Evaluating Financial Strength and Performance of Selected Indian Electric Vehicle Stocks using Piotroski Score

Shachi Mishra

Project Manager, I-DAPT Hub Foundation,
Indian Institute of Technology (BHU), Varanasi, Uttar Pradesh, India

ABSTRACT

The research article investigates the utility of the Piotroski Score in evaluating the financial performance of Indian Electric Vehicle stocks. Due to the rapid depletion of non-renewable fossil fuels like coal, petroleum etc., global companies have started the adoption of cleaner, renewable fuels with the characteristics of less emission, reduced carbon foot print. Moreover, till now automobiles use fossil fuels like petrol, diesel which have been the major source of rising air pollution levels and leads to several lung diseases like asthma, bronchitis etc. in all age groups. People across the world has become conscious towards the rising levels of global warming and have shown their inclination towards the use of better fuel alternatives that are safer for the environment and the living beings for a sustainable future.

The research work is conducted by using financial dataset of Indian Automotive industries specific to their adoption of electric mobility for the time period from 2006 till 2023. Different statistical analysis like descriptives, t-tests, anova etc. have been conducted to determine the significant difference between the Piotroski Scores of Indian EV stocks for the time duration 2006 till 2023. The findings provide insights into the effectiveness of the Piotroski Score as a tool for assessing the financial health of the automobile industries. It also evaluates the scope of investment opportunities within the automotive industry which will offer the valuable implications for investors and stakeholders.

INTRODUCTION

The research article investigates the utility of the Piotroski Score in evaluating the financial performance of Indian Electric Vehicle manufacturing companies. These days, there have been a growing emphasis on electric mobility not only in India but also throughout the global countries. With the focus on EV adoption, there have been major initiatives taken up by both the government and automotive manufacturers towards use of eco-friendly fuels and related manufacturing processes, reducing carbon emissions, and incorporating recycled

materials into vehicle production. Companies are increasingly investing in electric vehicle research, development, and production driven by concern towards innovation, competitiveness, and environmental sustainability. The sudden outbreak of COVID-19 pandemic has diverted the focus of Indian automobile companies for re-evaluating their supply chain strategies, prioritize use of pollution-free fuels, incorporating environment sustainability approach and adopt digital tools for enhanced visibility and agility.

In this research article, EV stocks have been evaluated by the use of Piotroski Score. It is a financial metric which was developed by Joseph Piotroski in the year 2000, used to evaluate the fundamental strength of a company. It consists of nine criteria that assess various aspects of a company's financial statements, including profitability, liquidity, and operating efficiency. Each criterion is assigned a score of 0 or 1, with a maximum score of 9. Higher piotroski score indicates stronger financial health of the company while low score indicates financially weak. The Piotroski Score helps investors identify companies with improving financial conditions and potential for future growth by focusing on companies that score high on these criteria.

For the research work, financial dataset of the EV Stocks of Indian Automotive industries has been analyzed for the time period from 2006 till 2023. The comparative statistical tests have been performed for the Piotroski Scores of selected automobile manufacturers for the time duration 2006-2023. The findings suggest the effectiveness of the Piotroski Score as a tool for assessing the financial strength of the company. Moreover, it also helps to evaluate the investment opportunities within the EV stocks of automotive industry, which will be helpful to make effective investment decisions by the investors and stakeholders.

LITERATURE REVIEW

Sharma et al., (2021) states that the modified Piotroski Score aims to improve upon the original methodology by incorporating additional financial indicators or adjusting existing criteria to better reflect the specific characteristics of the market or industry under study. This adaptation may involve refining the scoring system, adding new criteria, or weighting certain factors differently based on empirical evidence or theoretical insights.

Korir, C. J. (2019) focused on showing the utilization of Piotroski F-score framework in forecasting the economic or monetary depression among publicly

quoted organizations particularly the NSE 20 Price Index firms for the period of two financial years that is 2016 and 2017. The researcher derived that liquidity, leverage and source of assets are key determinants of fiscal strains among NSE recorded firms.

