whether adopting a mutually agreed-upon efficient stock valuation model can improve the information efficiency of the simulated stock market.

The study aims to evaluate the impact of the proposed stock pricing mechanism on the information efficiency of the market by conducting a statistical analysis of the growth rate data. Firstly, the quarterly stock price growth rates generated by the group of evaluators will be compared with those generated by the market under both the free pricing mechanism and the proposed regulated pricing mechanism. A linear regression analysis will be conducted between the two series of growth rate data, and the null hypothesis of no linear relationship between the two variables will be tested by analyzing the confidence interval of the beta variable. If the interval includes zero, it indicates that the market is not significantly correlated with the benchmark set by the group of evaluators, and therefore not information efficient. If the null hypothesis is rejected, implying that the market is efficient, ANOVA analysis will be conducted to measure and assess the level of information efficiency by analyzing the regression sum of squares (SSR), error sum of squares (SSE), and R-squared. All statistical tests will be performed at a 5% significance level.

4. Results

4.1 Main Results of the Experiment

4.1.1 The Group of Evaluators

The experiment involved creating an environment specifically designed for the group of evaluators to facilitate the analysis and digestion of all relevant information about the virtual company, Ahoo. This environment was intended to encourage rational thinking and enable evaluators to make informed decisions about the company's performance. Each evaluator was asked to provide a quarterly growth rate estimate for Ahoo's stock price based on the available information. The individual growth rate estimations were used to compute the arithmetic average of all growth rate estimations submitted by all evaluators for each quarter.

The following comprehensive table summarizes the observations of all evaluators about the growth rates estimations per each quarter and can be used to draw insights and conclusions about Ahoo's performance during the period under review.

Table 1. Quarterly Growth Rates 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
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
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
Growth rates	-13.06%	-16.23%	-11.54%	30.50%	-21.46%	-33.44%	-17.43%	-26.20%

Additionally, the above table provides the necessary information for estimating the equivalent stock prices for Ahoo in each quarter, assuming a starting stock price of $400 at the beginning of the experiment. This additional context 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 that helps in forming the information efficient benchmark as shown in the below graph:

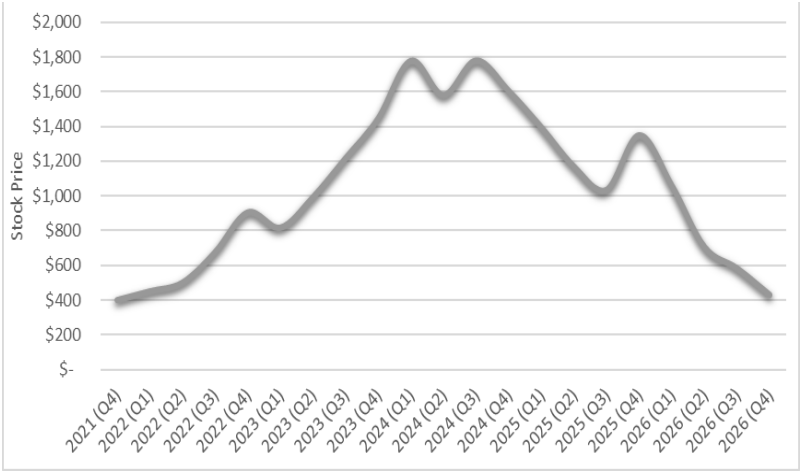

Figure 1. Efficient Benchmark Set by The group of Evaluators

4.1.2 The Group of Market Traders

This group of traders will have access to all available information about the virtual company, similar to real market conditions. These traders, behaving like shareholders, will be asked to provide daily stock price predictions and estimations under two scenarios: the free pricing mechanism and the proposed regulated pricing mechanism.

4.1.2.1 Stock Market Prices Under the Free Unregulated Pricing Mechanism

The table presented below provides a comprehensive summary of the unregulated traders' observations on the growth rate estimates for each quarter. This information can be used to gain insights and draw conclusions about the information efficiency of the market being studied.

