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Impact of Liquidity on Technical Efficiency of Automobile Firms in India

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ABSTRACT

Liquidity and efficiency run concurrently and are critical from the standpoint of any firm. Liquidity ensures smooth running in the short term and efficiency helps for the future growth of the firm. This research examines the liquidity and technical efficiency of selected automobile firms in India. This study's objectives are to ascertain the company's liquidity and technical efficiency as well as to investigate the relationship between the two during a ten-year period, from 2015 to 2024. The top four companies of the Indian automobile Industry, namely, Maruti Suzuki, Tata Motors, Mahindra & Mahindra, Hyundai Motor India have been selected based on market share and sales volume. The statistical approaches used for liquidity and technical analysis include arithmetic mean, standard deviation, variance, and panel data regression. Efficiency as a representation of technical efficiency (output-oriented) is determined using the data envelopment analysis approach. DEA measures the technical efficiency of selected automobile firms as per CRS and VRS approaches. According to the study, technical efficiency and liquidity do not significantly correlate. This study helps to understand the relationship between liquidity and technical efficiency of the selected enterprises in Indian automobile industry, helping them to make significant financial decisions.

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INTRODUCTION

Capital is the lifeblood of any organization. Proper management is essential for every organization to be successful in today's competitive market. Maintaining adequate liquid money, also known as working capital, is necessary for organization to run smoothly (Ramanuj & Memon, 2023). To understand an organization's success, many indicators may be used, with liquidity and efficiency being the most prominent. Liquidity refers to the capacity of an organization to pay its short-term financial requirements on time (Ramanuj & Memon, 2023). Liquidity is a ratio that indicates the ability of a company to convert assets

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into cash quickly to pay current obligations such as loans and payables due (Masood *et al*., 2016). Liquidity indicates the ability of a company to pay its debts in short-term maturing within one year (Mubashir Zaman *et al*., 2025). It acts a significant role in increasing the performance of companies because it ensures a company can pay its bills and continue operations fluently. A company's liquidity resources can be dealt with in a number of ways, including cash on hand, cash in bank, current assets, cash credit, and overdrafts (Ramanuj & Memon, 2023). Organizational efficiency is an important performance metric in today's economic management systems. Efficiency indicates the ability of company to maximize output with a given set of inputs (such as labor, capital and technology) (Adnan *et al*., 2024). It reflects how effectively resources are used without any wastage (Sidhu *et al*., 2022). It is the fundamental goal of any organization. Without efficiency, businesses will fail in the long run. Improving economic efficiency requires decreasing production costs per unit of output while balancing supply and demand for products and services (The Australian Productivity Commission Report 2013). Efficiency has various aspects, including operational, allocative, and financial efficiency, which all contribute to a company's overall performance and competitive advantage.

The aim of the study is to look at the influence of the liquidity ratios on the technical efficiency of India's top four listed automobile companies. The study also aims to establish that liquidity ratios have a crucial positive or negative impact on efficiency.

Concept of liquidity

The liquidity of the company depends upon its cash and other assets that can be instantly converted into cash irrespective of obligations for repayment in the near future and ability to raise cash through securities or borrowed money (Kumari, n.d.). Liquidity is a ratio that indicates the ability of a company to convert assets into cash quickly to pay current requirements such as loans and payables (AL-HOMAIDI *et al*., 2020) (Masood *et al*., 2016).

Liquidity ratios

Liquidity Ratios are financial measures that measure a company's liquidity status, and these ratios determine the company's capacity to repay current liabilities with current assets (Prasetya Wijaya *et al*., n.d.).

Current ratio: The current ratio examines the capability of an organization to meet short-term requirements using current assets (Ramanuj & Memon, 2023). If the firm has enough current assets, it can continue to pay its workers and supplier as well as satisfy other commitments, such as interest payment and taxes. High current ratio ensures a company has sufficient cash flow in order to meet its short-term debt obligations and operating expenses (Rahman, 2023).

Current Ratio = Current Assets/Current Liabilities

Where,

Current Assets **=** Sundry Debtors + Inventories + Cash-in-hand + Cash-at-Bank + Receivables + Loans and Advances + Disposable Investments + Advance Tax

Current Liabilities **=** Creditors + Short-term Loans + Bank Overdraft + Cash Credit + Outstanding expenses + Provision for Taxation + Dividend payable

Quick ratio: Liquidity ratio indicates a company's ability to pay its short-term obligations by having assets that can be easily converted into cash (Prasetya Wijaya *et al*., n.d.) (Ramanuj & Memon, 2023). These assets include cash, banks, accounts receivable, and marketable securities. These assets are known as "quick" assets because they are easily convertible into cash.

Quick Ratio = Current Assets – stock /Current Liabilities.

