Assessment of Supply Chain Finance Adoption Among Various Classes of Enterprises in the Indian Automotive Sector

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CERTIFICATE

This is to certify that the thesis entitled "**Assessment of supply chain finance adoption among various classes of enterprises in the Indian automotive sector"** submitted by **Hariprasad Ambadapudi** ID. No.**2020PHXF0517P** for the award of a Ph.D. degree of the institute embodies his original work under my supervision.

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ABSTRACT

India, a rapidly growing economy, has set a long-term goal of achieving net-zero emissions by 2070. The Indian auto industry plays a crucial role in boosting manufacturing contribution to India's GDP and supporting this vision. However, the decline in registered auto industry firms and continued departures from the sector are concerning. The profitability disparity among firms is significant, and larger firms extract favorable trade terms from smaller ones, which can negatively impact smaller firms and economic growth.

India's average bank lending rate is 9.75% over the past decade, compared to 4.8% in China and 3.7% in the United States. Indian macroeconomic indicators, such as lending rates and domestic credit availability as a percentage of GDP, are inferior to those of the United States and China. This disadvantages businesses, particularly smaller ones, as they struggle to obtain capital at reasonable interest rates. Smaller companies incur more debt obligations, reducing their profitability.

Businesses must integrate financial flows with information and physical goods flows to improve value chain collaboration. Supply Chain Finance (SCF) can generate a win-win situation for all business partners in the value chain. The past implementation of SCF solutions has yielded business results for buyers and suppliers, leading to improvements in profitability. The majority of the work, however, is limited to Europe and China, and very little focus has been extended to India. However, there is a need for a thorough evaluation of current levels of adoption and potential benefits related to adopting augmented supply chain finance across various classes of the Indian automotive sector.

This research examines the impact of firm class on profitability and the relationship between factors contributing to profitability. It quantifies the extensive benefits of SCF solutions for the entire value chain.

The study investigates the moderating effects of firm class on operating challenges in the business environment that significantly influence profitability. The author conducted a panel data analysis on 280 Indian automobile firms with ten independent variables that have maintained consistent performance over the past decade (2012-2022). The research confirmed the existence of significant differences in the operational conditions of various classes of firms, which call for the deployment of different strategies to achieve profitability. The study identified significant variables for each class of firms and subsequently determined the optimal levels for these significant factors (performance enablers) to enhance their respective financial performances. The results were presented in the form of a decision guide for practitioners.

The study also simulated the benefits value chain participants from different classes of Indian auto firms can obtain from adopting Supply Chain Finance (SCF). The ability to convert current assets into cash and effectively manage day-to-day expenses yielded substantial advantages, ultimately enhancing profitability as measured by the return on assets (ROA). A significant possibility of improvement in the median return on assets (ROA) is estimated for all classes. The study contributes to existing research on contingency theory and provides evidence linking SCF solutions' capabilities to organizations' financial efficacy. It is possible to realize the goal with the help of a shared value chain vision rather than a firm-focused strategy, aligning with stakeholder theory. This research will aid the Make in India initiative and contribute to India's economic growth.

Keywords: automobile industry, design of experiments, India, Make in India, MSME, operating challenges, panel data analysis, simulation, supply chain finance, sustainability

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ABS	Asset Backed Securities
ACMA	Automotive Component Manufacturers Association of India
AMP	Automotive Mission Plan
AP	Account Payable
APAC	Asia-Pacific
AR	Account Receivable
ASEAN	Association of South East Asian Nations
B2B	Business-To-Business
C2C	Cash-To-Cash
CAGR	Compound Annual Growth Rate
CCC	Cash Conversion Cycle
DD	Debtor Days
DIO	Days Inventory Outstanding
DoE	Design of Experiments
DPO	Days Payables Outstanding
DSO	Days Receivables Outstanding
EV	Electric Vehicle
FDI	Foreign Direct Investment
FSP	Financial Service Providers
G20	The Group of Twenty
GDP	Gross Domestic Product
GHG	Greenhouse Gas Emissions
GVA	Gross Value Added
ID	Inventory Discounting
IF	Inventory Factoring
IS	Inventory Securitization
LSP	Logistics Service Provider
MCA	Ministry Of Corporate Affairs
MSME	Micro, Small and Medium Enterprises
MSMED	Micro, Small & Medium Enterprises Development
NMEM	National Mission on Electric Mobility
OEM	Original Equipment Manufacturer
PLI	Production Linked Incentive
PO	Purchase Order
RBV	Resource-Based View
RDT	Resource Dependency Theory
RF	Reverse Factoring
ROA	Return on Assets
ROE	Return on Equity
SCF	Supply Chain Finance
SCI	Supply Chain Integration
SCM	Supply Chain Management
SME	Small and Medium Enterprises
SOF	Sales Order Financing
SPV	Special Purpose Vehicle
SVA	Shareholder Value Added
TCE	Transaction Cost Economics
TReDS	Trade Receivables Discounting System
US	United States
VMI	Vendor Managed Inventory
WACC	Weighted Average Cost of Capital
WC	Working Capital
WIP	Work in Progress

Chapter 1: Introduction

Preview: This chapter provides an overview of the aspirations of the Indian economy, the importance of the auto industry, and the anticipated contribution of auto firms to the economic growth trajectory with the successful implementation of supply chain financing (SCF). Section 1.1 emphasizes India's development and its significance on the international stage. Section 1.2 discusses India's sustainability aspirations and the auto industry's role. Section 1.3 summarizes the current financial challenges of the Indian auto industry. Section 1.4 describes the current state of the investment environment for the Indian auto industry. Section 1.5 presents the overview of supply chain finance, followed by Section 1.6, which is devoted to understanding the implications of adopting supply chain finance (SCF) for the Indian auto industry. Section 1.7 concludes with an overview of the thesis structure.

1.1 India's emergence on the world stage

Recent global events have significantly impacted the reorganization of the international order. Asia-Pacific (APAC) is widely regarded as the world's development engine in the coming decades (Biswas, 2022). India is expected to become the third-largest global economy by 2027 (Morgan Stanley, 2022), making it one of the most robust economies in the APAC region. Figure 1.1 of Goldman Sachs's (2023) projections for India's GDP in 2075 is optimistic; however, this can only be achieved by increasing manufacturing capacity and expanding services and infrastructure.

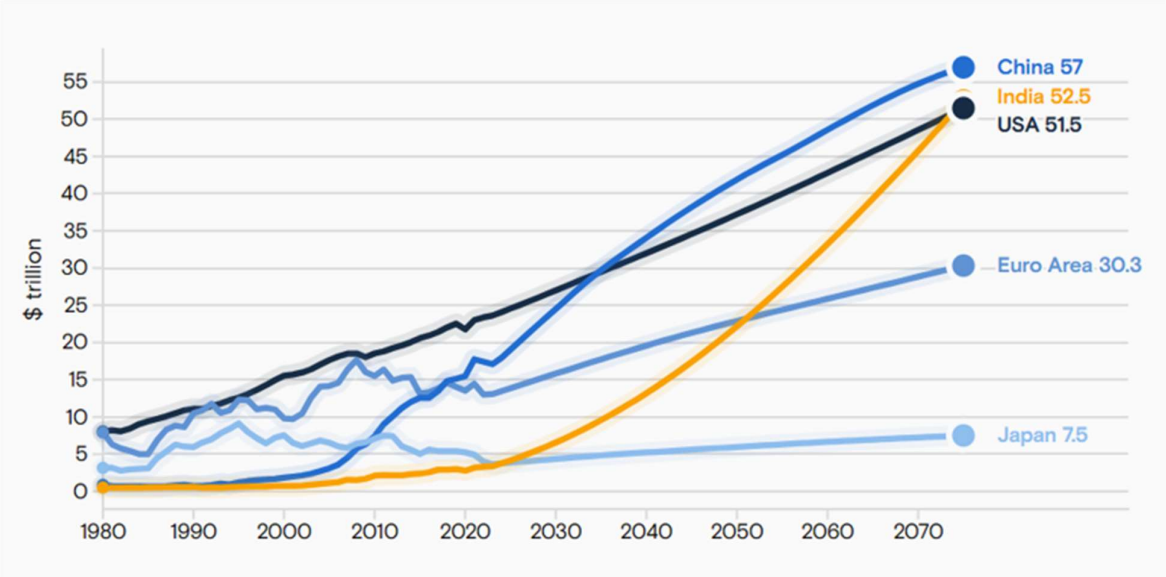

Figure 1. 1 GDP level projections in real (2021) USD trillion (Source: Goldman Sachs, (2023))

While the above statistics are encouraging, the Indian economy has recently struggled with the effects of COVID and the blockage of the Suez Canal (Asian Development Bank, 2020), resulting in the decline of many sectors and a severe blow to micro, small, and medium-sized enterprises (MSME). The MSME sector of India employs approximately 111 million individuals and contributes about 40% of total output, 30% of total GDP, and about 50% of total exports (A. Kumar et al., 2022).

