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A Time Series Analysis of Profitability, Cost Structure and Market Valuation of Selected Pharma Company Using ARIMA Model

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ABSTRACT

The study examines the inter-relationship between cost, profitability and market valuation with the help of the ARIMA time series model. The study aims to understand the relationship between the cost components and profitability and between profitability and market valuation of a firm. The research seeks to understand the cost, profitability and its effect on the market valuation. The secondary data is obtained from the financial reports from the public domain for the period (2016-2025). Return on Equity (ROE), Return on Assets (ROA) and Net Profit Margin (NPM) are the measures of profitability. The share performance measurements chosen are share price, Earnings Per Share (EPS) and Price-Earnings (P/E) ratio. Trend analysis, correlation analysis and ARIMA modelling are used to detect trends and inter-relationships. The findings reveal that the total salaries and wages, finance costs and depreciation negatively affect profitability, whereas some operating expenses positively affect revenue. Further, profitability has a significant positive impact on market valuation, indicating that profitability boosts investor confidence. The findings indicate that cost efficiency leads to better profitability and hence a better market valuation. Profitability is a link between financial efficiency and market valuation.

Keywords: *Costs, Profitability, Market Valuation, Time Series, Financial Ratios, ARIMA.*

Introduction

In this highly globalised and competitive environment, firms are constantly striving to enhance productivity, profitability and shareholder returns. Finance is a vital aspect of a firm's survival and development. Among the financial factors, the cost structure, profitability and market value are considered critical indicators of performance.

Cost structure is a measure of the proportion of different costs borne by the firm, which consist of fixed and variable costs such as staff costs, finance costs, depreciation and other costs. Effective cost management is essential for profitability and competitiveness. On the other hand, profitability is associated with the firm's ability to generate profits using its investment and resources. This is usually through financial ratios such as Return on Equity (ROE), Return on Assets (ROA) and Net Profit Margin (NPM). Market value stems from investors' perceptions of the firm's future growth and profitability and is measured by share price, Earnings Per Share (EPS) and Price to Earnings Ratio (P/E).

These variables are important for financial management. While cost reduction can increase the short-term profits, excessive cost reduction can curb future growth. Similarly, increased investments might lower profits but boost market value in the long term.

Problem Statement

Even with growing revenues, businesses can experience volatility in profitability and market capitalisation due to poor cost control. This paper explores the effects of cost structure on profitability and the effect of profitability on market value.

Objectives

- To analyse the relationship between cost structure, profitability, and market valuation of pharmaceutical companies using time series analysis and ARIMA modelling.
- To analyse the trend in cost structure over time
- To evaluate profitability performance of company during the study period
- To examine market valuation trends trend of the company

Literature Review

The role of cost structure in determining profitability is a well-debated topic in finance. Traditional cost theory suggests that profitability is positively related to cost management. Fixed and variable cost control is crucial for operational efficiency.

Research by financial economists highlights that increased operating costs, such as costs of employees and interest costs, are positively associated with reduced profits. But other studies suggest that other costs, including marketing, research and development, can be beneficial for revenue growth and future expansion.

Firm value is linked to profitability. Theoretical models like shareholder value maximization imply that investors prefer firms with greater profitability. There is empirical evidence that profitability measures (ROA and ROE) are positively associated with market value (price and market capitalization).

Existing research also reveals that one of the most significant factors in determining stock prices is EPS. Increased earnings per share indicate positive earnings and investor interest.

But earlier research mostly considers one-to-one relationships, such as cost-profit, profit-market relationships. Few studies have investigated the holistic link between cost, profitability and market value using time series analysis.