Dambach, P. M. (2016). investigates the effectiveness of Joseph Piotroski's F-Score model in the context of the German stock market over a period spanning from 2002 to 2016 to examine its performance predictability. In this study, financial data was collected from companies listed on the German stock market and calculate their respective F-Scores over the specified time frame. The F-Scores are then used to classify companies as either financially strong or weak based on predetermined thresholds.

Heryanto & Sukarno, (2023) examines the best portfolio for each year of 2020, 2021, and 2022 using sector rotation investment strategy by implementing sector comparison analysis and Piotroski F-score for stock screening method, while using Markowitz portfolio optimization theory for portfolio construction. The Markowitz Portfolio Theory is employed to optimize portfolio construction by diversifying investments across different sectors within the Indonesian stock market. This theory emphasizes the importance of achieving an optimal risk-return trade-off by allocating investments across assets with low correlation.

Deng, X. (2016). study suggests investors can use Piotroski's F-Score to identify mispriced stocks and earn abnormal returns in the Chinese A-share market, especially within a low BM firm sample. The empirical evidence shows that in the Chinese A-Share market, the high F-Score portfolio significantly outperforms the low F-Score portfolio.

Chakraborty, S. (2018) collected and analysed the data from companies within the Indian cement sector are to calculate their respective Piotroski Scores. This paper focuses on analyzing the Profitability, Leverage & Liquidity and Operating Efficiency ratios as well as the impact of Operating Cash Flow/Total Assets, Leverage, MV/BV, Return on Equity and Piotroski F Score on P/E of the Leading Indian Cement Companies.

Mallick, S., & Das, S. (2022). analyzed the newly listed stocks in the Indian stock market using Altman Z Score and Piotroski F Score to determine their financial stability and potential for future performance. The study indicates that even though some stocks are not performing well in the stock market, investing in those shares, when they have lower prices, can give multiple returns in the future.

Tripathy, T., & Pani, B. (2017). seeks to examine whether value investing strategy based on F Score when applied to high book to market firms can significantly shift the current and future stock performance in favour of the investor in the Indian market. The study concludes that high book to market firms with high F Score can shift the distribution of contemporaneous and future stock performances in favour of investors in the Indian market.

Rangapriya & Meenakumari, (2021) examines the application of Piotroski's F-Score in assessing the financial health of leading Indian private banks. The research contributes to the understanding of financial analysis and risk assessment in the Indian banking industry by offering empirical evidence on the applicability of Piotroski's F-Score.

Bülow, S. (2017). The study replicates Piotroski's investment strategy on the US market for the period 2003-2015 for identifying value stocks. The results from the investment strategy indicate that fundamental analysis can be used to separate winner stocks from loser stocks.

Hyde, C. E. (2018). In this study, data from Australian companies are collected and analyzed to calculate their respective F-Scores and investigates the applicability and effectiveness of Piotroski's F-Score model in the Australian context. The findings suggests that the F-score strategy is very sensitive to the chosen universe of stocks and approach to portfolio construction.

OBJECTIVES OF THE STUDY

To study the piotroski scores of Electric Vehicle stocks for Indian Automobile sector from year 2006 till 2023.

To perform the comparative and statistical analysis of piotroski scores of selected EV stocks using different statistical analysis tools for the time period of 2006 till 2023.

