IPRPD
International Journal of Business & Management Studies
ISSN 2694-1430 (Print), 2694-1449 (Online)
Volume 07; Issue no 05: May, 2026
DOI: 10.56734/ijbms.v7n5a1

THE DUPONT FRAMEWORK REVISITED: ANALYSIS OF THE INTERACTIVE EFFECT OF PROFIT MARGIN, ASSET TURNOVER, AND EQUITY MULTIPLIER ON RETURN OF EQUITY

Sunny Onyiri, PhD, DBA[1]

[1]*Professor of Finance and Accounting, Campbellsville University*

Abstract

This study investigates the factors influencing return on equity (ROE) for the five largest U. S. companies by market capitalization, namely NVIDIA, Apple, Alphabet, Microsoft, and Amazon, using an extended DuPont analysis framework. The study uses 10 years of firm- level financial information from audited Form 10- K filings to decompose ROE into its components: profitability (profit margin), operational efficiency (asset turnover), and financial leverage (equity multiplier). Rather than relying exclusively on the classic multiplicative method, the research employs a multiple regression model that accounts for both main and interaction effects among these elements. Diagnostic assessments confirm the model' s validity, and heteroskedasticity- consistent (HC 3) standard errors are used to ensure robust inference. The regression findings reveal that asset turnover is a significant positive predictor of ROE (B = 0. 66, p <. .001), whereas profit margin (B =- 1. 18, p <. .001) and the equity multiplier (B =- 0. 14, p <. .001) have negative main effects. Notably, the interaction between profit margin and the equity multiplier shows a positive and highly significant relationship (B = 1. 56, p <. .001), indicating that financial leverage enhances the impact of profitability on shareholder returns. The model accounts for approximately 97. 8% of the variability in ROE (R^2 =. .978). The important interaction between profit margin (PM) and equity multiplier (EM) illustrates that profitability' s effect on the dependent variable is contingent on financial leverage. When leverage is low, the profit margin exerts a minimal effect on ROE. As leverage rises, the marginal effect of profitability shifts in a positive direction. From the estimated coefficients, the marginal effect of the profit margin is- 1. 184 + 1. 557 ·EM. This indicates that when leverage is lower, increases in profit margin correlate with declines in the dependent variable. As the equity multiplier (EM) increases, the negative influence of profit margin gradually lessens. Ultimately, the effect turns positive once EM surpasses roughly 0. 76. This research demonstrates that DuPont analysis remains a valuable and effective tool in modern financial analysis. It enhances the clarity of performance evaluations and facilitates more informed managerial and investment choices by pinpointing the true determinants of shareholder returns.

Keywords

DuPont analysis; return on equity (ROE); Profitability; Asset Turnover; Financial Leverage; Equity Multiplier; Interaction Effects; Firm Performance

1. Introduction

This study builds on and extends the DuPont framework by embedding its core components in an econometric regression model that accommodates both main and interaction effects. Rather than relying solely on descriptive ratio decomposition, the regression-based approach enables empirical testing of the joint influence of profitability, operational efficiency, and leverage on ROE (Endris & Babu, 2026; Turner

et al., 2022). Using 10 years of audited financial data from the five largest U.S. companies by market capitalization (NVIDIA, Apple, Alphabet, Microsoft, and Amazon), this analysis moves beyond mechanical ratio interpretation to model ROE as an integrated outcome of interconnected financial and operational decisions. By explicitly modeling interaction effects, particularly between profit margin and the equity multiplier, the study provides a more realistic and flexible representation of firm performance dynamics, consistent with recent advances in extended DuPont research (Endris & Babu, 2026; Salma & Hariyono, 2025).

Return on equity (ROE) is widely regarded as one of the most important measures of corporate performance because it captures a firm's ability to generate returns for shareholders on invested equity (Kaur & Mulugeta, 2022; Turner et al., 2022). Investors, analysts, and managers frequently rely on ROE to evaluate profitability, compare firms, and inform strategic decisions. Despite its popularity, ROE in isolation offers limited diagnostic value, as similar ROE levels can stem from very different combinations of operating performance, asset utilization, and financial leverage (Kishibayeva & Jaxybekova, 2023). A high ROE, for example, may reflect strong underlying profitability, superior efficiency, aggressive leverage, or a combination of these factors. Without dissecting its components, stakeholders risk misinterpreting the sources, sustainability, and risk profile of observed performance (Kaur & Mulugeta, 2022).

The DuPont framework addresses this limitation by decomposing ROE into three fundamental drivers: profit margin, asset turnover, and the equity multiplier. This decomposition enables a more granular understanding of how firms create shareholder value through operational profitability, asset efficiency, and financing choices (Turner et al., 2022). However, traditional DuPont analysis assumes a strict multiplicative relationship among these components, implicitly treating their effects as proportional and uniform across firms and time. Recent empirical research challenges this assumption, showing that the effects of leverage and profitability are often conditional and context-dependent (Abadiyah, 2023; Salma & Hariyono, 2025). In practice, leverage may amplify returns when profit margins are robust but magnify losses and financial risk when operating performance weakens, suggesting that its impact is interactive rather than mechanical (Abadiyah, 2023).

The objective of this study is to examine how the components of the DuPont framework, namely profit margin, asset turnover, and financial leverage, jointly and interactively influence return on equity (ROE). Rather than treating these components as mechanically multiplicative, the study focuses on the conditional and context-dependent effects of leverage and profitability on shareholder returns. Using financial data from real companies, the study explores whether and how financial leverage amplifies or mitigates the impact of operating performance. The study seeks to provide a more nuanced explanation of value creation that reflects real-world firm behavior across varying business settings.

2. Literature Review

2.1 The DuPont Framework

Kalesha et al. (2023) analyzed the financial performance of a sample of companies listed on the NSE-Emerge platform using the DuPont analysis framework. The study decomposed return on equity (ROE) into three key components (net profit margin, asset turnover, and financial leverage) of the DuPont framework to provide a clearer picture of what drives firms' performance. This decomposition offered a systematic way to assess how operational efficiency, profitability, and financing decisions jointly affect shareholder returns (Kalesha et al., 2023). Kalesha et al. (2023) suggest that these key elements provide a better understanding of how companies can create value. Based on the results of this study, fluctuations in ROE are primarily attributable to differences in asset utilization and profit margins, rather than to excessive reliance on financial leverage (Kalesha et al., 2023). This indicates that companies in the NSE-Emerge segment focused on effective operations and revenue generation rather than aggressive borrowing practices (Kalesha et al., 2023). In addition, companies with higher asset turnover are more likely to achieve better financial results despite comparatively modest profit margins. This supports the stance that effective utilization of assets is critical to maximizing returns. Simultaneously, companies with unstable profitability tend to exhibit fluctuations in ROE, indicating unstable earnings (Kalesha et al., 2023). Stable and predictable profit margins are therefore crucial to long-term financial growth. The research finds that DuPont analysis is a very useful instrument for assessing financial performance in an integrated, systematic way. It helps investors, managers, and analysts assess a firm's strengths and weaknesses, making strategic decision-making easier (Kalesha et al., 2023).