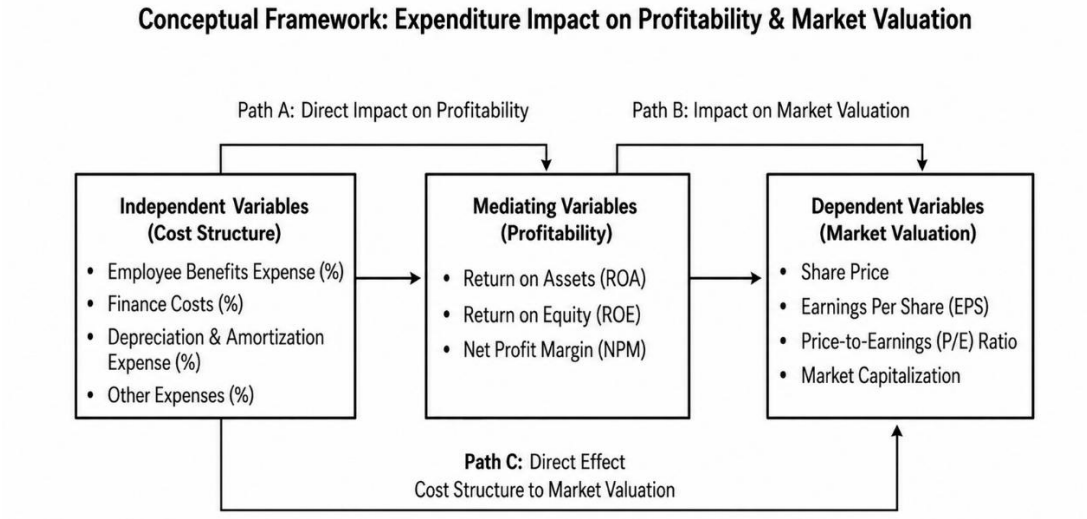
Research Gap

There is a lack of comprehensive studies analysing the combined effect of cost structure and profitability on market valuation over time.

Conceptual Framework

Cost Structure → Profitability → Market Valuation

Profitability acts as a mediating variable.



Research Methodology

The study adopts a quantitative research methodology using time series data to analyse the relationship between cost structure, profitability, and market valuation over a specific period. The research is based on secondary data collected from reliable sources such as company annual reports and financial databases, ensuring accuracy and consistency. Financial ratios are used as key instruments for measurement, where profitability is assessed through Return on Equity (ROE), Return on Assets (ROA), and Net Profit Margin (NPM), while market valuation is measured using share price, Earnings Per Share (EPS), and Price-to-Earnings (P/E) ratio. Standard financial formulas are applied to maintain uniformity. The reliability and validity of the study are ensured through the use of audited and published data sources. For analysis, techniques such as trend analysis and correlation analysis are employed to identify patterns and relationships, while the ARIMA model is used for forecasting. Tools like Microsoft Excel and Metric Gate are used for data analysis and interpretation.