According to the United Nations (2023), Micro, Small, and Medium Enterprises (MSMEs) constitute 90% of all firms, contribute to 60-70% of total employment, and contribute to 50% of the Gross Domestic Product (GDP) globally. Nevertheless, the maturity levels exhibited by small and medium-sized enterprises (SMEs) and the conditions under which they operate differ across different countries. Small enterprises generated two-thirds of the newly created employment opportunities between 1995 and 2021 in a mature economy such as the United States. Additionally, they employ nearly half (46%) of the private sector employees in the United States and contribute to 43.5% of the country's gross domestic product (U.S. Chamber of Commerce, 2023). In the context of a developing economy such as China, small enterprises

make up over 60% of the overall Gross Domestic Product (GDP), contribute 50% of tax revenue, generate 79% of employment opportunities, and account for 68% of exports (Asian Development Bank, 2023). According to the (Government of India, 2023a), the proportion of MSME Gross Value Added (GVA) in the overall Gross Domestic Product (GDP) of India was 30.5% in 2019–20, 27.2% in 2020–21, and 29.2% in 2021–22. An analysis of the contributions made by MSMEs to the GDP in the three major economies indicates a less favorable situation for India. It is crucial to prioritize the factors that assist Indian MSMEs in improving their performance and increasing their contribution to GDP.

There are approximately 63.39 million MSMEs in India. About 99.5% of these businesses are microenterprises. Figure 1.2 presents a comparison (Sonobe et al., 2021) of the MSMEs in the Asian region that experienced temporary cash shortages and temporary business exits during COVID-19. MSMEs found it difficult to confront this unanticipated business obstacle, whereas larger firms could withstand the storm and overcome the headwinds. While this disruption resulted in cash shortages and temporary exits for MSMEs, it is also being hailed as a wake-up call for many businesses worldwide regarding their preparedness to address supply chain risks.

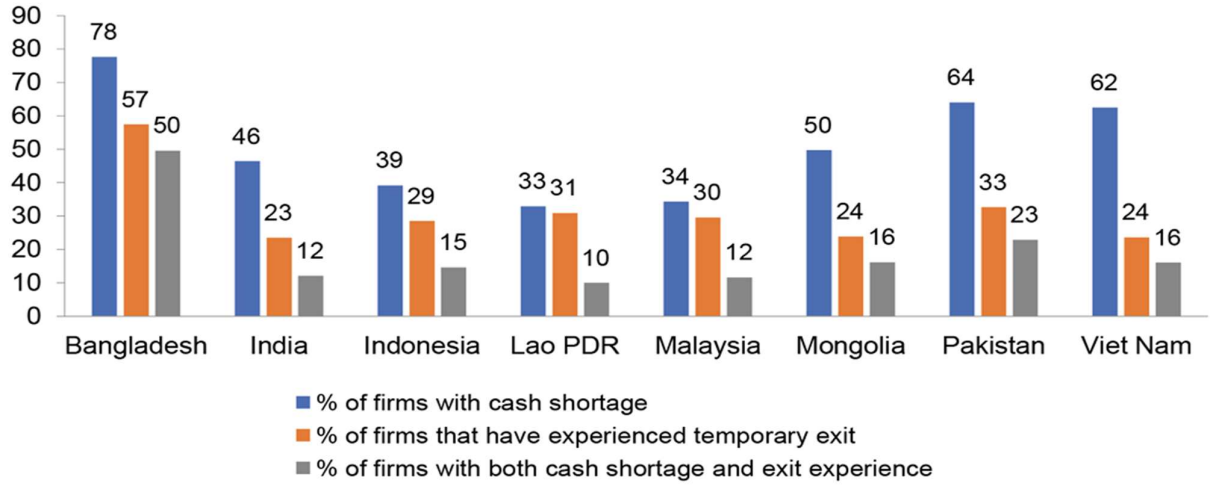

Figure 1. 2 Percentage of firms that experienced a cash shortage and temporary exit (Source: Sonobe et al. (2021))

Historically, supply chains have evolved globally owing to many compelling factors. These include trade liberalization, cost efficiency, market demand, expansion, etc. (Unctad, 2013). These strategies undoubtedly benefit businesses and introduce large-scale complexities and risks (Novoszel & Wakolbinger, 2022). A few such examples summarized by (Tang, 2006a) include Ericsson's loss of 400 million euros after a fire accident in Philip's semiconductor plant in New Mexico in 2000, an incident of layoff of 1,400 workers by Land Rover after one of their key suppliers became insolvent in 2001; decrease of Dole's revenue after their banana plantations in Central America were destroyed by Hurricane Mitch in 1998; closure of Ford's plants for several days after all air traffic was suspended after September 11 in 2001. Hendricks & Singhal (2003) assessed the impact of supply chain risks on businesses and confirmed inferior business results during the disruption period. Numerous approaches to mitigating and managing the adverse effects of supply chain risks are discussed in the literature (Chopra S & Sodhi M.S, 2004). However, these strategies employ a focal-firm perspective, i.e., they are internal business practices and do not consider an ecosystem or value chain view (Munir et al., 2020).

The pressure to operate efficiently and use capital and manufacturing capacity optimally will persist as the world moves forward. As a result, global manufacturers will face more significant political and competitive pressure to increase their domestic production, increase employment in their home countries, and reduce or eliminate their reliance on perceived risky sources (Shih, 2020). Such efforts would undoubtedly lead to a more localized sourcing strategy (Simchi-Levi & Haren, 2022). This observation is consistent with a published McKinsey Global Institute (2019) study. The study identifies three distinct global trends: a) a significant shift in consumption towards developing countries and b) the emergence of larger regional centers of supply to accommodate shifting consumption orientations. c) increased service traffic. By 2040, Biswas (2022) anticipates that the economic weight of the APAC region will account for

approximately 42% of global GDP, driven primarily by the continued economic expansion of China, India, and the ten Southeast Asian nations constituting the Association of South East Asian Nations (ASEAN). All of these developments provide India with an unprecedented growth opportunity. India's complete business ecosystem must be prepared to capitalize on this opportunity. Notable areas include businesses, manufacturing policies, banking, and the credit environment.

1.2 India's sustainability aspirations and role of the auto industry

To align with global sustainability expectations, India has set a long-term goal of achieving net-zero emissions by 2070. Reducing carbon emissions from the transportation and energy sectors has become crucial for realizing India's ambitions (Government of India, 2022b). India's automotive industry contributes 16% of greenhouse gas emissions (GHG) in India (ACMA, 2022). Under these circumstances, specifically, the Indian auto industry has two critical roles to play: 1) boosting the contribution of manufacturing to India's GDP and 2) capacity to support India's vision of becoming a net-zero nation by 2070 (Government of India, 2022a). Concurrently, the auto industry is also entering a new era of mega trends leading to large-scale innovations (Forbes, 2021). These include the development of autonomous vehicles and fleets, data from connected vehicles, car-sharing programs, alternative transport-on-demand initiatives, and, of course, the industry's paradigm shift toward electric vehicles (EV). New technologies and companies are anticipated to collaborate to help India realize its vision of zero net emissions.

A quick assessment of Figure 1.3 reveals a declining trend for the registered companies in the auto industry by year of incorporation in India (registered with the Ministry of Corporate Affairs (MCA), Government of India). The graphic begins in 1991, representing the beginning of the liberalization era. The initial decline occurred in 2001 due to the impact of the World Trade Center disaster on enterprises worldwide. In addition, there has been a substantial

decrease in registered entities following the 2008 financial crisis. This trend is counterintuitive as the global automotive industry prepares for the electric vehicle (EV) revolution. Dash (2023) discovered that existing automobile and automobile component manufacturers in India consider financial and technology-related factors to be the most challenging when transitioning to the electric vehicle industry. Financial considerations such as obligations for investing in capital, the expense of borrowing, insufficient subsidies, and inadequate financial incentives in different areas of value enhancement have been identified as significant obstacles, particularly for smaller companies that usually need more accessible access to capital or credit. A pertinent issue in this context is, *"Are operating conditions unfavorable to smaller firms, resulting in a substantial decline in the number of registered entities?"*