Kalesha et al. (2023) study was supported by Paul (2025). Paul (2025) investigated how DuPont analysis in the pharmaceutical sector enables a deeper understanding of company profitability than simply using the return on equity ratio. Paul's (2025) study goes beyond the three-part DuPont framework of profit margin, asset utilization, and leverage. The study included additional variables, namely interest and tax burden. The presence of these variables can affect a company's overall financial measures (Paul, 2025). As a result of this broader interpretation of DuPont analysis, Paul (2025) presents DuPont analysis not just as a calculation method but also as a structured, systematic diagnostic tool that can illustrate the reasons for profitability trends across companies. The findings from this study provide a valuable contribution to understanding how pharmaceutical companies operate. Due to high research costs, intense regulatory scrutiny, and pricing constraints, profitability cannot simply be measured using a single ratio. Using a set of 170 pharmaceutical companies' financial outcomes from 2009-2010 to 2017-2018, the analysis uses two methods: regression analysis (panel data) and stepwise regression analysis. According to Paul (2025), profitability is strongly correlated with profitability through profit margin, asset use, and leverage. This research supports the use of the extended DuPont Model as a tool for managers to assess performance.

Paul's (2025) study was corroborated by Srisakornborisut and Nimtrakoon (2025). Srisakornborisut and Nimtrakoon (2025) explored the connection between the individual elements of the DuPont model and return on equity (ROE) in the real estate and construction industry. The research was based on panel data from 215 firms over a five-year period and analyzes the contributions of each component to total financial performance using statistical analysis. The authors extend the conventional DuPont model by adding factors such as the tax burden, interest burden, and the earnings before interest and taxes (EBIT) margin. This longer-term strategy provides more specific insight into the relationship between operational efficiency, financial structure, and shareholder returns. The results indicate that the predictive power of the EBIT margin and asset turnover is substantial, and that operational and revenue-generating efficiency plays a critical role in firm performance. Moreover, this study focused on financial leverage (equity multiplier) as a two-sided factor. Although leverage can boost ROE, overreliance on debt increases financial risk and volatility (Srisakornborisut & Nimtrakoon, 2025). The presence of taxes and interest expenses also shows the impact of external financial requirements on profitability and, therefore, shareholder returns (Srisakornborisut & Nimtrakoon, 2025). The study finds that the DuPont model is highly useful for explaining differences in ROE across firms and industries.

Endris and Babu (2026) also analyzed the DuPont framework using data from the manufacturing industry. This study was similar to Srisakornborisut and Nimtrakoon (2025). Endris and Babu (2026) extended the classic DuPont model to create a broader framework that includes new elements such as the tax burden, interest burden, and operating efficiency. This improved methodology provides a more detailed and comprehensive analysis of return on equity (ROE), enabling a stronger assessment of financial performance. The extended model enables a deeper analysis of the factors that affect profitability by separating the effects of financing, taxation, and operational activities (Endris & Babu, 2026). The research focused on manufacturing companies and examined how operational and financial factors contribute to overall performance. The results indicate that profitability largely depends on operating efficiency and effective cost control. Companies that are efficient in their production processes and incur low operating costs, such as tax and interest burden, are more likely to achieve higher returns on equity (Endris & Babu, 2026). This underscores the need for strong internal management practices and effective resource utilization to maintain financial success. Endris and Babu (2026) indicate that financial structure plays a role in determining firm performance. Although financial leverage may boost returns due to the possibility of higher earnings, overreliance on debt increases interest payments and the cost of capital. The extended DuPont model can be used to isolate these effects, providing a clearer picture of how financing decisions affect profitability. This will enable managers to seize opportunities while remaining financially stable. Jain and Tiwary (2024) also conducted a study in the manufacturing sector. This research explored the factors that influence the profitability of manufacturing companies using the DuPont framework. Companies with higher profit margins, effective asset utilization, and appropriate leverage ratios achieved higher ROE and better rankings. Jain and Tiwary (2024) contribute to theory-linked knowledge creation in the industry by deepening the understanding of financial analysis methods for manufacturing firms, thereby improving the ability to evaluate business performance relative to rankings. The results imply that businesses can enhance their rankings by focusing on increasing profit margins, optimizing asset utilization, and maintaining a balanced leverage ratio. Moreover, industry-specific studies and benchmarking can provide valuable insights.

Shabani et al. (2021) used the DuPont Model to assess the financial health of SMEs. They emphasize that a key advantage of DuPont is its ability to decompose composite metrics like ROE into simpler components, enabling analysts to understand what truly drives performance beyond just the overall ROE. The model calculates ROE based on asset utilization, profit margin, and leverage, which is especially useful for resource-limited SMEs. The study examined 40 SMEs in Kosovo from 2016 to 2018 using an econometric approach to analyze the relationship between ROE and its determinants. Results indicated that all three components (asset utilization, profit margin, and leverage) positively affect ROE. However, the effects of the three components on ROE varied. Profit margin has the strongest impact, followed by asset utilization, with leverage having a smaller positive effect. The regression results highlight profit margin as the main short-term driver of shareholder returns, suggesting that firms should focus on sustainable growth and high-quality earnings rather than relying solely on leverage to improve ROE. Overall, Shabani et al. (2021) provide further evidence of the usefulness of the DuPont analysis.

While Shabani et al. (2021) were limited to 40 companies, Jape and Malhotra (2023) presented an extensive empirical analysis of the DuPont model using a large sample (more than 13,000 publicly listed companies). The results of this study were consistent with a previous study of the DuPont framework. The analysis confirms that the DuPont framework is an effective instrument for decomposing return on equity (ROE) into its fundamental drivers: profitability, efficiency, and leverage. By applying regression and ratio analysis, Jape and Malhotra (2023) assessed the relative significance of each component in evaluating ROE. The results suggest that profitability measures, especially margins such as the profit-volume ratio and the safety margin, have the greatest impact on ROE. Although asset turnover contributes to performance by indicating operational efficiency, its effect on profit was not significant in this study. Financial leverage, as included in the DuPont identity, shows relatively low sensitivity to changes in ROE among the sampled firms. Notably, this shows that ROE is not a single measure but a product of numerous financial aspects. The DuPont model allows managers to determine whether performance should be improved through cost management, asset management, or capital structure optimization (Jape & Malhotra, 2023; Shabani et al., 2021).