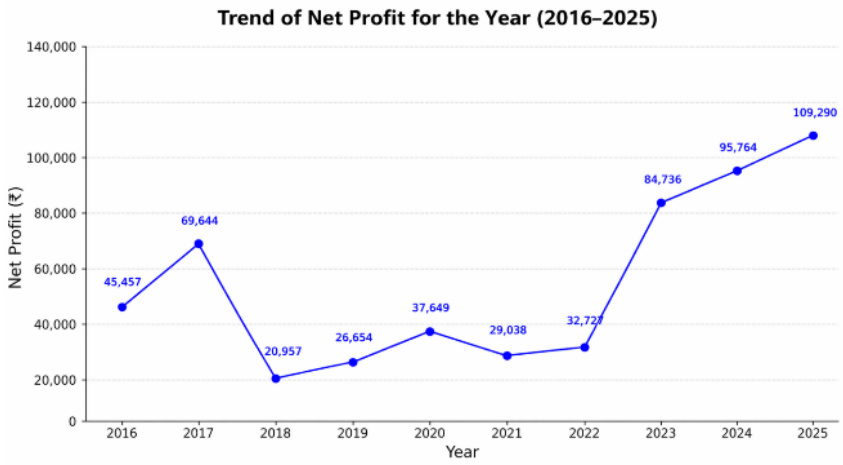
Results and Discussion

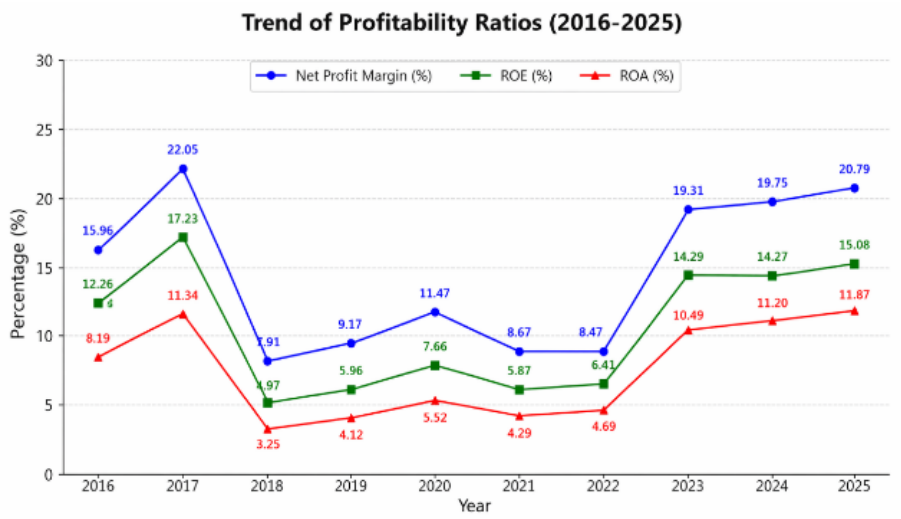
Dataset

Year	Net Profit (₹ Crore)	Net Profit Margin (%)	ROE (%)	ROA (%)	Total Cost (₹ Crore)	Employee Benefits (%)	Finance Costs (%)	Depreciation Expense (%)	Share Price (₹)	Earnings Per Share (EPS) (₹)	Price-to-Earnings (P/E) Ratio
2016	45,457	15.96	12.26	8.19	2,18,894.80	21.8	2.39	4.74	588.8	18.9	31.15
2017	69,644	22.05	17.23	11.34	2,31,537.20	21.17	1.73	5.46	537.4	29	18.53
2018	20,957	7.91	4.97	3.25	2,28,987.40	23.44	2.26	6.55	406.28	8.7	46.7
2019	26,654	9.17	5.96	4.12	2,50,668.20	23.8	2.21	6.99	410.87	11.1	37.02
2020	37,649	11.47	7.66	5.52	2,82,032.50	22.56	1.07	7.28	567.79	15.7	36.16
2021	29,038	8.67	5.87	4.29	2,72,281.50	25.2	0.52	7.64	819.89	12.1	67.76
2022	32,727	8.47	6.41	4.69	3,05,278.60	23.91	0.42	7.02	981.71	13.6	72.18
2023	84,736	19.31	14.29	10.49	3,49,403.20	23.74	0.49	7.24	1248.34	35.3	35.36
2024	95,764	19.75	14.27	11.2	3,82,688.30	24.63	0.62	6.68	1886.35	39.9	47.28
2025	1,09,290	20.79	15.08	11.87	4,01,135.00	24.86	0.58	6.42	1719.7	45.6	37.71

Trend Analysis

Output: Profitability





Between 2016 and 2017, profitability (NPM, ROE, ROA) and net profit increased, but in 2018, they showed a significant decrease, reflecting lower performance. From 2019 to 2022, profitability is volatile with fluctuations, and net profit is partially recovered with an interim dip in 2021. Since 2022, profitability and net profit have shown robust growth, signifying enhanced profitability. Wages and salaries grow to reflect increased labour costs and human capital investment, and finance costs reduce to enhance profitability through debt management. Depreciation increases until 2021, reflecting asset growth, and decreases, reducing costs and improving profits. Other expenses exhibit a U-shaped pattern, decreasing due to cost efficiency until 2019, then rising due to growth and inflation, putting pressure on profitability. In summary, despite increasing operating costs, better financial management and robust profit growth led to a positive trend in the share price with a minor dip in 2025 following strong growth.