RESEARCH METHODOLOGY

Need/importance of the study

The study of Piotroski Score of Electric Vehicle stocks of Automobile Companies is relevant because it provides a concise, insightful evaluation and quantitative measure derived from various financial metrics. It will be useful for the investors, analysts, and stakeholders to assess the company's fundamental strength and stability. For automobile companies which involves significant capital investment, undergo cyclical market fluctuations, and dynamic technological advancements, it is crucial to understand their

financial robustness. The Piotroski Score aids in investment decision-making by identifying companies with improving financial fundamentals, thereby potentially reducing investment risks. Moreover, it facilitates comparative analysis among automobile firms which is helpful in selecting the best stock for investment purpose by measuring the financial performance of EV stocks. Strategic planning within automobile companies can also benefit from Piotroski Score analysis, as it highlights areas for improvement and guides resource allocation to enhance financial performance and competitiveness. In summary, studying the Piotroski Scores of EV stocks of Indian automobile companies serves as a valuable tool for investors, analysts, and companies themselves, enabling informed decision-making, risk management, and strategic planning in the dynamic automotive industry landscape.

Methods of Data Collection

Secondary data has been collected to study the Piotroski Scores of the Electric Vehicle stocks of selected Indian Automobile manufacturers from financial website like. www.topstockresearch.com. Some of the other financial websites referred for the secondary data collection are moneycontrol, tradebrains, equitymaster etc. Piotroski Score is used as a screening tool in investment analysis to identify companies with potentially strong financial metrics from that of undervalued stocks. The Indian Automobile manufacturers selected for the research study are Tata Motors Ltd., Mahindra & Mahindra Ltd, Maruti Suzuki India Ltd, Ashok Leyland Ltd, Eicher Motors Ltd, Olectra Greentech Ltd, SML Isuzu, TVS Motor Company Ltd, Hero MotoCorp Ltd and Bajaj Auto Ltd.

Research Tools

Several statistical tools like Jamovi, Microsoft Excel have been used for the data analysis using t-test, Anova and descriptives to study the trends in the piotroski scores of selected EV stocks from 2006 till 2023.

DATA ANALYSIS

Piotroski score values have been analyzed for the EV stocks of the selected Indian Automobile manufacturers i.e. Tata Motors Ltd., Mahindra & Mahindra Ltd, Maruti Suzuki India Ltd, Ashok Leyland Ltd, Eicher Motors Ltd, Olectra Greentech Ltd, SML Isuzu, TVS Motor Company Ltd, Hero MotoCorp Ltd and Bajaj Auto Ltd for the time period 2006 till 2023.

Distribution of Piotroski Score Values of Automobile Companies from the year 2019 till 2023
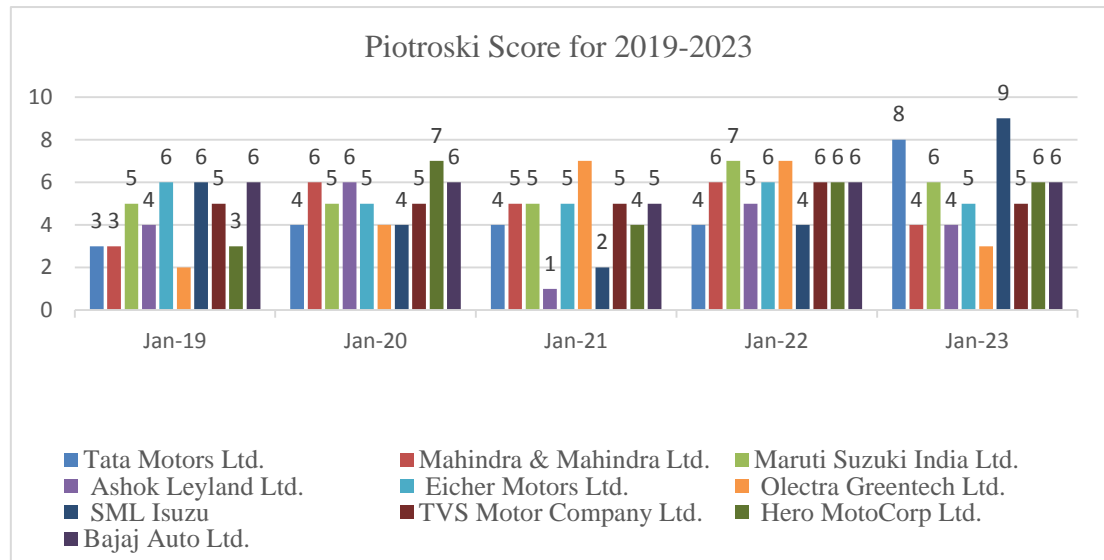
Figure 1