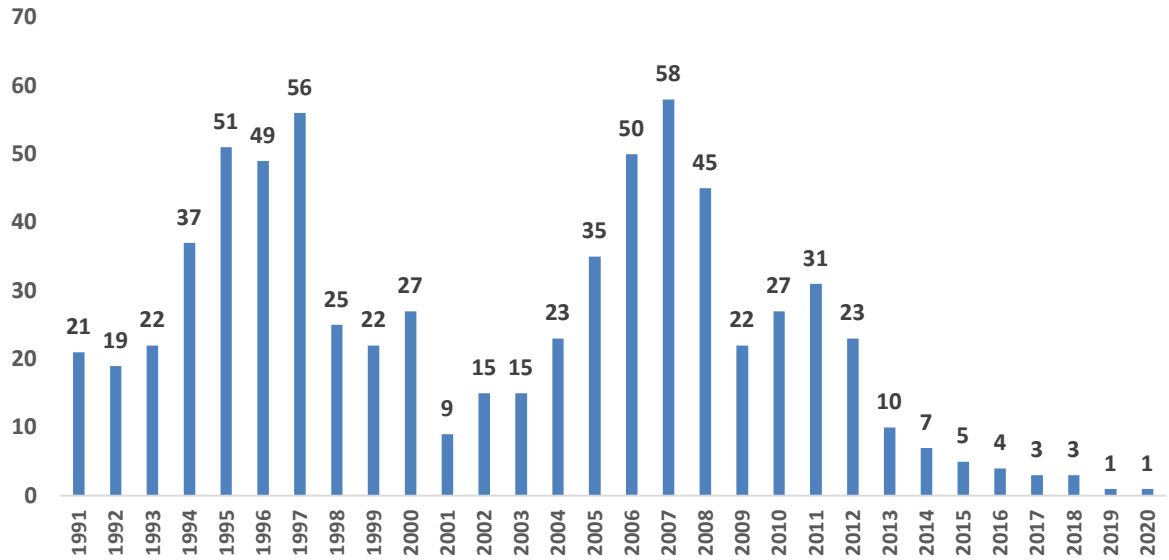

Figure 1. 3 Trend of registered auto companies with MCA by year (Source: Data from (CMIE, 2021))

1.3 Current financial challenges of the Indian auto industry

By exploiting their production and distribution advantages and concurrently bolstering their economies, nations become indispensable to the global value chain (Fan et al., 2022). Numerous players of varying sizes within an economy cater to the need for global supply.

However, the revenue-generating potential for all the firms in a value chain is not alike. Typically, the magnitude of a company's revenue correlates with the scope of its operations. In the auto value chain, firms with smaller revenue sizes typically supply their downstream larger-sized firms. Due to their limited ability to generate revenue in the value chain, smaller businesses face the enduring obstacles of little collateral to pledge, challenging access to credit, higher receivables, and low production efficiencies (Klapper, 2006). While the Indian auto component industry has historically exhibited robust growth, its overall contribution to the manufacturing sector and performance on the macro variables are inferior to those of its Asian competitors (Dhawan et al., 2018).

In his study, Behcet (2019) compared the return on assets for various countries for nine years (2008–2016) to assess the performance of automobile companies. The author extended the data for the Indian companies of multiple sizes (basis revenue) on Behcet's work for the same period. The summary provided in Figure 1.4 provides an overview of the Indian auto industry's performance compared to its peers.

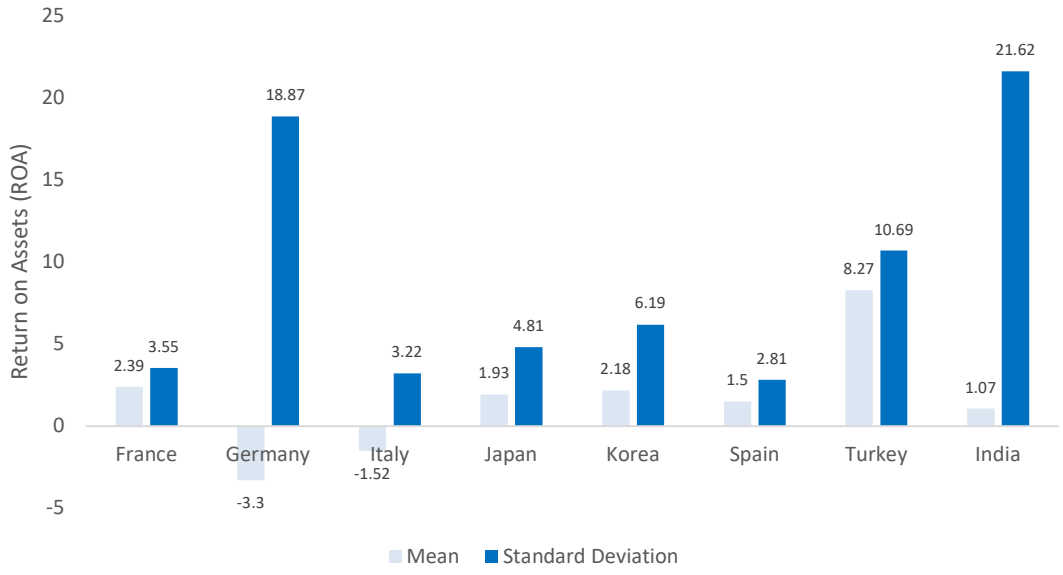

Figure 1. 4 Comparison of return on assets (ROA) among various countries

According to the above graph, Turkey has the highest average return on assets. However, India, Germany, and Turkey are the top three nations with the highest standard deviation for the return on assets. For Germany and Italy, the average return on assets is negative. In the case of India, the mean ROA is 1.07, and the standard deviation is 21.62. Observation indicates that the return on assets is highly variable across the sample evaluated. The observation is supported by the fact that the rapid growth of the Indian economy led to the emergence of many smaller businesses with differing performance levels.

A cursory examination of the profitability metrics of the Indian auto industry firms reveals a challenging picture. The author observed that enterprises with revenue up to INR 250 crore ($30 million) have a median accounts receivable value of 23% of revenue. Sixty-two percent of these businesses have no cash reserves, while the remaining 38% carry cash reserves, amounting to only 6% of their revenue. In the Indian context, a sales revenue of INR 250 crores is used for discussion purposes because it is a threshold for micro (INR 0 to INR 5 crores), small (INR 5 crores to INR 50 crores), and medium enterprises (INR 50 crores to INR 250 crores) (MSME). In reality, the majority of micro-enterprises in India are unregistered. The median proportion of these MSMEs' current assets is 56% of total assets. As we delve further into the minor revenue categories defined for micro and small businesses, the financial health of the companies appears significantly more precarious. They are incredibly modest and need more credit history to obtain external financing at enticing rates. Unlike OEMs and other large businesses, smaller firms have almost no cash reserves and must rely on regular and punctual cash inflows to survive. Investment in current assets under a scenario with limited cash reserves forces firms to obtain short-term external financing, which results in obligatory current liabilities. Working capital management becomes crucial for businesses to maintain operations and achieve sustainable development.

Consequently, it is essential to effectively manage the current assets and liabilities of the SME (García-Teruel & Martínez-Solano, 2007). There is a massive credit imbalance that can be addressed for Indian MSMEs. In their report, Tandon et al. (2018) outlined the specifics of credit to Indian MSMEs and recommended a framework to facilitate the development of financing for Indian MSMEs.

1.4 Investment environment for the Indian auto industry

As per the data from the Reserve Bank of India (2021), the proportion of Foreign Direct Investment (FDI) funds to total investments for the auto industry is 5.13 percent (December 2018–January 2020) and 4.89 percent (January 2020–December 2020). Due to the limited availability of capital from external institutions, capital management for the auto industry is a domestic responsibility.

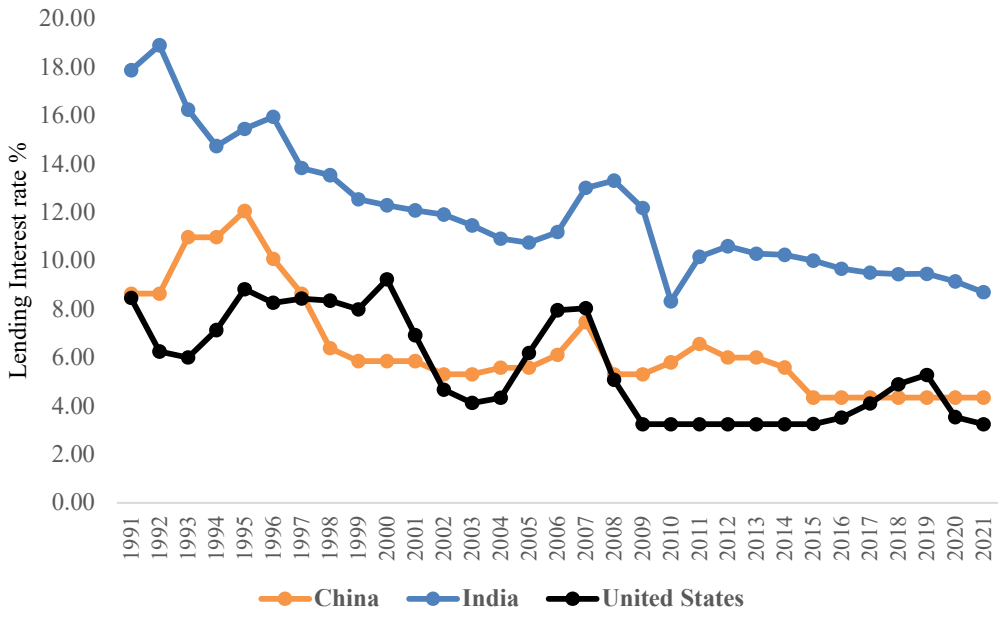

Figure 1. 5 Comparison of lending rates

Figure 1.5 shows the trend of lending interest rates for India, China, and the United States from 1991 to 2021(World Bank Data, 2021b). India's average bank lending rate over the past decade has been 9.75%, compared to 4.8% in China and 3.7% in the United States. These rates apply to all industries and businesses with a solid credit history. The weighted Average Cost of

Capital (WACC) for the Automobile industry is 12.5% (RBSA Advisors, 2020). Typically, these rates are pertinent to businesses with solid financials and order books. As Shankar (2000) outlined, the insufficient financing of MSMEs is frequently attributed to a lack of information about these organizations. Many small and medium-sized enterprises lack financial records, credit histories, and collateral, which lenders use to evaluate creditworthiness. In their absence, lenders are unable to move forward with credit evaluations. Hence, access to capital will be challenging for smaller firms, or the rates will be significantly above average.