Table 2. Quarterly Growth Rates as Estimated By Traders (Unregulated) From Dec. 31, 2021 To Dec. 31, 2026

Period	2021				2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Growth rates	N/A	N/A	N/A	N/A	-7.25%	0.00%	-4.31%	-6.97%
Period	**2023**				**2024**			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Growth rates	8.10%	-2.24%	5.73%	-4.07%	5.93%	2.93%	3.89%	3.49%
Period	**2025**				**2026**			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Growth rates	4.10%	0.23%	-4.16%	-1.93%	-0.74%	-7.92%	-6.45%	-5.75%

The table above contains the relevant data required to estimate the equivalent stock prices for Ahoo in each quarter, as estimated by the market. This estimation assumes a starting stock price of $400 at the beginning of the experiment and is necessary for creating the market trend depicted in the graph below:

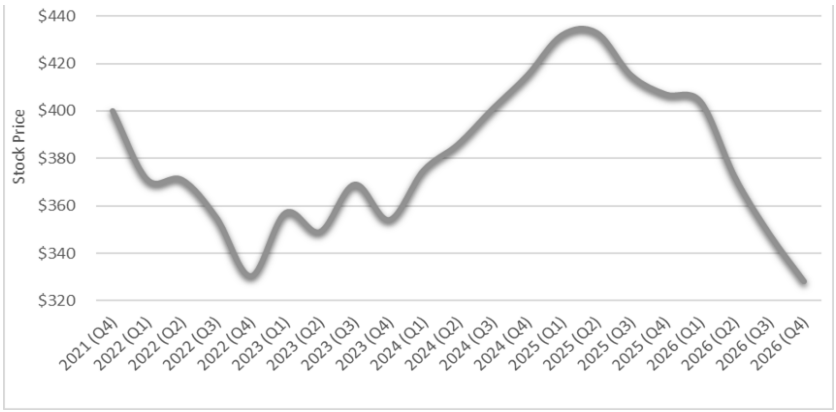

Figure 2. Stock Price Trend Under the Unregulated Pricing Mechanism

4.1.2.2 Stock Market Prices Under the Proposed Regulated Pricing Mechanism

The table below summarizes the observations of regulated market on growth rate estimates for each quarter,

under three different scenarios: assuming traders agree, as shareholders, on the NAPV model, the constant-growth DDM model, and the constant-growth RIM model to be used by the company for deriving quarterly stock values. This information can be used to understand the impact of the proposed pricing mechanism on the information efficiency of the market under study.

Table 3. Quarterly Growth Rates as Estimated By The Regulated Market From Dec. 31, 2021 To Dec. 31, 2026

Period	2021				2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Adopting NAPV	N/A	N/A	N/A	N/A	18.00%	13.23%	23.66%	35.48%
Adopting DDM	N/A	N/A	N/A	N/A	*Dividend Payout Ratio is zero in year 2022*			
Adopting RIM	N/A	N/A	N/A	N/A	39.58%	6.43%	18.37%	12.83%
Period	**2023**				**2024**			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Adopting NAPV	-5.52%	23.40%	21.78%	20.86%	16.67%	-11.41%	12.94%	-11.76%
Adopting DDM	65.59%	41.63%	38.61%	-9.81%	20.99%	32.50%	2.23%	-61.28%
Adopting RIM	10.82%	16.16%	19.71%	22.82%	16.76%	17.36%	19.60%	-1.16%
Period	**2025**				**2026**			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Adopting NAPV	-11.67%	-14.15%	-10.13%	16.17%	-14.98%	-21.16%	-14.78%	-44.10%
Adopting DDM	-37.20%	-16.50%	2.23%	309.92%	2.23%	-61.13%	2.23%	8.91%
Adopting RIM	6.56%	3.52%	3.12%	-0.45%	11.71%	-30.71%	6.00%	-78.84%

The table presented above contains the necessary data to estimate the equivalent stock prices for Ahoo in each quarter, as generated by the regulated market under three different scenarios. These estimates are essential for creating the regulated market trend for each scenario, as illustrated in the following three graphs:

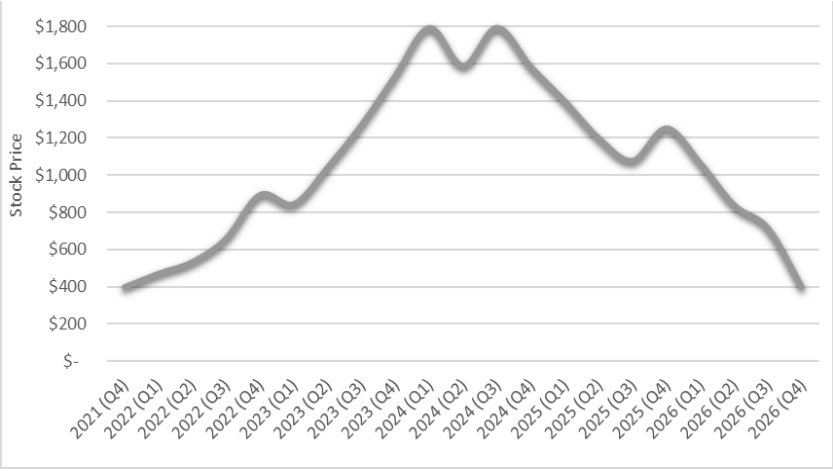

Figure 3. Stock Price Trend Under the Regulated Pricing Mechanism (Adopting NAPV Model)