Figure 1 presents the graphical representation of piotroski values of EV stocks of Automobile companies for the last 5 year from 2019 till 2023. The Piotroski values varies from 0 to 9 which signifies the increasing level of financial strength of company. As can be seen from the figure that SML Isuzu has attained the highest level of 9 in the year 2023 followed by Tata Motors Ltd with the PS value of 8. Most of the companies have managed their piotroski scores of 4, 5 and 6 from 2019 till 2023 but Ashok Leyland falls to PS value of 1 in the year 2021 which indicates the weak financial position of the company. It can be seen from the graph that Tata Motors Ltd has followed an increasing trend from 2019 till 2023.

Descriptives for Piotroski Scores for the Automobile Companies from the year 2006 till 2023

Table 1

Descriptives	Tata Motors Ltd.	Mahindra & Mahindra Ltd.	Maruti Suzuki India Ltd.	Ashok Leyland Ltd.	Eicher Motors Ltd.	Olectra Greentech Ltd.	SML Isuzu	TVS Motor Company Ltd.	Hero MotoCorp Ltd.	Bajaj Auto Ltd.
N	18	18	18	18	18	18	18	18	18	18
Mean	5.22	4.72	5.78	5.00	5.61	4.56	5.39	5.39	**6.33**	5.78
Median	5.50	4.50	6.00	5.00	5.50	5.00	5.50	5.00	6.00	6.00
Mode	4.00	4.00	**6.00**	5.00	5.00	5.00	**6.00**	5.00	**6.00**	**6.00**

Standard deviation	1.56	1.32	0.878	1.57	1.04	1.34	**1.65**	1.33	1.28	1.11
Minimum	3	3	4	**1**	4	2	2	**1**	3	3
Maximum	8	8	8	8	8	7	**9**	7	8	8

According the cumulative data mentioned in the Table 1 from the year 2006 till 2023, Hero MotoCorp Ltd has the highest mean value (=6.33) and Olectra Greentech Ltd. has the lowest mean value (=4.56) while Maruti Suzuki India Ltd, SML Isuzu, Hero Moto Corp Ltd and Bajaj Auto Ltd have the maximum mode value of 6. It can be seen from the table that highest standard deviation (=1.65) has been reported in the Piotroski Values of SML Isuzu while lowest standard deviation (=0.878) values for Maruti Suzuki India Ltd. During the time period from 2006 -2023, TVS Motors Ltd and Ashok Leyland have attained low value (=1) of Piotroski score while SML Isuzu is the only company among the selected automobile stocks which has attained the highest Piotroski Score of 9.

Proportion Test (N Outcomes) of Piotroski Score Values (in the range of 0-9) for the Automobile Companies from year 2006-2023

Ho: There is no significant difference between the piotroski score values of the EV stocks for the time period 2006-2023

H1: There is significant difference between the piotroski score values of the EV stocks for the time period 2006-2023

Table 2

Level	Tata Motors	Mahindra & Mahindra Ltd.	Maruti Suzuki India Ltd.	Ashok Leyland Ltd.	Eicher Motors Ltd.	Olectra Greentech Ltd.	SML Isuzu	TVS Motor Company Ltd.	Hero MotoCorp Ltd.	Bajaj Auto Ltd.
1	0	0	0	1	0	0	0	1	0	0
2	0	0	0	0	0	1	1	0	0	0
3	2	3	0	1	0	3	0	0	1	1
4	6	6	1	4	2	4	5	0	1	1
5	1	4	5	5	7	7	3	9	0	3
6	6	4	10	5	6	1	6	5	8	10
7	1	0	1	1	2	2	1	3	5	2
8	2	1	1	1	1	0	1	0	3	1
9	0	0	0	0	0	0	1	0	0	0
χ^2	9.33	3.67	17.6	9.22	8.11	8.67	10.8	7.78	9.78	20.7
df	5	5	4	6	4	5	6	3	4	5
p-value	0.096	0.453	0.002	0.161	0.088	0.123	0.095	0.051	0.044	<0.001