2.2 Interactive Effects of Profit Margin, Asset Turnover, and Equity Multiplier on Return on Equity

In addition to recent empirical studies, earlier finance and accounting research provides a solid theoretical and empirical foundation for understanding ROE as the outcome of the interplay between operational and financing factors, rather than as a standalone metric. Nissim and Penman (2001) decompose ROE into operating and financing components, showing that profitability, asset efficiency, and leverage are economically interconnected through residual income, which supports the multiplicative principle in the DuPont analysis. Likewise, Fairfield and Yohn (2001) show that variations in profit margins and asset turnover together explain the consistent return on net operating assets, indicating that margin improvements are most effective when paired with efficient asset use. Hawawini, Subramanian, and Verdin (2003) also argue that a firm's operational performance, together with industry structure, influences financial results, suggesting that ROE dominance stems from coordinated operational and financial strategies within competitive contexts.

Additional evidence from forecasting and valuation research strengthens the interaction perspective by linking DuPont components to expectations of long-term performance. Soliman (2008) finds that the relative balance between profit margins and asset turnover contains incremental information about future earnings and stock returns, indicating that investors implicitly price the interaction between efficiency and profitability. Penman (2013) emphasizes that financial leverage merely redistributes operating performance between equity and debt holders, reinforcing the argument that leverage enhances shareholder returns only when supported by strong operating fundamentals. Collectively, this literature aligns with recent empirical findings by framing ROE as an integrated performance construct, driven by the dynamic interaction among margins, asset utilization, and leverage rather than mechanical ratio enhancement. This supports the view of DuPont interaction analysis as both an explanatory and predictive tool.

Return on Equity (ROE) remains a central indicator of firm performance because of its direct linkage to shareholder wealth, and the DuPont framework provides a structured basis for understanding its drivers through profit margin, asset turnover, and the equity multiplier. Owing to its multiplicative structure, DuPont analysis inherently emphasizes interaction effects among these components rather than isolated ratio movements. Recent empirical research increasingly adopts this perspective, demonstrating that ROE outcomes reflect the joint behavior of operational efficiency, asset utilization, and financial

leverage. Shabani, Morina, and Berisha (2021) show that profit margin and asset turnover jointly shape ROE in SMEs, with leverage either amplifying or dampening returns depending on efficiency levels, while Kaur and Mulugeta (2022) similarly argue that combined profitability and efficiency measures explain performance variations more comprehensively than single-ratio analysis.

Subsequent studies further reinforce the primacy of interaction effects in shaping both the level and sustainability of ROE. Ortiz et al. (2021), using a financial return on equity (FROE) model, show that leverage enhances ROE only when operating margins and asset turnover are both strong, a finding echoed by Endris and Babu (2026), who identify strong interactions among leverage, tax burdens, and interest costs within an extended DuPont framework. Sector-specific evidence supports this view: Jain and Tiwary (2024) find that manufacturing firm rankings are driven by the coordinated optimization of margins, efficiency, and leverage, while Liu and He (2025) show that ROE maximization occurs when margin growth and asset utilization interact positively under moderate leverage. From a sustainability perspective, Andriyanto et al. (2026) conclude that firms whose ROE is driven by margin–turnover interactions exhibit lower financial risk than those relying primarily on leverage, underscoring leverage's role as a conditional amplifier rather than a standalone driver within the DuPont interaction structure.

2.3 Summary of Literature Review

The literature consistently presents the DuPont framework as a powerful, integrative tool for understanding the drivers of return on equity (ROE) by decomposing it into profitability, asset efficiency, and financial leverage. Across markets, firm sizes, and industries, studies show that ROE is driven primarily by how effectively firms generate margins and utilize assets, rather than by aggressive leverage. Evidence from emerging markets, pharmaceuticals, SMEs, and large public firms demonstrates that fluctuations in ROE are most closely tied to operational performance, particularly stable profit margins and efficient asset deployment. High asset turnover can compensate for modest margins, while unstable profitability often leads to volatile returns, underscoring the importance of consistent operating efficiency. Overall, the DuPont model enables managers and investors to pinpoint whether performance issues stem from cost control, revenue generation, asset utilization, or financing decisions.

An expanding body of research underscores that ROE should be understood as the outcome of interactions among DuPont components rather than as isolated ratios. Extended DuPont models that incorporate the tax burden, interest burden, and operating efficiency show that leverage acts as a conditional enhancer of returns, benefiting firms only when supported by strong operational fundamentals. Sector-specific studies, particularly in manufacturing, construction, and real estate, show that firms achieve superior, more sustainable ROE through coordinated improvements in margins, asset utilization, and balanced leverage, whereas excessive debt increases financial risk and earnings volatility. Theoretical and valuation-focused research reinforces this interaction perspective by showing that investors and analysts implicitly value the balance between profitability and efficiency. Collectively, this body of work establishes ROE as an integrated performance outcome shaped by dynamic interactions among operational efficiency, asset productivity, and financial structure, validating the DuPont framework as both a diagnostic and a strategic decision-making tool.

3. Methodology

3.1 Sample

The sample for this research was limited to the top five U.S. companies by market capitalization (CompanyMarketCap.com, n.d.). Although 10 years of market capitalization data were examined, the 2025 end-of-year value was the sole criterion for inclusion in this study. Market capitalization is the number of outstanding common shares multiplied by the current market price of the common stock. It is an important metric for investors, providing a quick assessment of a company's size and relative valuation compared to peers in the same sector. It also helps investors evaluate risk, growth potential, and portfolio diversification.