Stock is deducted from current assets to calculate the capacity of a business to pay its creditors immediately, and it shows a company's liquid assets in comparison to its current liabilities. current ratio and quick ratios may be good indicators of a firm's ability to fast repay its current liabilities with the cash raised from the sale of current assets, but they are not reliable measures of a firm's capacity to meet its cash requirements on a current basis. (Gao, 2016)

Concept of efficiency

Efficiency refers to the ability of a corporation to minimize the inputs required to achieve a

certain level of output or maximize outputs from a given set of inputs (such as labor, capital, and technology) (Adnan *et al*., 2024). It determines how effectively a business uses its resources, including material, labor, and technology. Given a set of inputs, technical efficiency states the highest output, but allocative efficiency means the best proportionate utilization of inputs, subject to pricing and production technique (Abel & Bara, 2017). This study focuses on technical efficiency. A firm is said to be technically efficient when it uses the minimum number of inputs to produce the given output (Adnan *et al*., 2024a).

Types of Efficiency

Technical Efficiency: It refers to getting the highest possible output with the given inputs and focuses on the physical relationship between inputs and outputs without considering costs (Mazumder & Adhikary, 2010). Firms achieve technical efficiency by optimizing their production processes, using the best available technology, and removing wastage (Yadav & Katib, 2015). Technical efficiency indicates the optimum utilization of inputs (resources) for obtaining a specified result (Charnes *et al*., 1978).

Allocative Efficiency: It involves distributing resources in a way that promotes customer satisfaction. It occurs when the price of the good is equal to the marginal cost of production and commodities and services are distributed based on consumer preferences (Yadav *et al*., 2024)

Automobile Industries in India

The automobile sector is a key driver in India's economic and industrial growth. It is one of India's top revenue-generating industries and the third-largest vehicle market in the world and makes a significant economic contribution to the economy. It comprises cars, trucks, buses, two-wheelers, and three-wheelers, all of which contribute significantly to India's economic growth. India is Asia's fourth-largest vehicle exporter, behind China, South Korea, and Japan. The number of products and services supplied to support transportation and automobile sales determines the economic performance of this business. Largest players in the industry include Maruti Suzuki, Mahindra and Mahindra, Hyundai, Tata Motors, Honda, Hero MotoCorp, TVC Motor Company and Bajaj Auto Limited.

Literature Review

The important literature review on liquidity and efficiency is concise below:

Literature review on liquidity

The concept of liquidity is not new in financial literature. Several scholars have studied how an organization's liquidity affects profitability using conventional indicators. (Ramanuj & Memon, 2023), (AL-HOMAIDI *et al*., 2020), (Chukwunweike, 2014) explore the relationship between liquidity and profitability of companies using correlation and regression techniques. (Chandra *et al*., 2022) stated a strong and positive relationship between liquidity and profitability when studied 117 listed companies in Indonesia completed seven years (2010–2016). Nguyen *et al*. (2024) evaluated the impact of liquidity and corporate efficiency on profitability of 100 listed companies in Vietnam. This study reveals that companies with high efficiency are more profitable compared to ones with poor efficiency, and it supports the favorable and significant effect of liquidity on profitability. Yameen *et al*. (2019) aimed to evaluate liquidity position and examine its impact on financial performance used a balance panel of data from 82 pharmaceutical businesses listed on the Bombay Stock Exchange (BSE) from 2008 to 2017. According to the study's use of the regression equation, the profitability of pharmaceutical companies as determined by return on assets is positively and significantly impacted by the current liquidity ratio and quick ratio, but it is negatively impacted by age, firm size, and leverage. Ramanuj & Memon (2023) "liquidity and profitability analysis of the selected automobile companies of India" examined the liquidity and profitability performance of Maruti Suzuki India Ltd., Mahindra & Mahindra Ltd. and Tata Motors over a 10-year period (2013-14 to 2022-23) using various ratios and regression analysis. It discovered that Mahindra and Mahindra Ltd. performed better in liquidity measures, and Maruti Suzuki India Ltd. improved in profitability ratios. AL-HOMAIDI *et al*. (2020) "The Liquidity of Indian Firms: Empirical Evidence of 2154 Firms" The study looks at the drivers of liquidity for 2154 Indian-listed companies from 2010 to 2016, using liquid assets to total assets by way of the liquidity indicator. H. M. T. Nguyen & Vu (n.d.) "The Impact

of Stock Liquidity on Firm Value: Evidence from Vietnam" Due to higher opportunity costs and cash being tied up in working capital, this study examines the negative impact of liquidity on the profitability of businesses listed on the Ho Chi Minh City Stock Exchange during the COVID-19 pandemic. The findings highlight the constraints that manufacturing enterprises confront in a stable country setting and propose a cross-country database with greater relevance. Jain & Gupta (2025) Using structural equation modeling, evaluates how liquidity and leverage effect profitability in 124 Indian manufacturing enterprises between 2011 and 2019 and findings show that liquidity positively affects profitability in two ways: directly, promoting better working capital management, and indirectly, enabling access to beneficial financing. Liquidity has a negative influence on leverage because efficient asset management lowers loan costs. Furthermore, leverage reduces profitability, confirming the pecking order argument. Almakura *et al.* (2024) "Effect of Liquidity Management on the Financial Performance of Nigerian Oil and Gas Firms" between 2012 and 2021, the study observed the impact of liquidity management on the financial performance of oil and gas firms in Nigeria. As input variables, it used the cash ratio, quick ratio, and current ratio;

Table 1: Past studies on liquidity.