In a scenario with a deficit reserve, when investments are locked up in the form of current assets, MSMEs resort to short-term external financing at higher interest rates to manage their operations. Such practice, in turn, increases the recurring payment of high debt obligations and strains the company's ability to generate profitability. Over the years, observations indicate that smaller firms' (revenue-based) profitability is declining, eventually leading to their demise. Government policies, the structure of a country's financial institutions, and the lending infrastructure fundamentally influence the operating environment of businesses. This arrangement substantially impacts the availability of finances for smaller enterprises (Berger & Udell, 2006).

Figure 1.6 depicts the trend of domestic credit to the private sector as a percentage of GDP for India, China, and the United States from 1991 to 2020 (World Bank Data, 2020). Domestic lending to the private sector refers to the financing provided by financial institutions to the private sector via various claimable means. The pattern indicates that the United States and China offer significantly more credit to enterprises than India. The prevalence of higher lending rates and lower domestic credit to the private sector as a percentage of GDP create operational difficulties for firms with prevalent liquidity problems. Efforts to improve the performance of businesses in response to the anticipated increase in demand in the region without addressing structural issues may not contribute to the survival or growth of the companies.

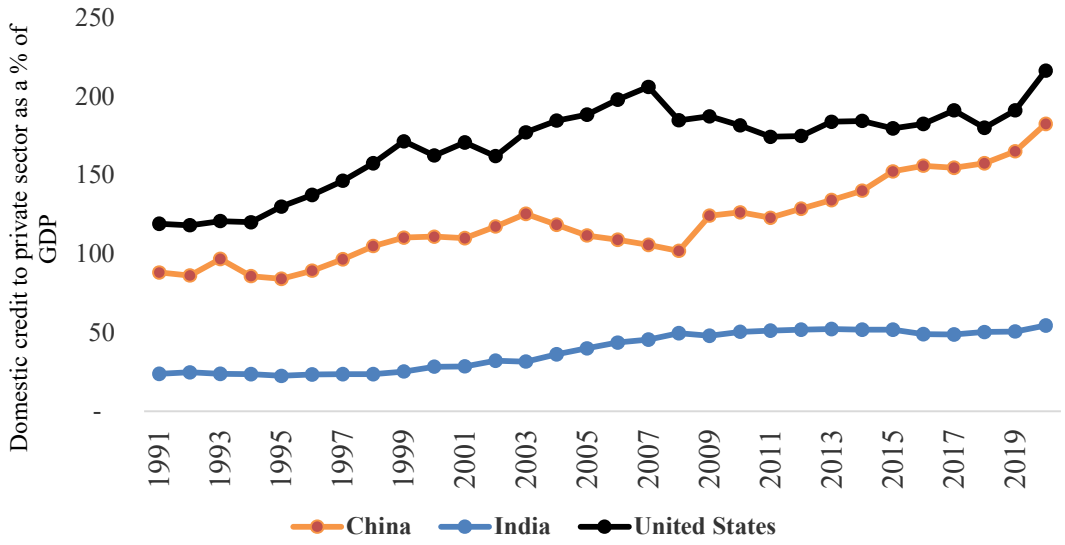

Figure 1. 6 Comparison of domestic credit to the private sector as a % of GDP

1.5 Overview of Supply Chain Finance (SCF)

The allocation of financial resources in supply chains is becoming increasingly prominent. The responsibilities of supply chain managers commence with the financial and capital budgeting choices on investments that generate value and conclude only upon receipt of payment from the client. Consequently, the convergence of finance and logistics/supply chain management creates new opportunities for banks and financial and logistical service providers to expand into new business sectors (Hofmann, 2005).

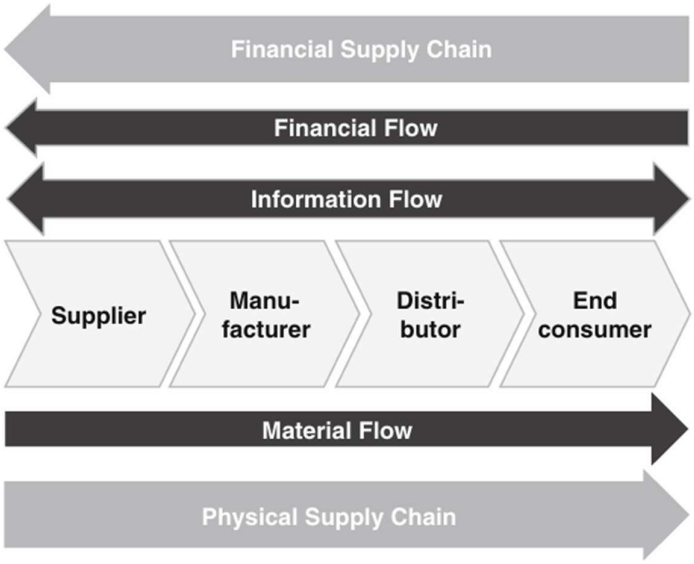

Figure 1. 7 The physical and financial supply chain (Source: Hofmann & Belin, 2011)

The critical flows in the supply chain are depicted in Figure 1.7. Supply Chain Finance (SCF) involves the efficient administration of working capital and financial transactions. Equally crucial is the effective management of information throughout the supply chain, including the many documents and data that support these transactions, such as purchase orders (POs), invoices, and payment approval processes. Most of the information in these documents is used to handle increasingly complex physical movements in the supply chain effectively. In recent years, the effective management of physical and financial supply chains through electronic information flows has been a crucial aspect of developing supply chain finance (SCF). Improving openness and visibility in both chains has become a central goal in the increasingly interconnected Supply Chain Finance (SCF) field.

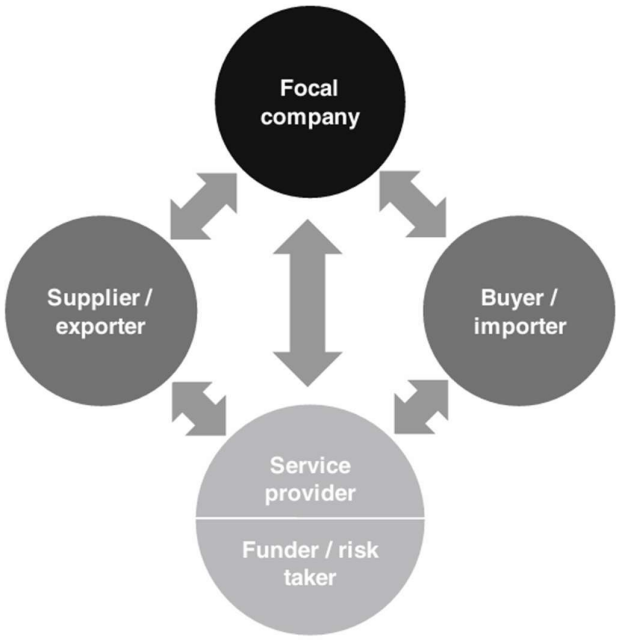

Figure 1. 8 The market players of SCF solution (Source: Hofmann & Belin, 2011)

Supply chain finance (SCF) solutions blend technological solutions and financial services that establish strong connections between key players in the global value chain, including lenders, suppliers, financial institutions, and often technology service providers. Figure 1.8 depicts the typical market players in a SCF solution setup. The key participants in the SCF solution are the focal company, which is at the core of the solution; the suppliers and buyers of the focal company; the funder and risk taker who provide liquidity and risk mitigation for the market participants; and the service provider who offers the necessary framework and platform for the establishment of SCF solutions.

SCF solutions are created to enhance the efficiency of financial supply chains by eliminating harmful cost shifting and improving the transparency, accessibility, delivery, and cash cost for all value chain participants. SCF solutions apply to several industries: retail, automotive, manufacturing, electronics, food and beverage, pharmaceuticals, distribution, heavy equipment, and technology (Lamoureux & Evans, 2011).

Unlike typical advancements that prioritize enhancing product or information movement, supply chain finance (SCF) explicitly addresses the financial flow. It enables buying organizations and suppliers to improve working capital and reduce expenses. Nevertheless, the adoption process of SCF is intricate and needs more research in academia. Wuttke et al. (2013) presented the first stage in understanding supply chain finance (SCF), specifically how companies implement SCF, the reasons for their varying adoption approaches, and the involvement of suppliers in the adoption process. The author uses an inductive multiple-case study method using six European organizations. They put out an expanded framework for adopting supply chain finance (SCF), which focuses on the interconnected adoption processes of buying firms and their respective supplier bases.