As per the Table 2, p-values for the Maruti Suzuki India Ltd., Hero MotoCorp Ltd. and Bajaj Auto Ltd are less than 0.05 which depicts that there has been significant difference between the piotroski score values of the EV stocks for the time period 2006-2023.

Financial Strength of Automobile Companies based on Piotroski Score values for time duration 2006-2023

The final Piotroski Score values have to be between 0 and 9. The higher the score, the better a company's financial strength.

- The best score: 9, Strong score: 8, Good or high score: 7

  Piotroski Score of 7, 8, 9: Indicates very healthy situation of the company)

- Average score: 4, 5, 6 indicates that the financial strength of company is stable

- Bad or low score: 1, 2, 3 indicates financially weak company; poor business operation; better to weed out of the portfolio). Piotroski score equals to 0 is considered as the worst score.

Table 3

Financial Health of Company	Tata Motors Ltd.	Mahindra & Mahindra Ltd.	Maruti Suzuki India Ltd.	Ashok Leyland Ltd.	Eicher Motors Ltd.	Olectra Greentech Ltd.	SML Isuzu	TVS Motor Company Ltd.	Hero MotoCorp Ltd.	Bajaj Auto Ltd.
High score (PS=7,8,9)	3	1	2	2	3	2	3	3	**8**	3
Average score (PS=4,5,6)	13	14	**16**	14	15	12	14	14	9	14
Low score (PS=1,2,3)	2	3	0	2	0	**4**	1	1	1	1
	18	18	18	18	18	18	18	18	18	18

According to Table 3, Hero MotoCorp Ltd. has achieved the high piotroski scores values for 8 times while Maruti Suzuki India Ltd attained average score values for 16 times. It is the Olectra Greentech Ltd which has faced weak financial position for 4 times within the time duration of 2006-2023.

Anova Single Factor Result Summary of Piotroski Score of Automobile Companies from 2006-2023

Ho: There is no significant difference between the year-wise (from 2006-2023) data of different Electric Vehicle stocks

H1: There is significant difference between the year-wise (from 2006-2023) data of different Electric Vehicle stocks

Table 4

Anova: Single Factor of Piotroski F-Score						
Groups	*Count*	*Sum*	*Average*	*Variance*		
Tata Motors Ltd.	18	94	5.222222	2.418301		
Mahindra & Mahindra Ltd.	18	85	4.722222	1.74183		
Maruti Suzuki India Ltd.	18	104	5.777778	0.771242		
Ashok Leyland Ltd.	18	90	5	2.470588		
Eicher Motors Ltd.	18	101	5.611111	1.075163		
Olectra Greentech Ltd.	18	82	4.555556	1.79085		
SML Isuzu	18	97	5.388889	2.722222		
TVS Motor Company Ltd.	18	97	5.388889	1.781046		
Hero MotoCorp Ltd.	18	114	6.333333	1.647059		
Bajaj Auto Ltd.	18	104	5.777778	1.24183		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	46.08889	9	5.120988	2.899745	0.0032337	1.935315
Within Groups	300.2222	170	1.766013			
Total	346.3111	179				

As per the Anova results mentioned in the Table 4, p-value (0.003237) is less than the 0.05 which means there is significant difference between the year-wise (from 2006-2023) data of different Electric Vehicle stocks.