Author(s)	Year	Methodology	Focus Area	Key Findings
Chukwunweike	2014	Correlation and regression analysis	Liquidity-profitability relationship	A significant positive relationship.
H. M. T. Nguyen & Vu	2017	Regression analysis	Stock liquidity and firm value during COVID-19 in Vietnam	Negative effect of liquidity on profitability during pandemic due to opportunity costs.
Yameen *et al.*	2019	Regression analysis	Liquidity impact on profitability of Indian pharmaceutical firms	Current and quick ratios positively influenced profitability, while size, age, and leverage had negative effects.
AL-HOMAIDI *et al.*	2020	Liquidity indicator: Liquid assets/Total assets	Liquidity drivers of 2154 listed firms in India	Identified key drivers of firm liquidity.
Chandra *et al.*	2022	Regression techniques	Liquidity and profitability of Indonesian companies	Solid and confident connection between liquidity and profitability
Ramanuj & Memon	2023	Correlation and regression analysis	liquidity and profitability	Positive relationship between liquidity and profitability.
T. T. C. Nguyen *et al.*	2024	Regression analysis	Liquidity and corporate efficiency in Vietnam	Efficiency enhances profitability; liquidity has a favorable impact.
Almakura *et al.*	2024	Panel regression	Liquidity management in Nigerian oil and gas firms	Quick and Cash Ratios positively effects on ROCE (insignificantly), but Current Ratio had a significant negative effect.
Aufa Salsabila Yan Alfarah & Hadinugroho	2025	Regression Analysis	How efficiency and liquidity affect firm profitability	Efficiency positively affects profitability, while liquidity shows mixed effects.
Jain & Gupta	2025	Structural equation modeling	Liquidity and leverage effects on profitability of Indian manufacturers	Liquidity positively impacts profitability directly and indirectly; leverage reduces profitability.
Mubashir Zaman *et al.*	2025	Regression analysis	Liquidity, leverage, and working capital turnover impact on profitability in Pakistani firms	Liquidity significantly boosts profitability, debt has a negative influence, and working capital turnover has no significant effect.

as an output variable, it used return on capital employed. By applying panel multiple regression, the study found that cash and quick ratios had a favorable but insignificant effect on ROCE, but current ratio had a significant negative influence. Mubashir Zaman *et al*. (2025) focus at the effects of working capital turnover, liquidity, and leverage on the profitability of 25 manufacturing businesses listed on the Pakistan Stock Exchange (PSX) 100 index, using data from 2015 to 2024. Regression analysis reveals that liquidity has a considerable positive influence on profitability, leverage has a negative impact, and working capital turnover has no apparent impact. The study uses a causal associative method with panel data approaches to confirm normal variable distributions using the Shapiro-Wilk test. Aufa Salsabila Yan Alfarah & Hadinugroho (2025) "Examining Firm Size as a Moderator of Efficiency and Liquidity Effects on Profitability" this study examined the relationship between efficiency, liquidity, and profitability in financial and accounting research. The finding shows firm size influences how efficiency and liquidity translate into profitability, highlighting its importance in financial performance analysis.

Literature Review on Efficiency

It is slightly challenging to discover past research on technical inefficiency of the Indian automobile industry using quantitative approaches such as data envelopment analysis (DEA). Khan *et al*. (2025) uses stochastic frontier analysis to evaluate the efficiency of Indian commercial banks (2002-2018), finding that new private banks are more efficient than foreign banks. Sidhu *et al*. (2023a), "Impact of Liquidity on the Efficiency of Banks in India Using Panel Data Analysis" investigate how liquidity coverage ratio effects Indian banks' efficiency (2010–2019). Technical efficiency at CRS is positively impacted by the LCR, whereas the connection for VRS is non-linear. While liquidity boosts efficiency in banks with larger promoter stakes, it has negative effects on institutional investors and technical advancements. Efficiency is measured using data envelopment analysis and panel data regression. Abdulla & Kumar (2021) in the study on "Technical efficiency and its determinants in the Indian textile garments industry" Using unbalanced panel data from 2005–2006 to 2015–2016, this study looks at the factors that affect technical efficiency in the Indian textile garment industry. With small businesses having the greatest technical efficiency ratings and medium-sized businesses having the lowest technical efficiency scores across all MSMEs, this study suggests that the whole ecosystem of textile garment value chains may be modified to increase their technical efficiency.