Table 1: Market Capitalization of Top Five U.S. Companies
(T = Trillions of Dollars; B = Billions of Dollars)

Year	NVIDIA	Apple, Inc.	Alphabet, Inc	Microsoft	Amazon
2025	$4.24 T	$3.77 T	$3.44 T	$2.73 T	$2.26 T
2024	3.29 T	3.77 T	2.37 T	3.20 T	2.35 T
2023	1.22 T	2.99 T	1.76 T	2.79 T	1.57 T
2022	364.18 B	2.07 T	1.15 T	1.78 T	856.94 B
2021	735.27 B	2.90 T	1.92 T	2.52 T	1.69 T
2020	323.24 B	2.26 T	1.19 T	1.68 T	1.63 T
2019	144.00 B	1.29 T	921.55 B	1.20 T	920.22 B
2018	81.43 B	746.04 B	723.55 B	780.36 B	737.46 B
2017	117.26 B	860.88 B	729.45 B	659.90 B	563.53 B
2016	57.53 B	608.96 B	539.06 B	483.16 B	356.31 B

Source: CompanyMarketCap.com (n.d). Largest American companies by market capitalization. Retrieved from Largest American companies by market capitalization

While market capitalization is a metric used by investors, it reflects only a company's equity value and does not account for debt, cash reserves, or other financial obligations. To obtain a holistic valuation of a company beyond financial data, consider metrics such as revenue growth, dividend policy, market share, debt obligations, and other macroeconomic factors. The analysis of the sample in this study is limited to each company's reported financial data.

3.2 Data

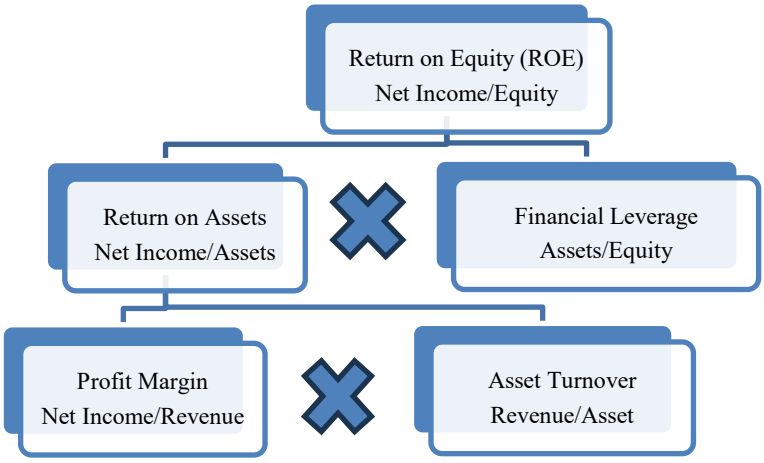
Ten years of financial data were extracted from the annual reports (Form 10-K) of each company in this study. Form 10-K is the required annual audited financial report for U.S. publicly traded companies. To calculate the variables for this study, the extracted financial data included net income, total assets, total stockholders' equity, and total debt. These line items were used to compute profit margin, total asset turnover, equity multiplier (financial leverage), return on equity, and the interaction effects of the variables.

3.3 Model

The model for this study is based on the 3-step DuPont analysis. The 3-step DuPont model decomposes return on equity into three components: profitability, asset utilization (efficiency), and leverage. This framework is particularly useful for companies in understanding their overall return on equity. The DuPont Model is also important because it guides the use of limited resources that enterprises operate with and shows the effect, however minor, of changes in efficiency or profitability on return on equity. The simplified DuPont Model uses the following equation:

Return on Assets (ROA) = Profit Margin x Asset Turnover x Equity Multiplier

Figure 1: DuPont Framework



To examine the determinants of firm performance, this study used the following linear regression model:

$$ROE_i = \beta_0 + \beta_1(\text{Profit Margin}_i) + \beta_2(\text{Asset Turnover}_i) + \beta_3(\text{Equity Multiplier}_i) + \beta_4(\text{Profit Margin} \times \text{Equity Multiplier})_i + \varepsilon_i$$

Table 1: Definition of model components

Model Regression Components	Definition/Explanations
ROE_i	Return on equity (ROE) measures the return on common stockholders' investment in the firm's assets. It indicates the company's ability to generate profits from shareholders' equity and demonstrates overall financial performance from the owners' perspective.
β_0	The intercept reflects the expected value of ROE when all explanatory factors, such as profit margin, asset turnover, equity multiplier, and their interactions, are held at zero (Grace-Martin, 2021).
Profit Margin$_i$	Profit margin indicates operating profitability by measuring the fraction of revenue retained as profit. It shows how effectively the company manages costs in relation to its sales. Assuming other variables remain unchanged, its coefficient illustrates the incremental impact of profitability on ROE when leveraging is absent.
β_2	This coefficient quantifies the impact of profit margin on return on equity (ROE) under the assumption that the equity multiplier is equal to zero. In the presence of an interaction term, this coefficient should not be considered as the total effect of profit margin; instead, it signifies a baseline effect that varies with leverage (Grace-Martin, 2021).
Asset Turnover$_i$	Asset turnover is an efficiency ratio that measures the utilization of a firm's assets. The asset turnover ratio measures the number of dollars of sales produced per dollar of total assets. For this study, asset turnover is calculated as revenue divided by total assets.
β_3	The interaction coefficient measures how the marginal influence of profit margin on ROE changes as leverage increases. A positive value suggests that the effect of profitability on ROE becomes more pronounced at higher levels of leverage (Grace-Martin, 2021)..
Equity Multiplier$_i$)	The equity multiplier assesses financial leverage, showing how a company finances its assets with equity versus debt. An elevated equity multiplier indicates greater leverage.
β_4	The interaction coefficient reflects how the marginal effect of profit margin on ROE varies with increasing leverage. A positive value indicates that the influence of profitability on ROE intensifies as leverage rises (Grace-Martin, 2021).
Profit Margin × Equity Multiplier)$_i$	This interaction term allows the impact of profitability on ROE to vary with leverage (and vice versa). It evaluates whether leverage affects the connection between operating profitability and returns to shareholders.
ε_i.	The error term accounts for unobserved factors influencing ROE that are not captured by the included explanatory variables, such as management quality, market conditions, or firm-specific shocks.

4. Empirical Results

Based on the findings from the multiple regression analysis conducted in this study, several diagnostic tests were performed to confirm that the model met the necessary assumptions and that the results were valid, reliable, and interpretable. These tests included evaluating multicollinearity using Variance Inflation Factors (VIFs), assessing normality with the Shapiro-Wilk test, and examining heteroskedasticity with the Breusch-Pagan test.

4.1 Multicollinearity Test

Methodology: A diagnostic test for multicollinearity was performed using Variance Inflation Factors (VIFs):

Table 2: Variance Inflation Factors (VIFs)

Variable	VIF	Comment
Net Income	1.92	No evidence of multicollinearity
Profit Margin	2.34	No evidence of multicollinearity
Asset Turnover	1.81	No evidence of multicollinearity
Equity Multiplier	2.11	No evidence of multicollinearity
Constant	1.00	---

Variance Inflation Factors (VIFs) greater than 10 indicate severe multicollinearity. VIFs between 5 and 10 indicate moderate multicollinearity in the data (Jeng, 2023). Based on the multicollinearity test results in Table 2, all variables have VIFs below 5. Harmful multicollinearity was not observed in the model (Jeng, 2023).