1.6 Implications of Supply Chain Finance (SCF) for the Indian auto industry

As per the agency theory (Eisenhardt, 1989), it is evident that the principal and the agent's approaches to the incentives of the supply chain would be different. Regarding liquidity management, the responsibilities of the buyer and the supplier are contradictory. In a typical supply chain scenario, the buyer will always attempt to extend the payment terms to improve his working capital position. This practice negatively affects the supplier's cash flow, resulting in a fragile and unstable supply base. A persistent emphasis on reducing the cash conversion cycle days (receivable days plus inventory days minus payables days) at an individual firm level (Randall & Farris, 2009) without consideration of the catastrophic effects on the entire supply chain results in the substandard performance of the value chain. Such practices will exacerbate supply chain difficulties, resulting in a domino effect that will eventually affect the market share of original equipment manufacturers.

Baumol (1959) indicated that "increased money capital will not only increase the firm's total profits, but because it puts the firm in a higher echelon of imperfectly competing capital groups, it may very well also increase its earnings per dollar of investment." He outlines the distinct

advantages that larger firms enjoy compared to smaller businesses in terms of investment and operational flexibility, which are essential to achieving profitability. Stekler (1964) concluded the inverse correlation of variability of the profit rates of firms with size. He argued that several small firms enter the loss categories in recessionary years, and a number go out of existence simultaneously. Hall & Weiss (1967) summarized that size does tend to result in high-profit rates, as Baumol proposed, that there is a significant though probably not enormous capital requirements barrier as a result, and that this barrier very likely has a more significant effect on profit rates than concentration, the traditional index of market power. Samuels & Smyth (1968) examined the behavior of profit rates and the variability of profit rates concerning the firm's size and concluded that the profit rates and firm size are inversely related. Treacy (1980) confirmed a strong negative correlation between the firm's size and variance of return on equity and a moderate correlation between firm size and average return on equity. The profitability of larger firms in the Indian automobile industry is unquestionably superior to that of smaller firms, and the larger firms deliver consistent performances over time (CMIE, 2021). Understanding the intersection of the operations and finance disciplines throughout the value chain can generate a compelling value proposition for the industry. Specifically, more accessible credit and improved working capital management approaches help alleviate the current operational challenges.

Numerous researchers have acknowledged the need for consistency in supply chains' financial and tangible information flows. Johnson & Templar (2011) discussed operations and finance relationships and elaborated on effective supply chains in working capital management. Hofmann & Belin (2011) described how supply chain finance (SCF) assists smaller businesses in meeting their working capital needs. SCF creates a win-win situation for all stakeholders (sellers, buyers, lenders, and technology firms). Theoretically, SCF can provide multidimensional advantages within supply chains by connecting all relevant parties to a single

platform. SCF is concerned with the inter-organizational administration of working capital, financial flows, and information flow throughout supply chains (Pfohl & Gomm, 2009). SCF adoption results in numerous corporate benefits. Among the benefits enumerated in the literature are lower unit costs of purchased goods, a less risky supplier base, minimal supply disruptions, extended payment terms, and improved liquidity positions (Chakuu et al., 2019). The analysis of the impact of implementing reverse factoring (a supply chain finance solution) between consumers and suppliers reveals outstanding outcomes (Seifert & Seifert, 2011). The adoption of SCF solutions benefited both consumers and suppliers. It decreased customers' working capital by 13% and suppliers' working capital by 14%. Wuttke et al. (2019) created a research framework that identified the main drivers of supplier adoption velocity.

Despite its tremendous supply chain-wide benefits, SCF adoption in India still needs to achieve the anticipated level of success. According to More & Basu (2013), among the challenges identified for Indian businesses, the absence of a shared vision among supply chain partners is the most critical. Lack of a shared vision for the entire supply chain can result in catastrophic effects. In addition, numerous obstacles cited by smaller Indian firms were the primary cause of SCF adoption levels that were below expectations (Alora & Barua, 2019). Besides, initial studies by Ambadapudi & Matai (2021) revealed that the adoption of SCF among Indian auto firms is shallow.

A substantial body of work in this area corresponds to European SMEs, and recent research contributions indicate that China is acquiring significant momentum in exploring the challenges of Small and Medium Enterprises. More literature needs to address the difficulties of smaller enterprises, particularly in India. The preponderance of previous research consisted of case-based analyses and surveys. Very few studies have examined exhaustive empirical calculations based on financial data. Also, minimal efforts were made to analyze the efficacy of supply chains beyond the traditional way of limiting to the firm in question (Busi & Bititci,

2006). Enhancing and extending the literature's contributions to the Indian context will reveal new research insights and directions for producing a better operating environment for Indian auto firms. This study will contribute to the nation's economic growth and support the Make in India initiative. Such observations are the primary impetus for our research.

1.7 Overview of the thesis structure

This section presents a brief description of various chapters of this thesis.

Chapter – 1 provides a summary of emerging India and its significance on the international stage, India's sustainability goals and the role of the Indian auto industry, the current challenges of firms in contributing to the enhanced GDP and achievement of India's emission goals, the investment scenario for the Indian auto industry, and the role of Supply Chain Finance (SCF) in improving the sector's performance.

Chapter – 2 begins by discussing the growing interest in supply chain finance and the historical contributions to the area. The chapter leads to a discussion on the changing nature of global value chains, the increased demand for supply chain financing, information asymmetry, the effective adoption of supply chain financing, the enablers for supply chain financing, and the current state of digitization. The conclusion of the chapter provides a summary of the research gaps, research objectives, and the scope of the study.

Chapter – 3 presents an overview of the conceptual framework adopted for the research and the rationale behind the chosen research design. The author provided information regarding the data sources and their reliability to validate the research findings. Also included is a discussion of the scope of the data set and the critical variables considered for the study. The section concludes with a discussion regarding assessing the findings' validity and generalizability.

Chapter – 4. examines the adoption of supply chain finance (SCF) in micro, small, and medium-sized enterprises (MSME) in the Indian auto industry by using appropriate statistical techniques. Results indicate little to no adoption of SCF, leaving suppliers in the deepest tier

vulnerable to financial risks. The current research contributes a suggestive framework and critical strategies to expedite the coverage and adoption of SCF for Indian micro, small, and medium-sized enterprises (MSME) to capitalize on the latent opportunity and promote economic growth.

Chapter – 5 investigates the differences among the operational environments of various classes of companies in the Indian automobile industry. The author examined the impact of firm size on the capacity to generate profitability and outlined key levers that practitioners can use to achieve profitability based on firm class. The author provided a decision guide to aid practitioners of various classes in improving their respective organizational performances.

Chapter – 6 emphasizes the importance of comprehending the performance enablers for various (revenue-based) classes of firms to accomplish a shared vision for the auto value chain, which has received scant attention. Using the Design of Experiments method, the author attempted to address this deficiency by identifying significant variables that impact each class of firm and determining optimal levels for performance enablers to attain profitability expectations.

Chapter – 7 summarizes the potential benefits that can accrue to various firms within the value chain of the Indian auto industry by adopting a collaborative liquidity management approach. The findings can assist in accelerating the adoption of SCF to support firms with deeper tiers, which is consistent with the Make in India initiative. This study provides evidence linking SCF solutions' capabilities to organizations' financial efficacy.

Chapter – 8 concludes the research findings drawn from the study, provides recommendations for practitioners to benefit from SCF adoption, outlines the current study's limitations, and further suggests future research directions.

Chapter 2: Literature Review

Preview: This chapter comprehensively introduces the Indian automobile industry, the difficulties encountered by various classes of firms, and specific information regarding supply chain finance (SCF) instruments. Section 2.1 offers a comprehensive analysis of the Indian automotive industry and its position in the global context. Section 2.2 provides an overview of the industry's growth projections and the government of India's involvement in supporting this expected growth. Section 2.3 provides an in-depth analysis of the specific traits of smaller firms (MSMEs) in the Indian region. In addition, Section 2.4 outlines the difficulties that smaller firms encounter, explicitly concerning the lending environment and working capital. The methodology employed for the literature review is summarized in Section 2.5. Section 2.6 comprehensively analyzes the potential SCF choices for different stakeholders in the value chain. Section 2.7 examines prominent management theories and their applicability to the study. Section 2.8 presents the problem statement, followed by section 2.9, which provides a summary of the research gaps. Section 2.10 summarizes the research aims and objectives. Section 2.11 defines the scope of the investigation. Section 2.12 outlines the significance of the research and the implication of the research outcomes for the concerned stakeholders/beneficiaries.