Bhat & Kaur (2024) examine the technical efficiency of the Indian IT industry (2000-2016) using stochastic frontier analysis. It finds that R&D expenditure does not reduce inefficiency, but foreign capital, age, and profit ratio do. For a sustainable future, it recommends a change from a service-driven to a high-value, product-driven industry. Halkos & Tzeremes (2007) examine the technical efficiency of Missouri grain farms using several forecasting techniques, which significantly modify efficiency levels. A latent variable model indicates a positive link between farm size and efficiency, reconcile engaging efficiency measurements by accounting for measurement error. Yadav *et al*. (2024) "Input oriented super efficiency evaluation of Indian commercial banks" the paper assess and compare the super efficiency of 20 Indian public and private sector banks (2013-2014 to 2021-22) using Data Envelopment Analysis (DEA) with CRS and VRS approaches. Input-oriented super efficiency scores were calculated, and rankings of the banks were determined. Public and private banks are advised to handle non-performing assets (NPAs), adopt customer-friendly policies, and improve credit risk management. Gooley Sydney & Ian Blackadder (2024) uses DEA analysis to assess the technical efficiency of four major Australian and UK banks during the COVID-19 pandemic (2020-2022). The findings indicate that only one Australian bank obtained 100% technical efficiency when all banks are combined. Tumuri *et al*. (2024) examine the technical efficiency of maize production among smallholder farmers in Ethiopia, showing that model variables explain 89.2% of inefficiency, with an average efficiency score of 72.7%. The key factors affecting efficiency include age, livestock, education, land ownership, soil fertility management, and extension services. Kamarudin *et al*. (2019) titled is "Bank Efficiency in Malaysia a DEA Approach". The revenue efficiency of Malaysian Islamic banks (2006-2015) is assessed using DEA and panel regression with the OLS technique and

results show that local Islamic banks have lower revenue efficiency than foreign counterparts. Bank market power and management quality all contribute considerably to domestic banks' revenue efficiency. The research focuses on cost, revenue, and profit efficiency ideas, demonstrating their efficiency levels. Adnan *et al.* (2024b) assess the technical efficiency of state-owned enterprises (SOEs) in Europe and Asia-Pacific by using DEA. The study, which analyzed data from 170 SOEs between 2010 - 2017, discovered that developing nations had higher TE than advanced economies. Managerial inefficiency (PTE) is identified as the primary problem influencing SOE performance.

Research Gap

The current study extends to the existing literature by investigating the link between liquidity and efficiency in the Indian automobile sector, with a focus on four major firms: Tata Motors, Mahindra & Mahindra, Maruti Suzuki, and Hyundai. Despite previous studies that focused on profitability or firm value, this study uses Data Envelopment Analysis (DEA) to assess technical efficiency based on constant returns to scale and variable returns to scale. Furthermore, the study uses current data from 2015 to 2024, providing new insights into post-pandemic performance trends. This study

Table 2: Past studies on efficiency.

Author(s)	Years	Methodology	Focus Area	Key Findings
Halkos & Tzeremes	2007	Forecasting Techniques	Missouri grain farms	Positive link between farm size and efficiency, reconcile engaging efficiency measurements
Kamarudin *et al.*	2019	DEA & Panel Regression (OLS Technique)	Malaysian Islamic banks (2006–2015)	Islamic banks have worse revenue efficiency than global counterparts. Bank strength, liquidity, and management quality are all important variables.
Abdulla & Kumar	2021	Unbalanced Panel Data	Indian textile garments industry (2005-2015)	Small-scale firms are most efficient; medium-scale firms are least efficient among MSMEs.
Sidhu *et al.*	2023	DEA & Panel Data Regression	Indian banks (2010–2019)	LCR has a favorable impact on technical efficiency at CRS, but a non-linear relationship appears for VRS.
Bhat & Kaur.	2024	Stochastic Frontier Analysis	Indian IT industry (2000–2016)	R&D does not reduce inefficiency; foreign capital, age, and profit ratio do.
Yadav *et al.*	2024	DEA (CRS & VRS Approaches)	Indian commercial banks (2013–2022)	Super efficiency scores highlight to handle non-performing assets (NPAs), adopt customer-friendly policies, and improve credit risk management
Gooley Sydney & Ian Blackadder	2024	Data Envelopment Analysis (DEA)	Australian and UK banks during COVID-19 (2020–2022)	Only one Australian bank obtained 100% technical efficiency when all banks are combined.
Tumuri *et al.*	2024	DEA (Technical Efficiency Study)	Ethiopian maize production by smallholder farmers	Model variables explain 89.2% of inefficiency, with an average efficiency score of 72.7%. Age, education, and soil fertility are key determinants.
Adnan *et al.*	2024	DEA (VRS Model for TE, PTE & SE)	SOEs in Asia-Pacific and Europe (2010–2017)	Developing nations had higher TE than advanced economies.
Khan *et al.*	2025	Stochastic Frontier Analysis	Indian commercial banks (2002–2018)	New private banks are more well-organized than foreign banks.

offers a fresh and updated viewpoint by combining liquidity and technical efficiency analysis in a sector-specific context, which has received little academic attention till now.

In India there are a lot of studies carried out on the role of liquidity and technical efficiency in the automobile sector separately. But there is no specific study on impact of liquidity on technical efficiency based on constant returns to scale and variable returns to scale in the automobile industry. Exploring linkages between liquidity and technical efficiency of firms the present study is undertaken.

Research Methodology

The present study is mostly an empirical and descriptive research design, because researchers try to explore the impact of liquidity on the technical efficiency of firms. The sample for the study consists of four companies from the Indian automobile industry, namely Maruti Suzuki India Limited, Tata Motors Limited, Mahindra & Mahindra Limited, and Hyundai Motor India Limited. These companies were selected based on their market share and sales volume and are referred to as the "top four companies" in this study. This study relies on secondary data, and the data required for this study have been collected from the published and audited balance sheets and income statements of the selected companies for a period of ten years (2015-2024). The data were obtained from the CMIE Prowess IQ database and were analyzed and interpreted to achieve the aims of the study.