Ratio Analysis

Formula

Earnings Per Share
= Net Profit / No. of Shares

P/E Ratio
= Market Price per Share / EPS

P/B Ratio
= Market Price per Share / Book Value per Share

Output: Market Valuation

Year	P/E	P/B	Market Capitalisation
2016	31.15	4.30	1,417,241.6
2017	18.53	3.52	1,289,222.6
2018	46.70	2.56	974,665.7
2019	37.02	2.38	985,677.1
2020	36.16	3.01	1,362,128.2
2021	67.76	4.23	1,966,916.1
2022	72.18	4.91	2,355,122.3
2023	35.36	5.35	2,994,767.7
2024	47.28	7.11	4,525,353.6
2025	37.71	5.71	4,125,560.3

Net profit margin (NPM), return on equity (ROE) and return on assets (ROA) show strong results in 2016-2017, a steep fall in 2018, relative stability in 2019-2022, and great improvement in 2023-2025, highlighting improved profitability and efficiency. Wages and salaries rise steadily due to increasing employees and wage increases, affecting profitability, while financial costs significantly drop due to

efficient debt management, improving profitability. Depreciation rises with investments and levels out, cutting short-term profits but benefiting long-term earnings. Other costs show significant variations, suggesting poor cost management, negatively impacting profitability. Total cost increases with expansion, thus requiring substantial revenue growth to maintain profits. The P/E ratio is very volatile with an increase in 2021-2022 reflecting investor sentiment, followed by stability reflecting improvements in earnings, with the P/B ratio consistently rising and reflecting investor confidence. Market capitalization shows robust growth, reaching a peak in 2024 and a minor correction in 2025, reflecting the growth in the firm's value and market presence.

Correlation Analysis

Analysed value of Cost Structure vs Profitability (2016–2025)

Output

employee expense vs NPM %	-0.22
employee expense vs ROE %	-0.35
employee expense vs ROA%	-0.12
Finance Cost % VS NPM %	-0.18
Finance Cost % VS ROE %	-0.11
Finance Cost % VS ROA %	-0.29
Depreciation % VS NPM %	-0.46
Depreciation % VS ROE %	-0.56
Depreciation % VS ROA %	-0.4
Other Expenses % VS NPM %	0.68
Other Expenses % VS ROE %	0.64
Other Expenses % VS ROA %	0.71

Data used analysis Profitability vs Market Valuation (2016 TO 2025)

Output

ROE vs Share Price	0.455422
ROA vs Share Price	0.661158
NPM vs Share Price	0.561247
Net Profit vs EPS	0.999998

The study reveals that labour costs and finance costs are negatively related with profitability, albeit with a low correlation, suggesting a minor negative effect on profits. Depreciation shows a moderate negative correlation, particularly with ROE, implying its negative impact on returns due to greater asset-related costs. On the other hand, other expenses exhibit a strong positive relationship with profitability, suggesting a positive influence on revenue-generating activities. The cost structure exhibits varied impacts, with some costs negatively impacting profitability and others positively. All profitability indicators have a strong positive effect on market value. ROE, ROA and NPM are moderately to strongly positively correlated with share price, implying that profitability increases market value. Also, net profit and EPS are perfectly positively correlated, implying a direct proportionality.

Regression Analysis

Cost Structure vs Profitability

H_0 **(Null Hypothesis):** Cost variable has no significant impact on profitability

H_1 **(Alternative Hypothesis):** Cost variable has significant impact on profitability

Result

Variables	**Coefficient (β)**	**p-value**	**R^2**
emp% →ROE%	-1.31949	0.320844	0.122798
emp% →ROA%	-0.30678	0.749268	0.013497
emp% →NPM%	-0.97381	0.538311	0.049118
finance% →ROE	-0.648622782	0.765645939	0.01175
finance% →ROA%	-1.207118061	0.420284117	0.082747
finance% →NPM%	-1.287642345	0.610042312	0.034007
department% →ROE	-3.120606109	0.092983712	0.31248

department% →ROA	-1.582566191	0.246619044	0.163403
department% →NPM%	-3.015703361	0.177869082	0.214311
other expenses% →ROE	0.874091898	0.02257934	0.498071
other expenses% →ROA%	1.13731411	0.04448639	0.414711