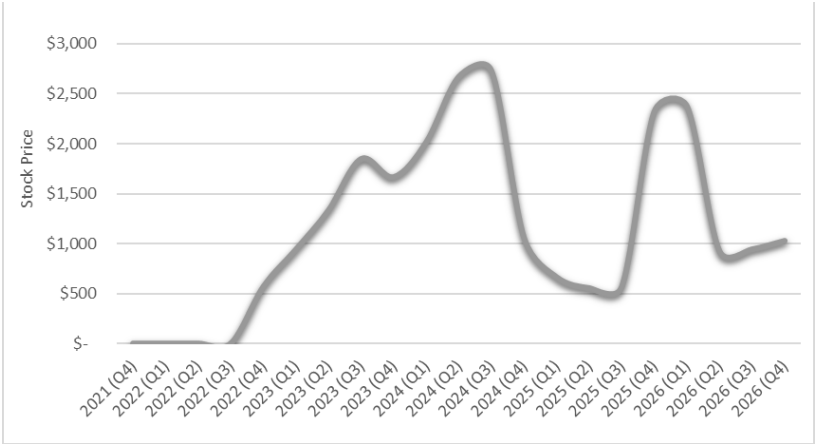

Figure 4. Stock Price Trend Under the Regulated Pricing Mechanism (Adopting DDM Model)

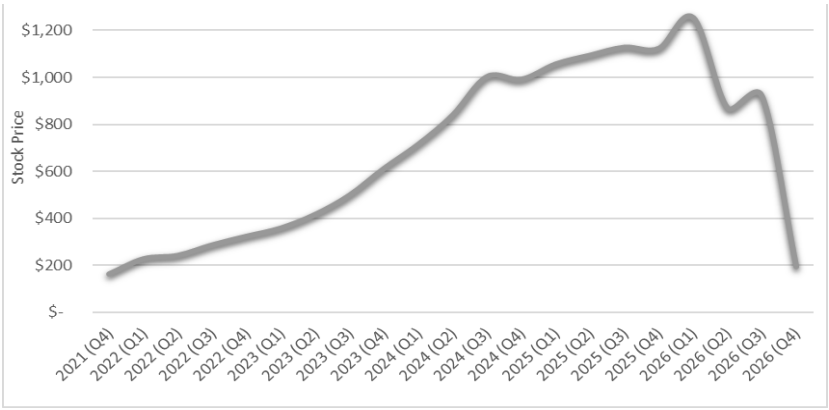

Figure 5. Stock Price Trend Under the Regulated Pricing Mechanism (Adopting RIM Model)

By combining the data from the table on unregulated traders' observations and the table on regulated traders' observations under three different scenarios and comparing the resulting data with an efficient benchmark, the following graph can be used to illustrate and compare the information efficiency of the market in two different scenarios: first, when it is unregulated, and second, when it is regulated using three independent valuation models:

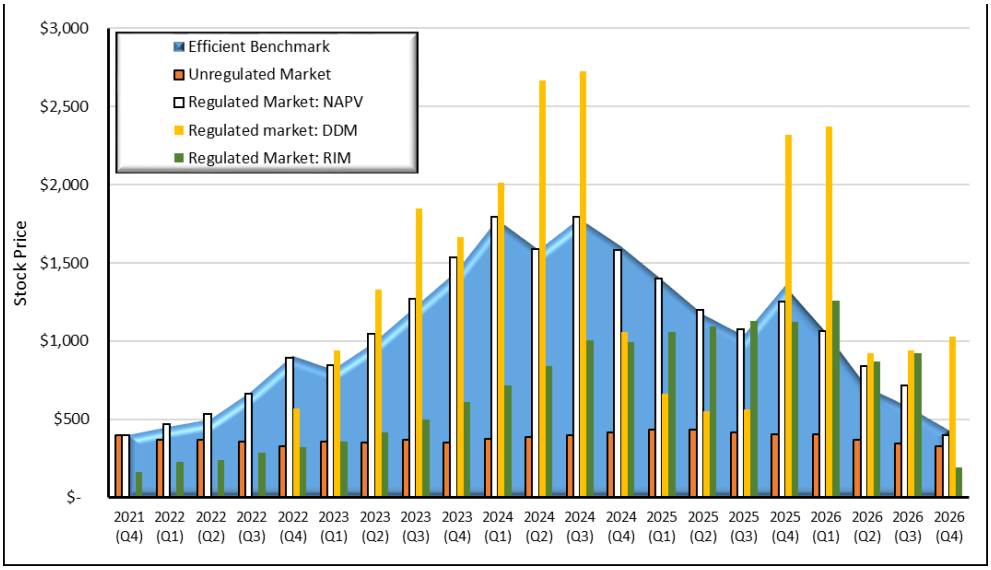

Figure 6. Stock Price Trend Under Each Stock Pricing Mechanism

4.2 ANOVA Results

The following table outlines the essential statistical measures obtained from the analysis of variance conducted on two groups, traders and evaluators, in both regulated and unregulated market scenarios. Specifically, in the regulated market scenario, ANOVA was performed for each of the three valuation models assumed to be adopted: NAPV model, Constant-Growth DDM, and Constant-Growth RIM.

Table 2. ANOVA Results of Market vs. Evaluators Under Different Pricing Mechanisms

	Correlation coefficient	**Slope coefficient**	**Regression sum of squares (SSR)**	**Error sum of squares (SSE)**	**R^2**	**Confidence Interval**		**P-Value**
						Lower 95%	Upper 95%	
Regulated Market: NAPV	0.94	0.89	0.71	0.09	0.89	0.74	1.05	0.00
Regulated Market: DDM	0.56	2.30	3.33	7.38	0.31	0.34	4.26	0.02
Regulated Market: RIM	0.55	0.61	0.33	0.77	0.30	0.15	1.07	0.01
Unregulated Market	0.04	0.01	0.00	0.05	0.002	-0.10	0.12	0.86

5. Discussion

5.1 Analyzing the Findings of the Experiment: Addressing the Research Question and Comparing with Previous Research

The research question that our study seeks to answer is whether the adoption of an agreed-upon efficient stock valuation model by a company can lead to improved stock market efficiency by generating periodic stock prices that differ from market prices. In order to investigate this question, we conducted a simulated stock market experiment. The purpose of this experiment was to shed light on the potential benefits of adopting an efficient stock valuation model that is mutually agreed-upon by company shareholders.

First, we conducted a trend analysis by analyzing the stock price charts. The chart showing the responses of the group of evaluators represents the benchmark for how the information efficient stock values were moving from quarter to another. From this chart, we see that the virtual company passed through three stages from 2022 to 2026. The first stage was characterized by an uptrend in stock price, the second stage was a pause, and third stage was a downtrend. We extended this trend analysis to other stock price charts generated under four different scenarios: first an unregulated market, second a market regulated to use NAPV, third a market regulated to use constant-growth DDM, and fourth a market regulated to use the constant-growth RIM. Under the first unregulated scenario, the first stage showed a downtrend despite increasing fair value, the second stage was an uptrend, and the final stage a downtrend similar to the benchmark. Under the NAPV scenario, the price chart largely resembled the benchmark. Under the DDM scenario, the chart showed relatively high volatility with five stages. Under the RIM scenario, the chart showed relatively low volatility with only two stages: an uptrend and downtrend. Notably, in 2026 the information mainly affected the basic and no-growth value, unlike 2022 to 2025 when it mainly affected the growth value. In 2026, all scenarios devalued the stock similarly to the benchmark, implying differing information efficiency when digesting speculative-growth versus no-growth information.

In addition to the trend analysis, we conducted ANOVA. This examined the linear relationship between evaluators' quarterly stock price growth rates and those of traders under four scenarios: unregulated market, NAPV-regulated market, DDM-regulated market, and RIM-regulated market. The linear regression analysis was conducted with a formulated null hypothesis that stated there was no linear relationship between the two variables being analyzed. Results showed the unregulated market had a very weak positive correlation of 0.04 with evaluators, while the NAPV-regulated market had a very strong positive correlation of 0.94. The DDM-regulated and RIM-regulated markets had moderate positive correlations of around 0.55. Regulation and the choice of valuation model thus significantly impacted the linear relationship and strength of correlation between traders' and evaluators' growth rates. The unregulated market displayed almost no linear relationship, while the NAPV model produced a strong linear relationship and close alignment between traders and the benchmark "information efficient" rates set by evaluators. The DDM and RIM models produced moderate correlations, suggesting partial alignment though also some deviations between traders and evaluators.