Data Set

The data for this study has been gathered from the annual financial reports of select automobile firms, including Maruti Suzuki, Mahindra & Mahindra, Tata Motors and Hyundai Motor India, and these firms have been selected based on market share and sales volume upon March 1, 2025. This study depends on selected secondary sources.

Objectives

- To study the liquidity of selected automobile firms.
- To measure the technical efficiency (output oriented) as per CRS and VRS approaches of selected automobile firms.
- To explore the impact of liquidity on technical efficiency of selected automobile firms.

Scope

The present study is examining the level of interrelationship between liquidity and technical efficiency in the automobile sector in India. In this study four companies are included: Mahindra & Mahindra, Maruti Suzuki, Tata Motors, and Hyundai Motor India. This study covers a period of ten years (2015 to 2024).

Statistical Model and Techniques

In this study, to find out the liquidity arithmetic mean, standard deviation and variance of the current ratio and quick ratio are used. For the measurement of technical efficiency (output oriented) Data Envelopment Analysis (DEA) is used. We preferred DEA to other analyses (such as SFA (Stochastic Frontier Technique) for technical efficiency computation. (Sidhu *et al.*, 2023) DEA offers an advantage over other techniques since it is non-parametric and does not require previous model specification, unlike SFA (Kamarudin *et al.*; Kamau). As a result, it uses the best-fit model, which yields better outcomes, and further, both the CRS (constant returns to scale) Banker *et al*. and VRS (variable returns to scale) Banker *et al*. DEA techniques are used to obtain reliable findings (Sidhu *et al.*, 2023). The CRS approach assumes that an increase in inputs leads to a proportionate change in output, while VRS assumes that an increase in inputs disproportionately changes the output (Cooper *et al*., n.d.). Input variables include raw materials, stores & spares, purchase of finished goods, fuel & water charges, power, compensation to employees, while sales and profit after tax are considered as the output variables for DEA analysis.

To explore the impact of liquidity on technical efficiency, the panel regression model includes two methods: the fixed-effect model and the random-effect model. To decide between these two models, the Hausman test is used. Finally, the results indicated that the random effects model is the most appropriate for the current study.

Variables of the Study

In this research paper, to explore the relationship between liquidity and technical efficiency, liquidity

ratios (current ratio and quick ratio) and technical efficiency (output-oriented) of firms are used. The study uses the production method to identify input and output variables. Input variables include raw materials, stores and spares, purchase of finished goods, fuel and water charges, power, and compensation to employees, while profit after tax and sales are considered the output variables of the current study.

Here,

CRS_TE- Technical efficiency based on constant return to scale

VRS_TE- Technical efficiency based on variable return to scale

Table 3: List of variables and statistical tools.

To check	Variables	Statistical tools used
Liquidity	Current ratio Quick ratio	Mean, Standard and Variance
Technical efficiency	CRS_TE VRS_TE	DEA
Choose between Fixed and Random effect models		Hausman test
To test the Hypothesis Fixed effect model		Random effect model

Source: Author's analysis

Hypothesis of the study

H01: There is no statistically substantial correlation between the CR and CRS_TE.

H02: There is no statistically substantial correlation between the QR and CRS_TE.

H03: There is no statistically substantial correlation between the CR and VRS_TE.

H04: There is no statistically substantial correlation between the QR and VRS_TE.

RESULT AND DISCISSION

Liquidity Analysis

After obtaining 10 years of data from four companies' statistical analysis is conducted using the descriptive statistics.

Table 4: Current ratios (Current Ratio = Current Assets – Current Liabilities).

Years	Hyundai Motors Ltd.	Mahindra & Mahindra Ltd.	Maruti Suzuki India Ltd.	Tata Motors Ltd.
2015	1.132	1.128	0.965	0.437
2016	1.507	1.181	0.711	0.646
2017	1.800	1.307	0.664	0.607
2018	2.072	1.235	0.513	0.629
2019	2.232	1.271	0.874	0.592
2020	2.066	1.374	0.747	0.541
2021	1.881	1.282	1.149	0.616
2022	2.157	1.377	0.986	0.588
2023	2.094	1.327	0.578	0.461
2024	1.216	1.348	0.775	0.568
Mean	1.816	1.283	0.796	0.568
SD	0.397	0.082	0.197	0.070
Variance	0.158	0.007	0.039	0.005
Min.	1.132	1.128	0.513	0.437
Max.	2.232	1.377	1.149	0.646

Source: Author's analysis

Table 4 shows that the current ratio of Hyundai Motors Ltd. increased from 1.132 in 2015 to 2.094 in 2023, but it declined significantly to 1.216 in 2024. It has generally maintained a healthy liquidity position, with a significant increase throughout the years, yet the sudden decrease in 2024 might be a point of concern. From 2015 to 2024, the current ratio of Mahindra and Mahindra Ltd. remained generally constant, with slight variations in the 1.18 to 1.38 range. Its liquidity position has been constant, showing sustained financial health and the ability to cover short-term requirements. The current ratio of Maruti Suzuki India Ltd. is highly volatility, dropping from 0.965 in 2015 to 0.514 in 2018, then rising to 1.149 in 2021, and fluctuating around 0.77 in later years. Current ratio of tata motors Ltd. has remained below 1 throughout the years, with minor improvements and declines. Tata Motors Ltd. has consistently faced with liquidity, indicating expected financial difficulties in achieving short-term obligations.