4.2 Normality Test of the Residuals

Methodology: To assess whether the model residuals are normally distributed, the Shapiro–Wilk normality test was applied (N = 50).

Table 3: Normality Test of the Residuals

Test	**Test Statistics**	***p*-value**
Shapiro-Wilk	0.96`	0.08

The Shapiro-Wilk test was used to assess the residuals. Based on the results, there is no evidence of non-normality (W = 0.96, $p = 0.08$). The normality of the residual distribution cannot be rejected ($p > .05$). The use of a t-test is validated, and the assumption of normality for the residuals is satisfied.

4.3 Heteroskedasticity Diagnostics using Breusch–Pagan Test

The Breusch–Pagan test examines whether residual variance depends on the regressors. In an ordinary least squares (OLS) regression, a key assumption is homoskedasticity—that the variance of the error term (residuals) is constant across all observations. The Breusch–Pagan (BP) test assesses whether this assumption holds. In this study, the Breusch–Pagan test was conducted to determine whether the variance of the residuals varies systematically with one or more explanatory variables (the regressors). If the residual variance is related to the regressors, this indicates heteroskedasticity.

Table 4: Breusch–Pagan Test

Statistic	**Value**	**p-Value**
LM Statistic	9.87	0.021
F-Statistic	2.56	0.029

The Breusch-Pagan test indicates heteroskedasticity in the regression model. The Lagrange Multiplier (LM) statistic is 9.87, with an associated p-value of 0.021. The F-statistic is 2.56, with a p-value of 0.029. Both p-values fall below the conventional 5% significance level for testing heteroskedasticity, suggesting that heteroskedasticity is present. This finding implies that the variance of the error terms may vary systematically with the regressors, potentially violating the constant-variance assumption (Frost, n.d.).

4.4 Diagnostic Summary

The diagnostic assessments confirm that the regression model meets the essential criteria for Ordinary Least Squares (OLS). The variance inflation factors indicate that multicollinearity is not a concern among the regressors. Additionally, the Shapiro-Wilk test indicates that the residuals are normally distributed. However, the Breusch-Pagan test reveals the presence of heteroskedasticity.

4.5 Test for Robustness

Considering the heteroskedasticity indicated by the Breusch-Pagan test, the model was reassessed for robustness using heteroskedasticity-consistent (HC3) standard errors to ensure reliable statistical inferences.

Table 5: Regression With Robust Standard Errors (HC3)

Predictor/dependent Variables	B	Robust Standard Errors (HC3)	Z-value	P-value
Intercept	-0.301	0.062	-4.86	<.001
Profit-Margin (PM)	-1.184	0.278	-4.26	<.001
Asset Turnover	0.662	0.051	12.94	<.001
Equity Multiplier (EM)	-0.144	0.031	-4.62	<.001
PM x EM	1.557	0.102	15.27	<001

The robust standard errors (HC3) reported in Table 5 indicate that all findings remain stable and that the statistical conclusions are consistent with expectations (Haye & Cai, 2007). Table 5 presents the results of the multivariate regression analysis, estimated using HC3 robust standard errors to address potential heteroskedasticity.

The findings indicate that profit margin has a negative and statistically significant relationship with the dependent variable ($B = -1.184$, $z = -4.26$, $p < .001$), whereas asset turnover is positively correlated with the dependent variable ($B = 0.662$, $z = 12.94$, $p < .001$). The equity multiplier also shows a negative and statistically significant coefficient ($B = -0.144$, $z = -4.62$, $p < .001$). Importantly, the interaction between profit margin and the equity multiplier is positive and significant ($B = 1.557$, $z = 15.27$, $p < .001$), indicating that profitability is influenced by financial leverage. Furthermore, the intercept is both negative and significant. Overall, the model accounts for a considerable proportion of the variance in the dependent variable ($R^2 = .978$) with 50 firm-specific financial observations.

Table 6: Regression Results for Return on Equity (ROE)

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.988995
R-Square	0.978111
Adjusted R-Square	0.976165
Standard Error	0.068391
Observations	50

ANOVA

	df	*SS*	*MS*	*F*	*SignificanceF*
Regression	4	9.405291	2.351323	502.7062	1.04E-36
Residual	45	0.21048	0.004677		
Total	49	9.615771			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-0.30134	0.057298	-5.25908	3.86E-06	-0.41674	-0.18593
Profit Margin	-1.18394	0.235857	-5.01973	8.61E-06	-1.65898	-0.7089
Asset Turnover	0.662488	0.049788	13.30629	3.32E-17	0.562211	0.762766
Equity Multiplier	-0.14419	0.026263	-5.4905	1.77E-06	-0.19709	-0.0913
PM X EM	1.556635	0.096659	16.10445	2.68E-20	1.361955	1.751316

5. Discussion of the Empirical Multiple Regression Result

The empirical model is grounded in the DuPont framework, which decomposes return on equity into profitability, efficiency, and leverage components. Under the traditional DuPont identity,

$$ROE = \text{Profit Margin} \times \text{Asset Turnover} \times \text{Equity Multiplier}.$$

To examine the interactive effects of the DuPont components, the following multiple regression model was used in this study:

$$ROE_i = \beta_0 + \beta_1(\text{Profit Margin}_i) + \beta_2(\text{Asset Turnover}_i) + \beta_3(\text{Equity Multiplier}_i) + \beta_4(\text{Profit Margin} \times \text{Equity Multiplier})_i + \varepsilon_i.$$

Rather than imposing a strict multiplicative structure on the DuPont framework, the regression model uses a flexible linear specification that allows each DuPont component to have an independent effect on ROE and permits interactions between operating profitability and financial leverage. Profit Margin captures the firm's ability to convert sales into profits, Asset Turnover reflects the efficiency with which assets are employed, and the Equity Multiplier represents the degree of financial leverage. The inclusion of the Profit Margin × Equity Multiplier interaction term aligns with the economic intuition underlying DuPont analysis, namely that leverage amplifies the impact of operating profitability on shareholder returns. By estimating this interaction directly, the model tests whether the profitability–ROE relation strengthens or weakens at different leverage levels, rather than assuming proportional amplification. This approach extends the traditional DuPont decomposition into a testable econometric framework.