The null hypothesis could not be rejected for the unregulated market since the confidence interval at the 95% significance level included a zero beta coefficient, indicating no significant linear relationship. However, the null hypothesis was rejected for the regulated markets adopting NAPV, DDM, or RIM models since their 95% confidence intervals did not include zero, indicating significant positive linear relationships. P-value analysis confirmed these results. Regulation and the choice of valuation model thus significantly shaped whether a linear relationship existed between traders' growth rates and the benchmark set by evaluators. In the unregulated market, there was no evidence of a significant linear trend between the two groups, but for the regulated markets, evidence indicated a positive and significant linear trend where traders' growth rates aligned to some degree with the benchmark rates.

The findings suggest that the unregulated market had no significant relationship with the evaluators, implying it was not information efficient in explaining their variations during the experiment. Conversely, the regulated market adopting the new pricing mechanism had a significant linear relationship with the evaluators, indicating it could explain their variations and thus be information efficient when reflecting relevant information into prices. However, the degree of information efficiency matters, as measured by R-squared showing how much of the evaluators' variation was reflected. The R-squared for the DDM and RIM-regulated markets was around 0.31, while that for the NAPV-regulated market was 0.89, indicating it was most efficient in reflecting information and estimating prices during the experiment. Furthermore, a higher R-squared implies lower estimation error when valuing stocks, another efficiency criterion.

The experiment aimed to test two areas. First, it tested the efficiency of an unregulated simulated stock market, with prices determined by supply and demand based on traders' own predictions and valuation approaches.

Second, it examined the regulated market's information efficiency under a new mechanism where traders agree on a single efficient valuation model supervised by the regulator and used independently by the company to generate prices. The results answered the research question and hypotheses posed in the introduction, showing that the unregulated market was information inefficient, contrary to efficient market hypothesis (EMH). The results also showed that adopting a mutually agreed valuation model by the company has great potential to improve efficiency by generating alternative prices based on fundamentals. In other words, the results demonstrated that a regulated market adopting the new proposed pricing mechanism would be significantly more information and value efficient. Regulation and oversight, coupled with agreement on an appropriate and efficient valuation model, thus appear crucial for enhancing information efficiency and ensuring prices accurately reflect companies' fundamental values.

The findings from the simulated stock market align with previous research showing that free markets are often inefficient while also providing new insights. The unregulated market in this experiment was unable to be information efficient, supporting other studies showing stock markets can be inefficient and that EMH does not always hold. However, when the market was regulated to adopt the new pricing mechanism, information efficiency greatly improved compared to the free market. While prior literature found insignificant impact from regulatory measures on stock market efficiency, the results here suggest a new pricing mechanism could significantly contribute by generating alternative stock prices based on agreed valuation models. Future research is recommended to test this proposed mechanism in combination with other regulatory measures, as an integrated approach may further enhance information efficiency.

5.2 Implications for Practice

The findings of this research demonstrate that regulating and modernizing the stock pricing mechanism has the potential to significantly enhance the efficiency of the stock market. The existence of stock market bubbles and crashes is a persistent problem for investors, the stock market, and the wider economy. Therefore, any steps taken to improve stock market efficiency are likely to benefit all stakeholders by protecting them from the negative consequences of such speculative bubbles and crashes. One potential solution is to remove the stock pricing task from the hands of speculators and instead use an efficient stock valuation model that is agreed upon by investors who are shareholders in the company. This model can be used by the company to derive and update stock values that confidently reflect the relevant information and fundamentals about the company.

This study also has implications for investors, as their stock values and wealth are going to be directly affected by the efficiency and effectiveness of the financial management of the company. Shareholders' wealth will increase only if the fundamentals and prospects of the company are improving, while it will decrease if the fundamentals and prospects of the company are deteriorating. Therefore, the need for more corporate governance activities and control is going to be an evident. This will emphasize the importance of financial transparency, accountability, and responsibility for companies who aim to maximize shareholders' wealth. Ultimately, these findings highlight the significance of regulatory intervention in improving the stock market efficiency and creating a more sustainable and stable financial environment for all stakeholders.

5.3 Limitations of the Study

When interpreting the findings of this study, it is important to acknowledge several limitations. One potential limitation is the small sample size used in the experiment for the group of evaluators. This limited sample size may not be representative of the larger population being studied, thus limiting the generalizability of the findings. Another limitation to consider is the missing stock values generated by certain stock valuation models during some periods. This missing data may impact the accuracy and reliability of the findings obtained from these models. Furthermore, it should be noted that the NAPV model may not be entirely applicable if there are no new regulatory measures in place, which could make the findings of this model less externally valid.