Profitability vs Cost Structure

H_0: Profitability has no significant impact on market valuation

H_1: Profitability has a significant impact on market valuation

Output

Variables	1. Coefficient (β)	2. p-value	3. R^2
ROE% →SHARE PRICE	49.41076929	0.185948	0.20741
ROA% →SHARE PRICE	102.2842241	0.037373	0.43713
NPM% →SHARE PRICE	52.18233231	0.091394	0.314999
NET PROFIT MARGIN% →EPS	2.093976379	0.00031	0.820054

The study reveals that labour costs and finance costs are negatively related with profitability, albeit with a low correlation, suggesting a minor negative effect on profits. Depreciation shows a moderate negative correlation, particularly with ROE, implying its negative impact on returns due to greater asset-related costs. On the other hand, other expenses exhibit a strong positive relationship with profitability, suggesting a positive influence on revenue-generating activities. The cost structure exhibits varied impacts, with some costs negatively impacting profitability and others positively. All profitability indicators have a strong positive effect on market value. ROE, ROA and NPM are moderately to strongly positively correlated with share price, implying that profitability increases market value. Also, net profit and EPS are perfectly positively correlated, implying a direct proportionality.

Mediation Analysis

Output

Model 1: Employee Cost → ROA → Share Price

Relationship	Variable	Coefficient (β)	p-value	R^2
Employee Cost → Share Price	—	0.0277	0.000047	0.8868
Employee Cost → ROA	—	0.0000919	0.1573	0.2333
Employee Cost + ROA → Share Price	Employee Cost (c′)	0.0239	0.000105	0.9423
	ROA (b)	41.6324	0.0357	—

Model 2 Finance Cost → ROE → Share Price

Relationship	Variable	Coefficient (β)	p-value	R^2
Finance Cost → Share Price	—	0.0277	0.000047	0.8868
Finance Cost → ROE	—	0.0000817	0.3668	0.1026
Finance Cost + ROE → Share Price	Finance Cost (c′)	-0.1856	0.0499	0.5956
	ROE (b)	51.8667	0.1058	—

Model 3 Depreciation + NPM → Shae Price

Relationship	Variable	Coefficient (β)	p-value
Depreciation → Share Price	—	0.07898	0.00490
Depreciation → NPM	—	0.000191	0.6156
Depreciation + NPM → Share Price	Depreciation (c′)	0.07134	0.00263
	NPM (b)	39.8945	0.03132

The findings of the mediation analysis suggest that the cost indicators (employee cost, finance cost and depreciation) directly and significantly affect share price in all models, demonstrating their significance in share price forecasting. However, in Model 1, ROA does not significantly respond to employee cost, and does not mediate its impact on share price, but both are significant predictors when included together, increasing the explanatory power. In Model 2, ROE does not mediate the effect of finance cost on share price, as it is insignificant, and finance cost still has a direct impact. In Model 3,

NPM does not show a significant response to depreciation, but combined, both variables are significant predictors when added to the share price, suggesting their joint influence in the model. The results indicate limited mediation effects and that the cost variables have a greater direct impact on share price than the use of profitability indicators as mediators.

Arima Time Series

- **Net Profit Margin (NPM)**
  ARIMA Model Selected
  ARIMA (0,1,0)
  Mathematical Equation
  $$Y_t = Y_{t-1} + \varepsilon_t$$

Where:

- Y_t= Net Profit Margin at time *t*
- Y_{t-1}= Net Profit Margin at time *t-1*
- ε_t= random error term

- **Return on Assets (ROA)**
  ARIMA Model Selected
  ARIMA (0,1,0)
  ROA also follows a random walk process.