Anova Result Summary of Piotroski Score for the year 2006-2023 of selected Automobile Companies

Ho: There is no significant difference between the data of different Electric Vehicle stocks taken together for time period from 2006-2023

H1: There is significant difference between the data of different Electric Vehicle stocks taken together for time period from 2006-2023

Table 5

Anova: Single Factor						
Groups	*Count*	*Sum*	*Average*	*Variance*		
01-03-2023	10	56	5.6	3.377778		
01-03-2022	10	57	5.7	1.122222		
01-03-2021	10	43	4.3	2.9		
01-03-2020	10	52	5.2	1.066667		
01-03-2019	10	43	4.3	2.233333		
01-03-2018	10	53	5.3	0.9		
01-03-2017	10	58	5.8	2.177778		
01-03-2016	10	54	5.4	1.377778		
01-03-2015	10	63	6.3	0.9		
01-03-2014	10	56	5.6	1.377778		
01-03-2013	10	49	4.9	0.988889		
01-03-2012	10	61	6.1	1.433333		
01-03-2011	10	61	6.1	1.655556		
01-03-2010	10	62	6.2	1.733333		
01-03-2009	10	44	4.4	1.155556		
01-03-2008	10	48	4.8	3.511111		
01-03-2007	10	54	5.4	2.044444		
01-03-2006	10	54	5.4	0.933333		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	68.31111	17	4.018301	2.3416	**0.003165**	1.68617
Within Groups	278	162	1.716049			
Total	346.3111	179				

As per the Anova results mentioned in the Table 5, p-value (0.003165) is less than the 0.05 which means there is significant difference between the data of different Electric Vehicle stocks taken together for time period from 2006-2023.

Paired Sample T-Test of Piotroski Score of Automobile Companies from 2006 till 2023

Table 6

Company Name	M & M Ltd.	Maruti Suzuki India Ltd.	Ashok Leyland Ltd.	Eicher Motors Ltd.	Olectra Greentech Ltd.	SML Isuzu	TVS Motor Company Ltd.	Hero MotoCorp Ltd.	Bajaj Auto Ltd.
Tata Motors Ltd.	0.284	0.116	0.631	0.369	0.204	0.712	0.698	**0.019**	0.145
M & M Ltd.		**0.007**	0.516	**0.022**	0.687	0.226	0.151	**< .001**	**0.014**
Maruti Suzuki India Ltd.			0.054	0.636	**0.002**	0.393	0.274	0.145	1.000

Ashok Leyland Ltd.				0.158	0.380	0.369	0.408	**0.002**	**0.049**
Eicher Motors Ltd.					0.014	0.586	0.552	0.061	0.660
Olectra Greentech Ltd.						0.160	0.056	**< .001**	**0.006**
SML Isuzu							1.000	**0.036**	0.422
TVS Motor Company Ltd.								**0.046**	0.130
Hero MotoCorp Ltd.									0.197

According to the results of paired sample T-Test of Piotroski Score of Automobile Companies from 2006 till 2023 as mentioned in the Table 6, p-values which are less than threshold value 0.05 suggests that there have been significant different between the piotroski values of the EV stocks considered for the time period of 2006-2023. While the p value is 1.0 between SML Isuzu and TVS Motor Company Ltd which indicates that the mean difference between them is zero.

CONCLUSION

The analysis of Piotroski Scores of Automakers' electric vehicle stocks is crucial because it offers a concise but thorough evaluation of their stability and strength of financial statement. Understanding a company's financial health is essential in the capital-intensive and volatile automotive industry, where technological advancements, economic fluctuations, and dynamic customer demands are prevalent. The Piotroski Score serves as a reliable metrics to gauge the fundamental soundness of automobile firms which provide essential insights for investors, analysts, and stakeholders by analyzing key financial indicators, the score helps identify companies with improving financial performance and potential investment opportunities. It further assists with risk management strategies to mitigate potential losses and make accurate choices avoiding investment in enterprises that have weaker financial positions. Monitoring their Piotroski Scores helps automakers allocate resources and plan their strategies more effectively, strengthening their financial stability and market competitiveness. In general, the analysis of Piotroski Score is helpful to automobile manufacturers in managing the industry's complexities, encouraging wise investment choices, and promoting long-term

growth. Insights gained from the analysis can inform investors, financial analysts, and policymakers about the reliability and robustness of the Piotroski Score in identifying financially healthy companies and potential value opportunities in the market.