2.1 Overview of the Indian auto industry

The Indian automobile industry, including the vehicle and automotive component sectors, is significant in driving India's economic growth. Its powerful integration with many industrial sectors makes it a vital catalyst for expanding manufacturing gross domestic product (GDP), exports, and employment. According to Liu & Racherla (2019), India holds the top position in tractor manufacturing, ranks second in two-wheeler manufacturing, is the second largest producer of buses, stands fifth in heavy truck manufacturing, is the sixth largest producer of automobiles, and ranks eighth in commercial vehicle manufacturing. India is ranked fourth in

global motor vehicle production, with an annual output of over 5.8 million vehicles (Statista, 2023). The sector's share of the GDP rose from 2.77% in 1992–1993 to 7.1% in 2023 (Government of India, 2023b). It has a workforce of about 29 million, encompassing direct and indirect employment. The automobile sector generated an estimated annual revenue of over $103 billion in FY23. According to (Invest India, 2024), India aims to double its auto industry size to $175 billion by the end of 2024. The output of the industry is primarily focused on four major automotive manufacturing clusters in India: Delhi-Gurgaon-Faridabad in the northern region, Mumbai-Pune-Nashik-Aurangabad in the western region, Chennai-Bengaluru-Hosur in the southern region, and Jamshedpur-Kolkata in the eastern region.

India is a favorable location for exporting compact vehicles because of its cost-effective labor and the advantages of producing on a large scale. Companies have integrated export promotion into their business plans to optimize the utilization of their installed capacities.

2.2 Indian auto industry growth estimates and role of the government

India has the largest population in the world. The population is roughly 1.4 billion. The per capita gross domestic product rose from approximately US$ 1,432 in 2010 to US$ 2,485 in 2023, according to World Bank (2024). The demand for vehicles in the future is expected to increase due to growing disposable incomes in rural agriculture, a substantial workforce of trained and semi-skilled laborers, and a robust educational system (Government of India, 2022c). India's substantial middle class is projected to expand by more than 68 million families by 2030, leading to a surge in automobile demand. The motor vehicle registration rate in 2023 was 246 per 1,000 residents (Statista, 2024). These findings suggest a significant possibility for future expansion in the ownership of private vehicles.

According to Thornton (2021), the Indian automobile sector is expected to expand at a compound annual growth rate (CAGR) of 12.7% from 2019 to 2026, with a predicted value of USD 512 billion by 2026. India has devised the Automotive Mission Plan (AMP) to foster and

advance the automotive sector within the country (Automotive Mission Plan, 2016). The Automotive Mission Plan (AMP) aims to facilitate the expansion and advancement of the Indian automotive sector by positioning India as a worldwide hub for producing and exporting automobiles and automotive parts. The Indian Government formulated a national auto policy (National Auto Policy, 2018) to bolster the aspirations of the automotive sector. This policy is a complete blueprint for developing the nation's automotive industry. This strategy aims to guide the Indian automobile industry towards sustainability, international competitiveness, and technical progress while tackling industry-specific obstacles and creating new prospects for growth.

The Indian Government authorized the National Mission on Electric Mobility (NMEM) to promote electric mobility. It was introduced in 2013 as a strategic plan for National Electric Mobility. This mission plan was established with a primary focus on the nation's energy security and the mitigation of environmental damage. According to a projection by Niti Ayog (2017), it was estimated that by 2030, 40 percent of the private automobiles in the country might be electric. In India, Electric vehicles (EVs) contributed approximately 5% of the overall vehicle sales from October 2022 to September 2023. It is projected that by 2030, EVs might achieve a market share of over 40% (Bain & Company, 2023). Nevertheless, suppliers and vendors are generally micro, small, and medium-sized firms (MSMEs) with few opportunities and resources to enhance or improve. The primary challenges these component makers encounter include exorbitant capital expenses, a more proficient workforce requirement, and rising operational costs.

2.3 Indian Micro, Small and Medium Enterprises (MSME)

India has almost 63 million micro, small, and medium enterprises (MSMEs). As of March 31, 2022, there were 80.16 lakh registered MSMEs. As of March 15, 2022, Maharashtra has the highest Udyam registrations among all states, with 27.60 lakh units. Tamil Nadu had the second

highest number with 15.43 lakh units, followed by Uttar Pradesh with 12.60 lakh units, Gujarat with 11.27 lakh units, and Rajasthan with 11.24 lakh units. As of December 31, 2022, service firms accounted for the majority (72%) of registered MSMEs, while manufacturing comprised 28%. The MSME Ministry declared in August 2021 its objective to increase the MSME sector's contribution to the GDP to 50% by 2025, as IBEF (2023) reported.

Consequently, the government intends to enhance the manufacturing base within the nation and bolster the competitiveness of micro, small, and medium enterprises (MSMEs). Over the past fifty years, the micro, small, and medium-sized companies (MSME) sector of the Indian economy has experienced substantial growth. It significantly contributes to the economic and social development of the country by promoting entrepreneurship and generating employment opportunities with comparatively lower capital requirements, second only to agriculture. MSMEs serve as supplementary entities to large businesses and substantially contribute to the nation's inclusive industrial growth.

Table.2.1. provides a summary of the MSME classification per the Micro, Small & Medium Enterprises Development (MSMED) Act provision.

Table 2.1 MSME classification

S.no	Type	Investment in Plant, Machinery & Equipment (INR)	Turnover (INR)
1	Micro	One Crore	Five Crores
2	Small	Ten Crore	Fifty Crores
3	Medium	Fifty Crore	Two hundred and fifty Crores

2.4 Typical challenges of MSME

MSMEs are essential for both social and economic growth. According to the Reserve Bank of India (2020), the primary challenges for MSMEs include physical infrastructure bottlenecks, a lack of formalization, resistance to technology adoption, capacity building, backward and forward linkages, restricted access to credit and risk capital, and the persistent problem of delayed payments.

A business needs working capital to function daily. MSMEs must have timely, sufficient, and affordable access to finance to grow. Financial institutions have limited their commitment to this industry because of the small loan size, high service costs, and inability to offer immovable collateral (Mund, 2020). Singh & Poornima (2016) outlined the multiple obstacles that MSMEs encounter when trying to find funding at various phases of their existence and investigated whether or not the financial literacy of MSME owners poses a significant barrier to finding and using funding sources. The study aligns with the results of previous studies, which showed that informal sources like family and personal wealth are far more frequently used than formal ones like banks. According to the research, the primary obstacles to underutilizing formal sources were the insufficiency of collateral assets and the businesses' need for financial literacy.

The Indian Government is implementing many initiatives to assist Micro, Small, and Medium Enterprises (MSMEs). The government sanctioned the Production Linked Incentive (PLI) scheme for the automotive sector on September 15, 2021, allocating a budget of Rs. 25,938 crores to bolster domestic car manufacturing. The PLI system encompasses electric vehicles (Financial Express, 2021). Following the G20 Declaration (2023), the Indian Government acknowledged the difficulties that MSMEs, specifically in developing nations, encounter regarding information accessibility. Consequently, they urged measures to improve MSMEs' access to information, facilitating their integration into global trade.

2.5 Methodology for literature review

Using the keywords "financial risk," "supply chain," and "supply chain finance," an initial universe of 1,938 papers was obtained from the Scopus and Web of Science databases.

Table 2.2 Summary of papers selection for literature review

Iteration	Review level	Description	# of Papers
1	Total universe	Total papers from Scopus and Web of Science	1,938
2	First pass	Papers with citation count more than 10 (Excluding common papers)	614
3	Second pass	Suitable papers based on abstract and conclusion criteria	307
4	Third pass	Suitable papers based on research criteria; methodology relevant to research objectives along with management consulting and Government of India reports	167
Total papers for detailed review			**167**

The steps to prepare the core papers for a thorough review are outlined in Table 2.2 above. The author started by looking for research papers with more than ten citations. Six hundred fourteen articles were found after this stage, pending additional review. The author reviewed their abstracts and conclusions to further filter the six hundred and fourteen (614) papers according to their relevance to the research objectives. After this stage, three hundred and seven (307) articles were shortlisted for additional review. Specificity, research methodology, and applicability to the planned research setting are further filters for these. After this phase, one

hundred and sixty-seven (167) papers became available for review. The author examined these papers in great depth.

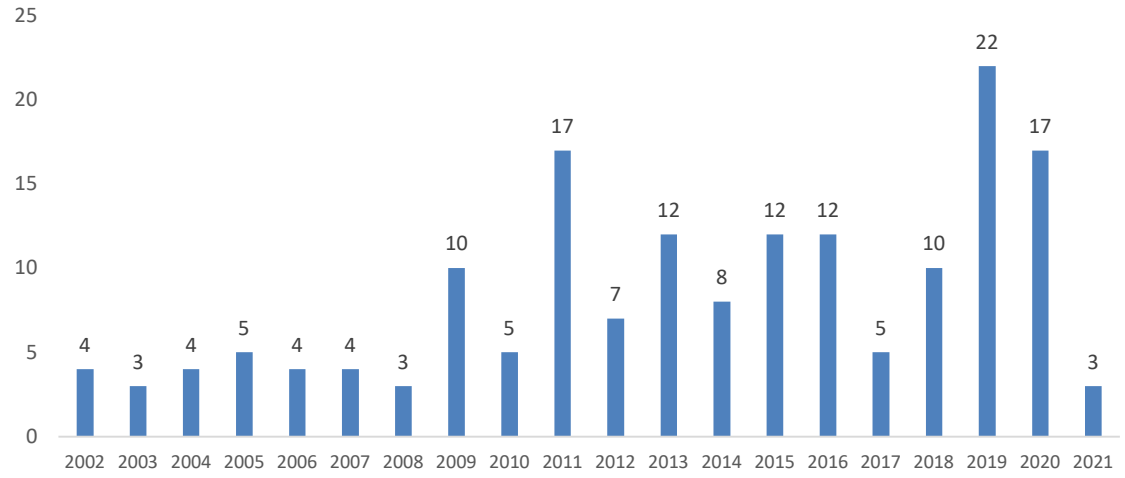

Figure 2. 1 The number of reviewed papers published per year

The publication range is restricted to the latest 20 years to comprehend the current trends in the field of study. The total number of reviewed papers by year is summarized in Figure 2.1. With a few exceptions, the research on the topic has been steady since 2009. The author carefully examined the literature from reliable sources. Enclosed below, Figure 2.2 is a summary of the journal's source. In his research journey, the author could refer to additional, prominent works within the SCF area, which helped broaden his understanding of the topic, and he cited them appropriately in the literature review section.