A multiple regression analysis was performed to investigate the factors influencing return on equity (ROE), with an emphasis on profitability, operational efficiency, and financial leverage, as well as their interactions. The overall regression model was statistically significant, $F(4, 45) = 502.71$, $p < .001$, accounting for roughly 97.8% of the variation in ROE ($R^2 = .978$).

Asset turnover was identified as a strong positive predictor of ROE ($B = 0.66$, $p < .001$), underscoring the crucial role of operational efficiency in generating returns for shareholders. In contrast, profit margin had a negative main effect ($B = -1.18$, $p < .001$), indicating that higher margins do not guarantee higher returns when leverage is accounted for.

The equity multiplier displayed a negative main effect ($B = -0.14$, $p < .001$). However, the interaction between profit margin and the equity multiplier was positive and highly significant ($B = 1.56$, $p < .001$). This suggests that financial leverage intensifies the relationship between profitability and ROE. Aligned with the DuPont framework, previous research indicates that leverage enhances shareholder returns when profitability is high (Tuvadaratragool, 2022; Razali & Abdul Kadir, 2024).

5.1 The Main Effects

Profit Margin (PM): The negative coefficient for PM ($B = -1.187$, $p < .001$) indicates that, when the equity multiplier (EM) is held constant at zero, higher profit margins are associated with a lower return on equity (ROE). Nevertheless, this primary effect should be interpreted carefully, as PM significantly interacts with EM (Bai et al., 2022).

Asset Turnover (AT): Asset turnover has a significant positive impact on return on equity (ROE) ($B = 0.661$, $p < .001$). This indicates that companies that convert their assets into sales more efficiently tend to achieve higher returns for shareholders if profit margins and leverage remain constant. Among the key factors analyzed, asset turnover is one of the most economically significant predictors (Grace-Martin, 2021).

Equity Multiplier (EM): The negative main effect of EM ($B = -0.143$, $p < .001$) indicates that leverage can reduce ROE when profit margins are very low. It is important to consider this finding alongside the interaction term (Bai et al., 2022; Tuvadaratragool, 2022).

Profit Margin × Equity Multiplier: The strong, significant interaction between Profit Margin and the Equity Multiplier ($B = 1.542$, $t = 15.42$, $p < .001$) indicates that leverage amplifies the positive effect of profitability on Return on Equity (ROE), and vice versa. This means that firms with both high profit margins and high leverage can achieve significantly higher returns for shareholders. Conversely, high leverage without adequate profitability can lead to weaker or even negative ROE. This finding aligns with the extended

DuPont framework and underscores the importance of assessing profitability and leverage together rather than separately (Tuvadaratragool, 2022).

5.2 Marginal Effects of Interpretation of the Interactions

The significant interaction between profit margin (PM) and the equity multiplier (EM) shows that the effect of profitability on the dependent variable depends on financial leverage. Specifically, the marginal effect of profit margin is expressed as

$$\frac{\partial Y}{\partial PM} = \beta_{PM} + \beta_{PM \times EM} \cdot EM.$$

=-1.184 + 1.557·EM.

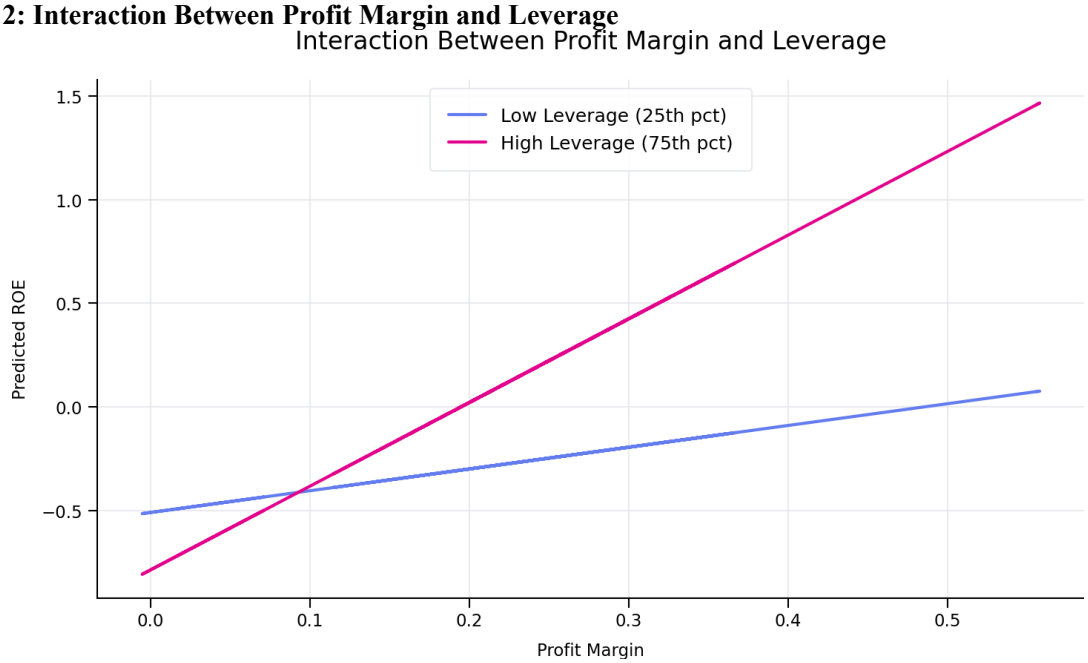
Table 6: Marginal Effect of Profit Margin (PM) on Return on Equity

Equity Multiplier (EM)	Net Effect of PM on ROE
1.0	+0.37
2.0	+1.93
3.0	+3.49

When leverage is low, profit margin has a weak effect on ROE. As leverage increases, the marginal effect of profitability turns positive. Based on the estimated coefficients, the marginal effect of profit margin can be expressed as -1.184 + 1.557·EM. This suggests that when leverage is low, increases in profit margin are associated with decreases in the dependent variable. As the equity multiplier (EM) rises, the negative impact of profit margin gradually diminishes. Eventually, the effect becomes positive when EM exceeds approximately 0.76 (calculated as -1.184 / 1.557). Conversely, the marginal effect of leverage is also conditional on profitability and can be expressed as

$$\frac{\partial Y}{\partial EM} = \beta_{EM} + \beta_{PM \times EM} \cdot PM$$

Figure 2: Interaction Between Profit Margin and Leverage



Since the interaction coefficient is positive, the negative main effect of leverage diminishes as profit margin increases, indicating that leverage is less detrimental. It could also be beneficial, especially when firms operate at higher levels of profitability. These results suggest that operating profitability and financial leverage jointly shape the outcome variable. Profit margin and leverage should therefore not be interpreted in isolation; rather, their economic effects depend critically on their combined configuration. This pattern is consistent with a moderating role of financial leverage in the profitability–outcome relation, whereby leverage amplifies the impact of profitability on the dependent variable (Bai et al., 2022; Tuvadaratragool, 2022).