RECOMMENDATIONS AND SUGGESTIONS:

For analyzing the financial stability and strength of automobile companies, investors should examine the Piotroski Scores. In the highly volatile market conditions and changing customer perception with the shift towards environmental sustainability approach, it is essential to understanding company's financial health for investors, stakeholders, and company management. High values of Piotroski Score for automakers is indicative of strong financial position, high resistance to market volatility, and the possibility of long-term growth. Moreover, analyzing the Piotroski Score can uncover areas of improvement, guiding strategic decisions within companies to enhance financial performance and competitiveness. Overall, the study of Piotroski Score for automobile companies serves as a valuable tool for risk assessment, strategic planning, and investment analysis in the dynamic automotive industry landscape.

LIMITATION & SCOPE OF THE STUDY:

The Piotroski Score is based on historical financial data and may not fully reflect current market dynamics or future performance prospects. Some of the external factors such as changes in consumer preferences, competitive environment, and macroeconomic conditions may impact automobile companies' financial health, potentially limiting the predictive power of the score.

While the Piotroski Score can aid in investment decision-making, it should not be the sole determinant of investment choices. Investors should consider other factors such as industry trends, competitive positioning, and qualitative assessments alongside the Piotroski Score analysis to make well-informed investment decisions.

The study enables ccomparative analysis of Piotroski Scores among automobile companies, facilitating benchmarking and performance evaluation. It guides the investors and management authorities in strategic decision-making within automobile companies. Hence, Investors can utilize Piotroski Scores to make informed decisions about investment opportunities within the automotive sector.

REFERENCES

- Bülow, S. (2017). The Effectiveness of Fundamental Analysis on Value Stocks–An Analysis of Piotroski's F-Score.

- Chakraborty, S. A. Impact of Piotroski Score On P/E Ratio: A Study on Indian Cement Sector.

- Dambach, P. M. (2016). Applying Piotroski's F_Score to The German Stock Market: Evidence From 2002-2016.

- Deng, X. (2016). Piotroski's F-Score in The Chinese A-Share Market.

- Heryanto, J., & Sukarno, S. Sector Rotation Investment Strategy by Implementing Piotroski F-Score and Markowitz Portfolio Theory For Portfolio Construction: Indonesia Stock Market 2020 To 2022.

- Hyde, C. E. (2018). The Piotroski F-Score: Evidence from Australia. Accounting & Finance, 58(2), 423-444.

- Korir, C. J. (2019). Applicability Of Piotroski F-Score Model in Predicting Financial Distress of Listed Companies At The Nairobi Securities Exchange 20 Share Index, Kenya.

- Mallick, S., & Das, S. (2022). Assessment Of Newly Listed Stocks in The Indian Stock Market with Altman Z Score and Piotroski F Score.

- Rangapriya, S., & Meenakumari, J. (2021). Using Piotroski F-Score for Assessing Financial Health: Evidence from Leading Indian Private Banks. Management, 8(S1), 117-32.

- Sharma, D., Kapur, S., Bhatnagar, S., & Singh, T. (2021). Modified Piotroski Score for Higher Returns. Asian Journal of Research in Banking and Finance, 11(1), 1-7.

- Tripathy, T., & Pani, B. (2017). Effect Of F Score on Stock Performance: Evidence from Indian Equity Market. International Journal of Economics and Finance, 9(2), 89-99.

- https://www.topstockresearch.com/

- https://www.moneycontrol.com

- https://www.equitymaster.com

- https://tradebrains.in/best-electric-vehicle-companies-india/

- https://www.jamovi.org/