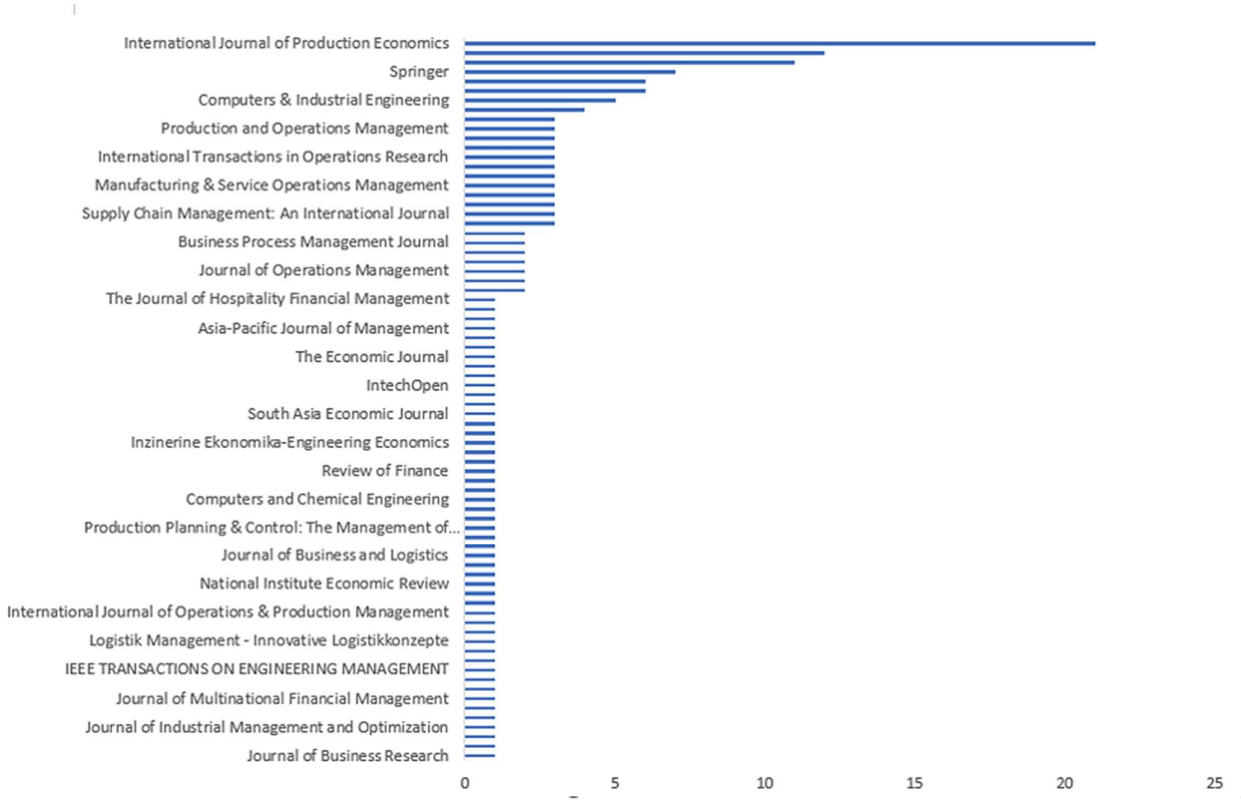

Figure 2. 2 Literature source summary

2.6 Summary of literature review

SCF research has grown to include a wide range of topics reflecting the ever-changing nature of modern supply networks and the critical role of finance in influencing supply chain performance and competitiveness. The literature provides thorough details on the vital role of trade credit in supply chain finance (SCF) by enabling effective management of liquidity, mitigation of risks, establishing relationships, and optimizing costs across the supply chain ecosystem. The discussion on supply chain risk assessment in SCF programs focuses on identifying areas that enable businesses to improve financial stability, operational efficiency, and competitiveness throughout the supply chain ecosystem. Examining the concept of information symmetry aids in comprehending the fundamental factors that contribute to the effectiveness of supply chain finance (SCF) projects. Information symmetry enhances trust and durability in SCF interactions by promoting openness and accountability. This, in turn, drives

value generation and resilience in dynamic and linked markets. It is crucial to comprehend the connection between the effective implementation of supply chain finance (SCF) and working capital. Supply Chain Finance (SCF) dramatically influences working capital management by offering inventive financing options that maximize the utilization of funds across the supply chain.

The following subsections provide a concise overview of the literature review's specifics. The comprehensive literature analysis and a thorough grasp of management theories facilitated the formulation of the relevant research questions.

2.6.1 Micro, Small and Medium Enterprises

International trade poses significant challenges and expenses for micro, small, and medium-sized firms (MSMEs). The restrictions can appear larger for smaller businesses. Micro, Small, and Medium Enterprises (MSMEs) constitute most enterprises in most countries, with an average representation of 95 percent. MSME's involvement in trade is generally feeble. Based on World Bank Enterprise Surveys of over 25,000 small and medium-sized enterprises (SMEs) in developing countries, the World Trade Organization has calculated that direct exports make up only 7.6 percent of the overall sales of SMEs in the manufacturing sector. The percentage for large manufacturing businesses is 14.1 percent, which is being compared here. In industrialized countries, enterprises with fewer than 250 employees make up 78% of exporters, yet they only account for 34% of exports. MSMEs in underdeveloped nations exhibit a productivity level that is 70% lower than that of large enterprises. The available research for industrialized countries indicates a similar pattern.

Resilience and agility are crucial for these firms to prosper in an unpredictable and demanding environment. Small and medium-sized enterprises (SMEs) and mid-sized organizations generally exhibit lower resilience than bigger companies but demonstrate significantly greater levels of agility (World Economic Forum, 2022). Small to medium-sized firms are dynamic

entities that adapt their scope of operations based on market forces. Organizations must adjust their strategies to align with the dynamic shifts in the environment, encompassing worldwide advancements in science, business, and technology, as these factors might impact corporate performance. Companies and other institutions can utilize digital technology like distant network systems, the Internet, and mobile technologies to streamline decision-making (Christauskas & Miseviciene, 2012).

Besides, MSMEs are observed to be less productive. The lower productivity of MSMEs is often linked to their limited ability to take advantage of economies of scale, challenges in accessing funding or investment, a lack of suitable skills, and an inability to operate formally (World Trade Organization, 2016). Albaz et al. (2020) estimated that reducing the disparity in productivity between small and medium-sized enterprises (SMEs) and large corporations by half would result in around $15 trillion in additional value created, equivalent to approximately 7 percent of the global Gross Domestic Product (GDP).

2.6.2 Trade credit

The relationship between a firm and its creditors impacts the company's accessibility and expense of cash. Relationships hold significant value and function based on quantities rather than monetary pricing (Petersen & Rajan, 1994). The level of competition in credit markets plays a crucial role in determining the worth of lending relationships. Numerous companies are either obtaining trade credits from their suppliers or providing credits to their customers as a means of financing purchases. Trade credit is a significant concern in supply chain management since it represents a critical transaction between suppliers and buyers within a value chain. Trade credit is a tool for coordinating supply chain activities (C. H. Lee & Rhee, 2011).

The issue of trade credit is of heightened importance for small and medium-sized enterprises (SMEs) in developing nations, especially in emerging market economies, since they continue to represent a growing portion of international trade. Small and medium-sized enterprises

(SMEs) in developing nations encounter barriers similar to those of their counterparts in industrialized countries, such as difficulties in establishing creditworthiness. However, they also confront additional problems, including smaller, more exclusive, and perhaps less evolved local financial sectors (Das, 2016).

Bastos & Pindado (2013) show that trade credit contagion commonly arises inside the supply chain during a financial crisis. Initially, companies with significant amounts of trade receivables delay making payments to their suppliers to mitigate the rise in the likelihood of insolvency. The supplier's automatic response is to replicate the same behavior with their suppliers, causing a payment delay. This leads to a trade credit contagion within the supply chain, typified by a cascade impact.