Hyundai Motors Ltd. has the greatest current ratio in all 10 years, indicating superior ability to meet

current liabilities (excluding 2024). In most years, Mahindra & Mahindra Ltd. has a higher current ratio compared to both Maruti Suzuki India Ltd. and Tata Motors Ltd., while Maruti Suzuki India Ltd. demonstrates better liquidity than Tata Motors Ltd. Furthermore, the mean, S.D., and variance of all four firms show that Hyundai Motors Ltd. has a stronger liquidity position on average than the other three companies, and Maruti Suzuki India Ltd. is in better condition than Tata Motors Ltd.

Table 5: Quick Ratio (Quick Ratio = Quick assets/Current Liabilities).

Years	Hyundai Motors Ltd.	Mahindra & Mahindra Ltd.	Maruti Suzuki India Ltd.	Tata Motors Ltd.
2015	1.128	1.161	0.937	0.395
2016	1.463	1.155	0.710	0.647
2017	1.841	1.313	0.628	0.595
2018	2.063	1.250	0.528	0.662
2019	2.229	1.205	0.889	0.598
2020	2.073	1.411	0.726	0.568
2021	1.893	1.259	1.166	0.593
2022	2.150	1.349	0.981	0.574
2023	2.083	1.287	0.558	0.479
2024	1.205	1.288	0.756	0.546
Mean	1.813	1.268	0.788	0.566
SD	0.402	0.080	0.203	0.079
Variance	0.162	0.006	0.041	0.006
Min.	1.128	1.155	0.528	0.395
Max.	2.229	1.411	1.166	0.662

Source: Author's analysis

The ideal quick ratio is 1:1. Table 5 shows that Hyundai Motors Ltd. has the greatest mean Quick Ratio of 1.81, indicating a good ability to meet its short-term requirements without relying on inventories. However, it's very high standard deviation (0.402) suggests significant changes over time, rising from 1.13 in 2015 to a high of 2.23 in 2019 before declining to 1.21 in 2024. These changes indicate instability in liquidity management; however, it stays consistently good when compared to its peers. From 2015 to 2024, quick ratio of Mahindra & Mahindra Ltd. remains generally constant with a mean Quick Ratio of 1.27 and the smallest standard deviation (0.080). It has shown consistent performance during the years, with values staying around the mean. This constancy demonstrates a balanced and dependable approach to meeting short-term responsibilities. Maruti Suzuki has a lower mean Quick Ratio of 0.79, showing less liquidity than Hyundai and Mahindra. The standard deviation of 0.203 indicates considerable variations, with the ratio falling from 0.94 in 2015 to as low as 0.53 between 2018 and 2023, before somewhat increasing to 0.76 by 2024. This implies difficulties in managing fast assets effectively and keeping a steady liquidity position over time. Tata Motors has the lowest mean Quick Ratio (0.57), indicating insufficient liquidity and possible challenges in meeting short-term obligations without relying on inventory. The low standard deviation (0.079) demonstrates stability, but the continually low values (range from 0.39 in 2015 to 0.65 in 2016) indicate difficulties in strengthening its liquidity position over time. The overall result shows that Hyundai Motors and Mahindra & Mahindra have stronger overall liquidity than Maruti Suzuki and Tata Motors. Tata Motors regularly fails to keep a strong Quick Ratio. Hyundai Motors has more variability over time, reflecting variations in its liquidity situation, but Mahindra has exceptional consistency.

Technical Efficiency Analysis

It assesses the efficiency of input resources to get maximum output. DEA is used to compute two TE variants: CRS_TE and VRS_TE. After obtaining 10 years of data from four companies' statistical analysis is conducted using descriptive statistics.

Table 6 shows that Hyundai Motors Ltd. maintains a technical efficiency score of 1 for all years. It continuously performed at the optimal level of technical efficiency, making the best use of available resources. Both mean and standard deviation (SD) indicate stability, with a mean of 1 and an SD of 0, indicating no variation. The score of Mahindra & Mahindra Ltd fluctuates significantly, ranging from 0.776 (2024) to 1 (2015). The mean efficiency is 0.6883, showing that it performs below ideal

Table 6: Technical efficiency (CRS_TE).

Years	Hyundai Motors Ltd.	Mahindra & Mahindra Ltd.	Maruti Suzuki India Ltd.	Tata Motors Ltd.
2015	1	1	1	0.904
2016	1	0.67	1	0.382
2017	1	0.546	1	0.321
2018	1	0.669	1	0.397
2019	1	0.811	0.979	0.411
2020	1	0.483	0.869	0.367
2021	1	0.456	0.891	0.342
2022	1	0.821	0.73	0.511
2023	1	0.651	0.701	0.529
2024	1	0.776	0.821	0.571
Mean	1	0.688	0.899	0.474
SD	0	0.169	0.116	0.173
Variance	0	0.028	0.014	0.030
Min.	1	0.456	0.701	0.321
Max.	1	1	1	0.904

Source: Author's analysis with DEA

Table 7: Technical efficiency (VRS_TE).