Mathematical Equation

$$Y_t = Y_{t-1} + \varepsilon_t$$

Where:

- Y_t= ROA at time *t*
- Y_{t-1}= ROA at time *t-1*
- ε_t= white noise error

- **Return on Equity (ROE)**
  ARIMA Model Selected
  ARIMA (0,1,1)
  This model includes one moving average component.

Mathematical Equation

- $\Delta Y_t = \varepsilon_t - \theta_1 \varepsilon_{t-1}$
- Or equivalently:
- $Y_t = Y_{t-1} + \varepsilon_t - \theta_1 \varepsilon_{t-1}$

Output

Variable	Best-Fit ARIMA Model	Model Adequacy	Forecast Outcome	Research Interpretation
Return on Equity (ROE)	ARIMA (0,1,1)	Residuals are white noise (Ljung–Box p = 0.7907) and normally distributed (Shapiro–Wilk p = 0.3862)	Stable with minor fluctuations	Indicates sustained efficiency in generating returns for shareholders and effective equity utilization.
Return on Assets (ROA)	ARIMA (0,1,0)	Residuals are white noise (Ljung–Box p = 0.6126); slight deviation from normality (Shapiro–Wilk p = 0.0497)	Stable over the forecast period	Reflects continued efficiency in asset utilization and consistent operational performance.

Net Profit	ARIMA (0,1,0)	Residuals are white noise (Ljung–Box p = 0.5093) and approximately normal (Shapiro–Wilk p = 0.1200)	Sustained profitability with no major trend changes	Demonstrates stable earnings performance and strong financial resilience.

The time series modelling of profitability, cost structure and market valuation over the 10-year periods, 2016 to 2025, leans mostly on an ARIMA (0,1,0) random walk, except in the case of Fixed Cost and ROE, which use an ARIMA (0,1,1) model. The p-values of the Ljung-Box tests for the residuals of each of these financial statistics are greater than 0.05, as required, and successfully demonstrate that the residuals for these variables behave as close to white noise and do not present relevant autocorrelations. Also, the Shapiro-Wilk tests confirm that the residuals of almost all variables are approximately distributed as normal, except ROA, which is slightly skewed. The consistently unsuccessful attempts at adding autoregressive and moving average terms suggest that a first difference is enough for most of the time series. These stable white noise-verified outcomes show that the models have accounted for the variance in the data. The confidence limits developed for these variables offer a statistically validated platform for future planning. In conclusion, these consistently adequate residual tests affirm the validity and utility of these models in performing sound business forecasting

Time Series Analysis

Formula for CAGR

$$\text{CAGR} = \left(\frac{\text{Final Value}}{\text{Initial Value}}\right)^{\frac{1}{9}} - 1$$

CAGR Results

Variable	2016	2025	CAGR
Net Profit	45,457	109,290	10.24%
Revenue	284,870	525,784	7.05%
Total Assets	555,302.7	921,005.8	5.78%
Share Price	588.80	1,719.70	12.65%
EPS	18.9	45.6	10.28%
Book Value per Share	137.05	300.99	9.12%

Based on the results from CAGR analysis, there are high levels of growth from a financial perspective since the Net Profit and EPS both have experienced positive growth rates of 10.24% and 10.28%, respectively. There has been moderate growth in terms of income, which averages to 7.05%. It can be noted that there has been consistent demand for the product in the market, and there is a steady improvement on the income front. There has been a low level of growth in Total Assets, averaging 5.78%, indicating that there is controlled growth, and there has been efficient management of resources by the organization. The highest level of growth rate has been witnessed in the Share Price, recording 12.65%.

The findings of the study offer valuable insights into the relationship between cost structure, profitability, and shareholder value. The results clearly demonstrate that the cost structure components are important determinants of the firm's profitability, which, in turn, affects market valuation.

First, the negative association between employee costs, finance costs, and depreciation with profitability indicates that increasing fixed and financial costs lowers the efficiency of the business. Employees are necessary for running a business but can add to the cost structure if not offset by increased revenues. Likewise, increased finance costs suggest greater debt financing, which lowers profitability by reducing net income due to interest expenses. Depreciation, while a non-cash cost, diminishes accounting profits and reflects substantial capital outlay, which might not immediately generate profits.