Because the model includes an interaction term, the estimated coefficients for profit margin and the equity multiplier cannot be interpreted independently. The effect of profit margin on return on equity (ROE) depends on the level of financial leverage, as shown in the following equation:

$$\frac{\partial ROE}{\partial \text{Profit Margin}} = \beta_1 + \beta_4 \cdot \text{Equity Multiplier.}$$

This indicates that the influence of operating profitability on shareholder returns systematically varies with leverage. A positive interaction coefficient implies that the marginal effect of profit margin becomes more favorable as leverage increases, which aligns with the amplification mechanism suggested by DuPont analysis. Likewise, the marginal effect of leverage on ROE is influenced by profitability: as the interaction effect increases, the effect of profit margin on ROE becomes more pronounced.

$$\frac{\partial ROE}{\partial \text{Equity Multiplier}} = \beta_3 + \beta_4 \cdot \text{Profit Margin.}$$

In summary, these conditional marginal effects show that operating performance and capital structure jointly influence ROE. The economic implication is that leverage does not inherently enhance or reduce shareholder returns; rather, its impact depends on the company's underlying profitability. This interaction underscores the importance of evaluating profitability, efficiency, and leverage as a cohesive system rather than as distinct elements that affect performance.

6. Conclusion, Implications, and Limitations

6.1 Conclusion and Implications

This study deepens understanding of return on equity (ROE) by extending the traditional DuPont framework into an empirically testable regression model that accommodates both independent and interactive effects among its core components: profitability, operational efficiency, and financial leverage. Using 10 years of audited financial data from the five largest U.S. companies by market capitalization—NVIDIA, Apple, Alphabet, Microsoft, and Amazon—the analysis moves beyond mechanical ratio decomposition to provide a more flexible econometric representation of firm performance. In doing so, the study contributes to both the theoretical refinement and practical application of DuPont analysis in contemporary financial research.

The empirical results strongly support the view that ROE is not driven by any single financial dimension in isolation, but rather by the joint configuration of profitability, asset utilization, and leverage. Asset turnover emerged as a consistently strong and positive determinant of ROE, underscoring the central role of operational efficiency in value creation among large market-leading firms. This finding aligns with the economic intuition that efficient asset deployment enables firms to translate scale and resources into superior shareholder returns, particularly in capital-intensive and technology-driven business environments.

In contrast, profit margin and the equity multiplier showed negative main effects when considered independently. At first glance, these results seem counterintuitive, since both profitability and leverage are traditionally viewed as positive contributors to ROE in the classic DuPont identity. However, including an interaction term between profit margin and leverage provides critical insight into this apparent contradiction. The negative main effects should be interpreted as conditional baseline relationships that hold only when the interacting variable is near zero—an assumption that rarely holds in practice. Once interaction effects are accounted for, the economic logic of the DuPont framework is restored in a more nuanced and realistic form.

Most importantly, the positive and highly significant interaction between profit margin and the equity multiplier shows that financial leverage moderates the relationship between operating profitability and shareholder returns. Leverage amplifies the impact of profitability on ROE when firms operate at sufficiently high margins, but it becomes detrimental when profitability is weak. This result reinforces a central insight of financial theory: leverage is neither inherently value-creating nor value-destroying; rather, its effect depends critically on the firm's underlying operating performance. For highly profitable firms, leverage can magnify returns to equity holders, whereas for firms with thin or volatile margins, increased leverage can erode or even reverse shareholder value.

By embedding DuPont components within a regression framework, this study challenges the conventional view of DuPont analysis as purely descriptive or accounting-based. Instead, the findings show that DuPont analysis can be reformulated as a statistically rigorous model for testing hypotheses about firm performance, interaction effects, and conditional relationships. This methodological extension is particularly

valuable in settings with complex financial structures, where the classic multiplicative identity's assumption of strict proportionality may not hold.

From a managerial perspective, the results have significant strategic implications. The dominance of asset turnover as a driver of ROE suggests that managers of large firms should sustainably emphasize asset efficiency, capacity utilization, and revenue generation relative to the asset base. Additionally, the conditional role of leverage implies that capital structure decisions must be closely aligned with operating performance. Firms should avoid using leverage as a substitute for weak profitability, as doing so may reduce shareholder returns and increase financial risk. Instead, leverage should be deployed judiciously to complement strong and stable operating margins.

For investors and financial analysts, the study highlights the limitations of interpreting ROE and its DuPont components at face value. A high ROE may mask fragility if driven primarily by leverage in the absence of solid profitability, while a lower ROE may conceal strong operational foundations that could translate into superior performance under a different capital structure. Evaluating profitability, efficiency, and leverage together, rather than in isolation, provides a more accurate and economically meaningful assessment of firm performance.

6.2 Limitations of the Study

Small Sample: The study is limited to the five largest U.S. firms by market capitalization, yielding 50 firm-year observations. While this focus enables an in-depth examination of market-leading companies, it limits the generalizability of the findings. The financial structures, competitive advantages, and operational efficiencies of these firms may differ substantially from those of mid-sized or smaller firms.

Industry and Firm Heterogeneity: All five firms in this study are broadly classified as large-cap firms. However, their business models differ considerably. These structural differences may affect the DuPont components in firm-specific ways that a pooled regression model may not fully capture.

Accounting-Based Measures: All variables are derived from accounting data reported in Form 10-K filings. Accounting policies, estimation methods, and firm-specific reporting practices may affect comparability across firms and periods, introducing noise measurement.

6.3 Suggestions for Further Studies

Expand the Sample Size and Scope: Future research could extend the analysis to a broader cross-section of firms, including mid- and small-cap companies, to enhance external validity and assess whether the observed interaction effects hold across firm sizes.

Industry-Specific Analyses: Conducting separate regressions by industry or including industry fixed effects could help isolate sector-specific dynamics and improve the interpretability of DuPont components. This approach will require a larger sample.

Extended DuPont Framework: Additional components—such as the tax burden, interest burden, EBIT margin, and R&D expenditure—could be incorporated to examine how financing, taxation, and innovation affect ROE.