Years	Hyundai Motors Ltd.	Mahindra & Mahindra Ltd.	Maruti Suzuki India Ltd.	Tata Motors Ltd.
2015	1	1	1	0.928
2016	1	0.698	1	0.729
2017	1	0.609	1	0.677
2018	1	0.673	1	0.976
2019	1	0.825	1	1
2020	1	0.803	1	1
2021	1	0.983	1	0.778
2022	1	1	1	0.938
2023	1	1	1	0.916
2024	1	1	1	0.841
Mean	1	0.859	1	0.878
SD	0	0.157	0	0.116
Variance	0	0.025	0	0.013
Min.	1	0.609	1	0.677
Max.	1	1	1	1

Source: Author's analysis with DEA

levels most of the time. Standard deviation (0.1686) demonstrates significant fluctuation in efficiency over time. This shows that there is potential for development and that resource use is unstable. Efficiency scores of Maruti Suzuki India Ltd. are generally high, with most years near 1, except for 2020 (0.869) and 2023 (0.701). The average efficiency is 0.8991, which indicates consistently greater performance than Mahindra & Mahindra but a little lower than Hyundai. With an SD of 0.1164, it has moderate variability, signifying rather constant but slightly inconsistent performance. Tata Motors Ltd has the lowest average efficiency of the four enterprises, at 0.4735. There is high variability (SD = 0.173), with efficiency improving over time but staying much lower than the others. The maximum efficiency in recent years (0.571 in 2024) indicates minor development, although Tata Motors seems to struggle with resource optimization.

Table 7 shows that both Hyundai Motors Ltd. and Maruti Suzuki Ltd. maintain a technical efficiency score of 1 consistently across all years. They operate at the most efficient level under Variable Returns to Scale (VRS), making the best possible use of its resources. The mean efficiency is 1 and the standard deviation (SD) is 0 indicating absolute stability and no fluctuation. The efficiency scores of Mahindra & Mahindra Ltd. vary from 0.609 (2017) to 1 (several years, including 2015, 2022, 2023, and 2024). The mean efficiency is 0.859, indicating that it performs around ideal levels most of the time, but periodic inefficiencies. The standard deviation (SD) is 0.157, indicating significant fluctuation in performance throughout the years. Efficiency scores have improved significantly over time, starting at 0.928 (2015) and rising to 1 (2019 and 2020). Despite variations, the firm has attractive excellent performance, with a mean efficiency of 0.878, suggesting that it runs at near-optimum levels on average. The SD is 0.1159, indicating significant fluctuation, but less noticeable than Mahindra & Mahindra Ltd.

Table 8: The summary result of Houseman test.

TE	Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f	Prob
TE_CRS	Cross-section random	1.302	2	0.521
TE_VRS	Cross-section random	0.408	2	0.815

Source: Calculated by Author with EViews 11

Table 8 shows the effect of the Hausman test. It has been executed to test the hypothesis of whether Random-effects or Fixed-effects regression models should be appropriate for this study. The null hypothesis advocates that random-effects are suitable, whereas the alternative hypothesis advocates the fixed-effects is suitable. The results show that researchers fail to reject the null hypothesis since the *p-value* is greater than 0.05. It implies that a random-effects model is suitable for the study.

Testing Hypothesis

Table 9: Regression results (random effect model).

Dependent variable – TE_CRS				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	***p-value***
C (Constant)	0.838	0.112	7.45	0.000
CR	0.924	0.870	1.062	0.296
QR	-0.995	0.855	-1.163	0.253
R-squared				0.733
Adjusted R-squared				0.694
F-statistic				18.677 (*p-value* = 0.00)

Source: Author's analysis with EViews

According to the results of the random-effects model, the value of R-squared is 0.733, suggesting that 73.3% of the variance in the dependent variable (TE_CRS) is very strong. The overall model is statistically significant, as indicated by the F-statistic *p-value* (0.00). The constant term is statistically significant (p = 0.00) and indicates the base level of TE_CRS when both CR and QR are zero.

H01: There is no statistically substantial correlation between the CR and CRS_TE.

The coefficient of CR (0.924) indicates a positive connection with TE_CRS. The *p-value* of CR is 0.296, which is greater than 0.05, which is not a substantial correlation at the 5% level of significance. So, the null hypothesis failed to be rejected.

H02: There is no statistically significant correlation between the QR and CRS_TE.

The coefficient of QR (-0.995) indicates a negative connection with TE_CRS, but its *p-value* (0.253), also shows that this relationship is not a substantial correlation at 5% level of significance. So, the null hypothesis failed to be rejected.

Table 10: Regression results (random effect model).

Dependent variable – VRS_TE				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	***p-value***
Constant (C)	0.934	0.084	11.114	0.000
CR	0.227	0.651	0.350	0.730
QR	-0.228	0.640	-0.357	0.723
R-squared				0.340
Adjusted R-squared				0.242
F-statistic				3.492 (*p-value*= 0.012)

Source: Author's analysis with EViews

It is detected that the value of R-squared is 0.340, representing 34% of the variance in the dependent variable (VRS_TE). While not very high, it does indicate that independent variables are responsible for part of the variance. The F-statistic is statistically significant (*p-value* = 0.012), representing that the overall model is meaningful and not the result of random chance, despite the fact that individual variables are not significant.