Another possible limitation of the research study is that the traders who were estimating quarterly results using quarterly reports on a daily basis timeframe may have been biased to give quarterly growth rate estimations equivalent to a daily growth rate estimation. This bias could have been driven by the fact that traders are accustomed to making daily estimates, and therefore may have been more influenced by short-term trends and fluctuations in the market. Additionally, the presence of conflicting data and mixed positive and negative information or rumors may have also contributed to the relatively small growth rate estimations submitted by the experimented market. This could have made it difficult for traders to accurately interpret and estimate growth rates, as they were exposed to a range of potentially contradictory information.

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 primary aim of this experiment was to investigate whether the adoption of an agreed-upon efficient stock valuation model by a company can lead to improved stock market efficiency by generating periodic stock prices that differ from and replace market prices. A group of evaluators representing Homo-Economicus investors served as a benchmark for assessing information efficiency by providing growth rate estimates based on a rigorous analysis of all relevant information regarding the virtual company, “Ahoo”. The evaluators' growth rates were compared to those of experimented traders in both an unregulated market and regulated markets where traders, acting as shareholders in Ahoo company, are assumed to agree on the NAPV, constant-growth DDM, or constant-growth RIM to be adopted by the company as the efficient stock valuation model.

The results indicate that the unregulated market displayed almost no linear relationship with the benchmark growth rates, suggesting it was highly information inefficient in reflecting relevant information into prices. In contrast, the NAPV-regulated market showed a strong linear relationship and high R-squared value, demonstrating it was most information efficient and capable of accurately reflecting the evaluators' variation. The DDM- and RIM-regulated markets exhibited moderate correlations, implying partial alignment and efficiency compared to the NAPV model. These findings were further corroborated through ANOVA analysis, supporting the hypothesis that adopting a mutually agreed-upon efficient valuation model can markedly improve the information efficiency of a simulated stock market.

The superior performance of the NAPV-regulated market implies that using an appropriate, agreed-upon stock valuation model to generate prices could significantly enhance information efficiency by discounting the influence of irrational speculators and focusing instead on reflecting fundamental value drivers. Nevertheless, the choice of valuation model matters, as seen by NAPV's relatively high R-squared value indicating it could explain a greater degree of the evaluators' variations compared to DDM and RIM.

Trend analysis of the stock price charts further illuminates these findings. The evaluator benchmark chart depicted three stages: an initial uptrend, a pause, and then a downtrend. The unregulated market chart showed a downtrend initially despite rising fair value, suggesting inability to properly reflect fundamentals. The NAPV-regulated chart largely mirrored the benchmark, while the DDM-regulated chart exhibited high volatility with five stages. The RIM-regulated chart showed relatively low volatility with only two stages: an uptrend followed by a downtrend. Notably, in year 2026 when the released information was mainly assumed to affect the no-growth value of the company, all scenarios similarly devalued the stock like the benchmark, implying differing information efficiency in digesting speculative growth versus no-growth information.

While initially promising, these results should be interpreted in light of various shortcomings. For instance, the small sample of evaluators may have limited the generalizability of the findings. Furthermore, certain valuation models could not generate stock values during some periods, potentially impacting the reliability of comparisons. Additionally, trader biases likely skewed growth rate estimates due to experimental design features.

Despite these limitations, the findings offer valuable insights and implications. Fundamentally, the results indicate that modernizing the stock pricing process through regulatory intervention and mutual investor agreement on an appropriate valuation model holds promise for significantly enhancing the functioning of capital markets. With proper limitations, such a regulated stock pricing mechanism warrants further exploration given its potential benefits for investors, companies and financial system stability overall. Consequently, future research incorporating larger evaluator samples, additional valuation models and efforts to mitigate experimenter biases would help refine and strengthen the initial evidence provided here.

In summary, this experiment provides a useful proof of concept indicating that adopting a mutually agreed-upon, efficient stock valuation model to generate stock prices could offer distinct advantages over current free market practices by properly reflecting the informational value of relevant company fundamentals. With appropriate follow-up studies to address its shortcomings, the proposed regulated pricing mechanism shows promise as a practical means of significantly improving the information efficiency of capital markets for the benefit of all stakeholders. Nonetheless, selecting the appropriate and the efficient valuation model to govern prices remains a crucial consideration to fully realize this potential.

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