Overall, this study demonstrates that the extended DuPont framework provides a powerful lens for analyzing modern corporate performance, particularly among large, complex firms. By revealing how profitability and leverage interact to shape shareholder returns, the findings move the DuPont model beyond static decomposition toward a dynamic, interaction-based understanding of financial performance. While the conclusions are subject to limitations related to sample size, scope, and model specification, the evidence strongly supports the central premise that sustainable value creation arises from the coherent alignment of operational efficiency, profitability, and financial structure. Future research that extends this framework across industries, firm sizes, and international settings can further enhance its explanatory power and relevance in financial analysis.

References

Abadiyah, F. (2023). The role of net profit margin, asset turnover, and equity multiplier in driving stock returns: Moderating effect of ROE DuPont. *Petra International Journal of Business Studies, 6(*2), 185–192. https://doi.org/10.9744/petraijbs.6.2.185-192

Andriyanto, A., Prabowo, M., & Nugroho, A. (2026). Sustainability and financial risk implications of DuPont-driven return on equity. *Journal of Sustainable Finance & Investment, 16(*1), 45–67.

Bai, G., Rajgopal, S., Srivastava, A., & Zhao, R. (2022). Profitability and risk–return comparison across health care industries: Evidence from publicly traded companies. *PLOS ONE, 17*(11), e0275245. https://doi.org/10.1371/journal.pone.0275245

CompanyMarketCap.com (n.d). Largest American companies by market capitalization. Retrieved from Largest American companies by market capitalization

Endris, H., & Babu, N. K. (2026). Examining financial performance of manufacturing companies: An extended DuPont analysis. *Future Business Journal, 12*, Article 82. https://doi.org/10.1186/s43093-026-00792-y

Endris, M., & Babu, G. (2026). Extended DuPont analysis and profitability dynamics in manufacturing firms. *Journal of Financial Economic Policy, 18*(2), 210–229.

Fairfield, P. M., & Yohn, T. L. (2001). Using asset turnover and profit margin to forecast changes in profitability. *Review of Accounting Studies, 6(*4), 371–385. https://doi.org/10.1023/A:1012430513430

Frost, J. (n.d.). Heteroscedasticity in regression analysis. Retrieved from https://statisticsbyjim.com/regression/heteroscedasticity-regression/

Grace-Martin, K. (2021). Interpreting regression coefficients. The analysis factor https://www.theanalysisfactor.com/interpreting-regression-coefficients/

Hawawini, G., Subramanian, V., & Verdin, P. (2003). Is performance driven by industry or firm-specific factors? A new look at the evidence. *Strategic Management Journal, 24*(1), 1–16. https://doi.org/10.1002/smj.278

Hayes, A. F., & Cai, L. (2007). Using heteroskedasticity-consistent standard error estimators in OLS regression: An introduction and software implementation. *Behavior Research Methods, 39(*4), 709–722. https://doi.org/10.3758/BF03192961

Jain, P., & Tiwary, S. (2024). DuPont-based performance ranking in manufacturing firms. *International Journal of Productivity and Performance Management, 73*(3), 612–630.

Jape, R., & Malhotra, D. K. (2023). Re-examining the DuPont model: Evidence from a large global sample. *Journal of Financial Analysis, 79(*3), 459–482. https://doi.org/10.1080/07366419.2023.2189046

Jeng, L. A. (2023). Interpreting variance inflation factors in regression diagnostics. *Journal of Applied Statistics and Econometrics, 7*(1), 41–53.

Kalesha, B., Hoxha, I., & Krasniqi, F. (2023). DuPont analysis as a tool for evaluating financial performance of firms listed on the NSE-Emerge platform. *International Journal of Finance and Economics, 28(*4), 4123–4136. https://doi.org/10.1002/ijfe.2641

Kaur, R., & Mulugeta, G. (2022). Profitability, efficiency, and firm performance: Evidence from ratio interaction analysis. *Journal of Accounting and Finance, 22*(4), 98–114.

Kaur, R., & Mulugeta, E. (2022). DuPont model: An overlooked tool to measure efficiency, effectiveness, and financial performance. *International Journal of Finance and Commerce, 4*(2), 6–10.

Kishibayeva, B. S., & Jaxybekova, G. N. (2023). Assessment of the return on equity of an enterprise using the DuPont method. *Journal of Economic Research & Business Administration, 144*(2). https://doi.org/10.26577/be.2023.v144.i2.05

Liu, Y., & He, W. (2025). Asset utilization, margin growth, and leverage interaction effects on firm performance. *Journal of Corporate Finance, 82*, 102463.

Nissim, D., & Penman, S. H. (2001). Ratio analysis and equity valuation: From research to practice. *Review of Accounting Studies, 6(*1), 109–154. https://doi.org/10.1023/A:1011338221623

Ortiz, E., Salas, J., & Mendoza, R. (2021). Financial return on equity (FROE): A sustainable performance framework. *Journal of Applied Accounting Research, 22*(3), 489–507.

Paul, S. (2025). An extended DuPont framework for analyzing profitability in pharmaceutical companies. *Journal of Accounting and Management, 15*(2), 85–104.

Penman, S. H. (2013). Financial statement analysis and security valuation (5th ed.). McGraw-Hill Education.

Razali, S. H. B. S., & Abdul Kadir, H. B. (2024). Assessing and evaluating financial performance of technology firms using DuPont model: Evidence from Malaysia. *International Journal of Multidisciplinary Trends, 6(*10), 21–25. https://doi.org/10.22271/multi.2024.v6.i10a.487

Salma, N., & Hariyono, A. (2025). Analysis of the effect of leverage on ROA and ROE performance. Economica: *Journal of Economic and Economic Education, 13*(2), 139–150. https://doi.org/10.22202/economica.2025.v13.i2.9860

Shabani, A., Morina, F., & Berisha, V. (2021). DuPont analysis and SME performance: Evidence from emerging markets. *Journal of Small Business and Enterprise Development, 28*(6), 900–918.

Soliman, M. T. (2008). The use of DuPont analysis by market participants. *The Accounting Review, 83(*3), 823–853. https://doi.org/10.2308/accr.2008.83.3.823

Srisakornborisut, P., & Nimtrakoon, S. (2025). Extended DuPont analysis and firm performance: Evidence from real estate and construction firms. *Journal of Property Investment & Finance, 43*(1), 27–46. https://doi.org/10.1108/JPIF-02-2024-0021

Turner, J., Broom, K., Elliott, M., & Lee, J.-F. (2022). A decomposition of hospital profitability: An application of DuPont analysis in Thailand setting. *Rajapark Journal, 16*(45), 1–16.