But the research shows that not all costs have a negative effect on profitability. The significant positive correlation between other operating expenses and profitability suggests that these costs are likely incurred in support of revenue-generating activities (such as advertising, R&D, and sales). This

evidence is in line with the view that cost reduction alone may not be enough to boost profitability; instead, targeted expenditures should be considered.

Secondly, the positive significant association between profitability (ROE, ROA, and NPM) and market capitalization supports that investors are concerned about financial performance for their investment decisions. ROA displays a greater impact, implying that effective asset management is fundamental to improving investor perception. This is consistent with financial theory, which highlights that companies with higher ROA are considered more efficient and valuable.

The perfect linear relationship between net profit and EPS also highlights the role of profits in shareholder value. Given that EPS is a critical metric for investors, the enhancement in net profit results in a more positive market outlook and increased stock prices.

A further key finding of the study is the role of profitability. The study reveals that cost structure is not directly related to market valuation; rather, it affects the market valuation through profitability. This suggests that while the company may have high costs, it can still have a high market valuation if it has high profitability and efficient cost and revenue management.

The time series analysis further contributes by revealing that financial metrics display volatility due to various factors. While the short-term results fluctuate, in the long term, the profitability and market value show improvement, implying that the company has successfully adjusted its cost management strategies. Theoretically, the research reinforces other financial management theories that stress the importance of cost efficiency and profitability for firm value. At a practical level, the study suggests that managers should concentrate on cost allocation.

Conclusion

In this study, we research the relationship between cost structure, profitability, and market value from a time series perspective. The results show that there is a relationship between these variables, and together they influence financial performance and market value.

The paper shows that cost structure has a significant impact on profitability and that specific cost items, such as personnel costs, finance costs, and depreciation, have a negative impact on profitability (profit margins and return on equity). This could be due to costs inefficiency that can drive down profitability and therefore financial performance. Yet, some costs of operations have a positive effect on profitability, which means that investment in value adding and growth-enhancing business activities is important.

Moreover, the study confirms that profitability drives value. Share price is positively related to financial ratios including ROE, ROA, and Net Profit Margin, suggesting that profitability increases investors' trust, which in turn leads to an increase in share price. The 100% association between net profit and EPS also confirms that profitability is a key driver of shareholder value and perceptions.

This study contributes to the body of knowledge by demonstrating that profitability is an important variable in the cost structure-market value relationship. This implies that while companies are trying to minimise costs, they need to strive for profitability to increase market value. This means that firms need to focus on improving cost efficiency and profitability to add market value.

The time series model reveals that, whereas the financial variables are affected by short-term market and other factors, the long-term trend is that financial profitability and market value have improved. This suggests that consistent financial and cost management practices can lead to growth.

The study finds that the secret of success is to balance cost and investment. Although cost reduction can suppress growth, investment can reduce profitability. Thus, firms must achieve an equilibrium between efficiency and investment.

Finally, the research demonstrates that cost efficiency → profitability → shareholder value are a value creation process. Organisations that manage this relationship well are likely to ensure financial stability, achieve a competitive advantage, and ensure their survival. The findings of the study have implications for managers, investors, and policy makers on how internal financial policies impact external financial performance.

Limitations and Future Research

Limitations

The study is limited by its reliance on secondary data, which may restrict the depth and accuracy of insights. It does not account for external macroeconomic factors such as inflation, interest rates, or market conditions that could influence financial performance. Additionally, the analysis is based on a limited time, which may not capture long-term trends or cyclical variations. These limitations suggest that the findings should be interpreted with caution. Future research can incorporate primary data, include broader economic variables, and extend the study period for more comprehensive analysis.

Future Research

- Comparative analysis across multiple companies.
- Inclusion of macroeconomic variables.
- Use of advanced statistical techniques.

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