H03: There is no statistically substantial correlation between the CR and TE_VRS.

The coefficient of CR (0.227) indicates a positive connection between CR and the dependent variable (VRS_TE). The *p-value* of CR is 0.730 which is greater than 0.05, this relationship is not statistically substantial at 5% level of significance. So, the null hypothesis failed to be rejected.

H04: There is no statistically substantial correlation between the QR and TE_VRS.

The coefficient of QR is (-0.228) indicates a negative connection between QR and the dependent variable (VRS_TE). The *p-value* of QR is 0.723 which is greater than 0.05, this relationship is also not statistically substantial. So, the null hypothesis failed to be rejected.

CONCLUSION

The goals of this study are to analyze the liquidity and technical efficiency (CRS_TE and VRS_TE) of enterprises, as well as to investigate the link between liquidity and technical efficiency (CRS_TE and VRS_TE) of chosen enterprises. Four businesses from the automotive industry have been selected for research. From the analysis, it has been detected that in liquidity ratios, Hyundai Motors Ltd. consistently demonstrated the highest liquidity position, with mean ratios of 1.816 (current) and 1.813 (quick). This suggests strong financial stability and effective management of short-term liabilities. Mahindra & Mahindra Ltd. maintained a relatively stable liquidity profile, with mean ratios of 1.283 (current) and 1.268 (quick), indicating consistency in managing working capital. The low standard deviation suggests minimal fluctuations over the years. Maruti Suzuki India Ltd. displayed a lower liquidity position than Hyundai and Mahindra, with mean ratios of 0.796 (current) and 0.788 (quick). Tata Motors Ltd. consistently had the lowest liquidity levels, with mean ratios of 0.568 (current) and 0.566 (quick). Overall, Hyundai Motors and Mahindra & Mahindra holding stronger positions than Maruti Suzuki and Tata Motors.

The technical efficiency (CRS_TE and VRS_TE) of four automobile companies shows Hyundai Motors Ltd. frequently achieves a perfect score on both scales, indicating optimum performance. Mahindra & Mahindra Ltd. exhibits variations, with a mean of 0.6883 (CRS_TE) and 0.8591 (VRS_TE), indicating increased efficiency under VRS_TE. Maruti Suzuki India Ltd. maintains high efficiency throughout, but Tata Motors Ltd. has the lowest efficiency, with significant variability in CRS_TE (mean: 0.4735) and better VRS_TE scores (mean: 0.8783).

The study employs a random-effects model, which the Hausman test determined was the best fit for the present research. This study examines the impact of liquidity on the technical efficiency of Indian automobile firms between 2015 and 2024 by using panel data regression analysis. When studying the CRS_TE, it is found that CR shows a positive correlation and QR shows negative correlation with CRS_TE but neither CR nor QR has a statistically significant impact on CRS_TE at the 5% level. In contrast, the data for VRS_TE demonstrate that CR and QR have positive and negative correlations with technical efficiency, respectively, but their effects are not statistically significant at the 5% level. Overall, the study emphasizes that liquidity management is important for financial stability, but it is not the only factor influencing efficiency. Other factors like scale production, managerial effectiveness, and managerial strategies also have a significant impact on the technical efficiency of automobile firms.

Implications

This research enhances the financial efficiency literature by finding that more liquidity does not naturally ensure higher efficiency. The CRS_TE and VRS_TE analyses emphasize the role of scale and managerial approaches in affecting efficiency outcomes. The findings highlight the need for a more comprehensive theoretical framework that integrates financial ratios with technical efficiency. Firms with high liquidity, such as Hyundai and Mahindra, show that balancing liquidity with effective resource utilization results in higher performance. Maruti Suzuki and Tata Motors, which have poorer liquidity profiles, demonstrate that managers should focus on enhancing processes, cost management, and adoption of technology in addition to liquidity. Excess cash, when utilized idle, may decrease efficiency. Managers should use flexible liquidity strategies to strike a balance between short-term solvency and technical efficiency. Policymakers should understand that inefficiencies in liquidity management may negatively affect the automotive industry's competitiveness. The study's findings will help the understanding the relationship between liquidity and technical efficiency of the selected enterprises in Indian automobile industry, helping them to make significant financial decisions.

Limitations and Future Direction

The current research only covers four companies in the automobile industry; still it may be expanded to include other companies and industries. This study's data is obtained from secondary sources. This study recognizes the limits of depending completely on secondary data for information. The research is only for ten years. This can be increased by expanding the scope of the investigation. Future research may expand the scope by investigating additional enterprises from different industries, comparing across countries, or using other efficiency measuring techniques. The current study utilized only a few variables and statistical approaches. It may be expanded with other variables and different statistical techniques to explore the link between liquidity and technical efficiency.

Abbreviations

CR- Current Ratio

QR- Quick Ratio

TE- Technical Efficiency

CRS_TE- Constant Return to Scale

VRS_TE- Variable Return to Scale

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