Suppliers typically provide buyers a grace period for payment, and this grace period from the supplier favors the buyer's demand. As the allowable delay increases, the supplier's risk of default also increases. Z. Liu & Cruz (2012) developed an analytical framework that examines the impact of financial risks on the values of interconnected supply chain enterprises from a network viewpoint. This framework also investigates how financial risks influence the profitability of supply chain firms and their cash and credit transactions.

Cai et al. (2014) examine the roles of bank and trade credits in a supply chain where a retailer with limited funds faces uncertain demand. The study is based on data from 674 enterprises in China between 2001 and 2007. In two scenarios, the study assessed the most advantageous order quantity for the retailer and the most favorable credit limits and interest rates for the creditors.

Jing & Seidmann (2014) evaluate the advantages and disadvantages of using bank credit compared to trade credit in a supply chain that includes a manufacturing facility and a retailer with limited access to cash. The study demonstrates that trade credit is superior to bank credit in reducing the negative impact of double marginalization, mainly when production costs are

relatively low. Conversely, bank credit becomes more successful in alleviating this issue in other scenarios.

H. H. Lee et al. (2018) distinguish between the typical trade credit for a whole industry and the extent to which an individual supply chain deviates from this industry average. This distinction is crucial in the study of the effect of trade credit on company performance. When suppliers provide trade credit at the average level for their industry, it helps facilitate trade and is positively linked to the performance of both parties. However, if suppliers are more aggressive in their trade credit strategy than the industry average, the excess trade credit harms the buyer's performance.

Smaller suppliers frequently need help in securing financing for their business activities. Particularly in emerging economies, conventional financing methods can be prohibitively expensive or inaccessible to these suppliers. Major buyers have recently adopted financing strategies that involve intermediaries between suppliers and financial institutions to decrease the expenses associated with channels. Utilizing buyer-intermediate finance can significantly enhance the efficiency of the distribution channel and provide mutual advantages to all parties involved in the supply chain. Tunca & Zhu (2018) prove that buyer intermediation reduces interest rates and wholesale prices, increases order fill rates, and enhances supplier borrowing and further anticipated that introducing buyer-intermediated finance will enhance channel earnings by 13.05%, resulting in a more than 10% increase in profits for suppliers and retailers.

Kumar et al. (2021) conducted a comprehensive analysis of trade credit in the Indian corporate sector, an emerging economy. The study utilized an extensive dataset containing information from 2006 to 2018, spanning 13 years. The dataset covered several industries: manufacturing, services, construction, and others. The study reveals that inventory management and macro factors are crucial in determining trade credit for Indian enterprises. The inventory of raw materials primarily influences trade payable. However, companies with sufficient raw or

finished inventories are less inclined to provide trade credit. Large-scale enterprises are identified as significant purchasers and providers of trade credit. The pecking order theory is unequivocally confirmed, as net profits are prioritized over trade credit, a comparatively costlier financing form. Formal financial credit is observed to serve as a replacement for obtaining trade credit.

2.6.3 Supply chain risk

Hendricks & Singhal (2003b) assessed the impact on shareholder wealth caused by supply chain disruptions leading to delays in manufacturing or shipment. The findings are derived from a subset of 519 glitch notifications reported between 1989 and 2000. Announcements of supply chain glitches are linked to a significant decline in shareholder value, namely by 10.28%. Analysis reveals that larger companies tend to see a less detrimental response from the market, whereas companies with more significant growth potential face a more adverse reaction.

Small and medium enterprises (SMEs), which comprise the majority at the supply chain's tier II and tier III levels, experience the most impact from supply chain failures. This is due to the need for more resources and insufficient strategic planning to mitigate supply chain risks. Risk management in supply chains is a complex subject that involves making decisions based on multiple criteria. Gaining comprehension of the priorities would enable organizations to allocate significance and formulate appropriate strategies for mitigating supply chain risks based on their respective levels of importance. This facilitates the efficient allocation of limited resources that small and medium-sized enterprises have for mitigating risks within their supply chains (Faisal, 2009).

Due to the growing interconnectedness of supply chain members, the bankruptcy of one member might lead to financial troubles for other enterprises in the chain. X. Xu et al. (2010) use a multi-agent simulation model to investigate the impact of coordination

mechanisms, specifically information sharing and vendor-managed inventory (VMI), on mitigating bankruptcy risks in a three-echelon supply chain. The simulation findings demonstrate that these coordination mechanisms are highly successful in mitigating the danger of bankruptcy.

Hua et al. (2011) utilized a simulation model to examine the effects of different operational parameters and decisions (including horizontal competition among retailers, order allocation strategies of retailers, wholesale prices of manufacturers, characteristics of market demand, and the number of retailers) on the propagation of bankruptcy. Given that a firm often makes operational decisions while facing financial limitations, the authors also examined the connection between its operational risks and financial choices. The results of the study demonstrate that the interplay between operational interactions among supply chain members and the operational decisions made by these members are significant factors contributing to the propagation of bankruptcy. However, the effects of these operational parameters and decisions are contingent upon financial decisions. These observations suggest that supply chain stakeholders might mitigate operational risk by making financial decisions.

There is disagreement about the advantages that small and medium-sized firms (SMEs) obtain from their collaborations in supply chain partnerships. Rezaei et al. (2015) analyzed various business functions (manufacturing, marketing and sales, purchasing and logistics, research and development (R&D), and finance) within a supply chain partnership involving small and medium-sized firms (SMEs) to gain a deeper understanding of the subject. The authors gathered data for each distinct function from a sample of 279 small and medium-sized enterprises (SMEs) in the high-tech industry. They then analyzed the relationship between different forms of partnerships and the overall performance of these SMEs. The findings suggest that partnerships notably impact total business performance solely in research and development (R&D). The findings indicate that small and medium-sized enterprises (SMEs)

can primarily gain advantages from specific supply chain collaborations, including research and development (R&D) partnerships. The findings contribute to the scholarly discourse by elucidating the reasons behind the lack of benefits seen by several small and medium-sized enterprises (SMEs) in these collaborative alliances.

Wandfluh et al. (2016) proposed a theoretical framework for a study that utilized hypotheses based on principal-agent theory. The aim was to elucidate the impact of collaboration on financial performance in the setting of a buyer-supplier relationship. An empirical test examined the hypotheses using a cross-industry survey with 145 responses. The findings suggest that aligning strategies between a company's purchasing and finance departments and between the buyer and supplier in a business relationship has a notable and beneficial impact on the overall financial performance. These findings offer researchers and practitioners a more distinct comprehension of upstream-oriented supply chain finance and the potential and constraints on its implementation.

Supply chain finance (SCF) seeks to enhance the overall creditworthiness of the entire supply chain, encompassing buyers, suppliers, and financial service providers, by employing an inter-organizational strategy. The discount rate in a supply chain finance (SCF) structure is primarily determined by the interaction between buyers and financial service providers. Hence, it is vital to comprehend the aspects that are considered when determining discount rates. Ma et al. (2020) utilized interpretive structural modeling to examine the significance of these elements for financial service providers. This approach allowed for the modeling of the interaction between collaboration components and facilitated the assessment of the value of each factor. According to the findings, financial service providers view top management support, trust, and IT infrastructure as the most crucial elements.

2.6.4 Information asymmetry

Easley & O'Hara (2004) examine the impact of information on a company's cost of capital. The authors demonstrate that variations in the information content between public and private sources affect the cost of capital. Investors require a greater return to maintain equities that possess a higher degree of private information. The increased return results from knowledgeable investors' ability to adjust their portfolios based on new information, giving them an advantage over uninformed investors. The equilibrium state is influenced by the quantity and quality of information, impacting asset prices. The research demonstrates that corporations can impact their cost of capital through strategic decisions regarding accounting treatments, analyst coverage, and market microstructure.

In their study, Pike et al. (2005) examine trade credit conditions by analyzing the answers of 700 major companies in the United States, United Kingdom, and Australia. They focus on two main goals: minimizing information imbalances and eliminating unfair pricing practices.

Song et al. (2016a) made significant contributions to the field of SME financing by researching the effects of supply chain finance and examining the influence of information sharing within supply chains. This study offers a comprehensive technological and social understanding of the supply chain network and its subsequent impact. This study aims to investigate the ability of supply chain networks to facilitate extensive information sharing, which is typically difficult to achieve using traditional methods. Additionally, it highlights the potential of both cliques and bridge structures in assisting small and medium-sized enterprises (SMEs) in improving their liquidity and working capital.

Song et al. (2018) examine various case studies by conducting comprehensive interviews with focal firms (lenders), three Chinese financial service providers (FSPs), and three commercial banks that offer working capital to the same small and medium-sized enterprises (SMEs). The case studies demonstrate that obtaining transaction information and company credit in SCF can

decrease the pre-existing information asymmetry. Supply chain finance (SCF) can reduce information asymmetry by employing receivable transfers, closed-loop business models, relational embeddedness, and a combination of outcome and behavioral control. Compared to SCF controlled by commercial banks, SCF implemented by FSPs in the supply chain is more effective in reducing information asymmetry.

The funding challenges faced by SMEs arise from the presence of information asymmetry between lenders and borrowers. However, there is a new business trend where traditional lending is being replaced by supply chain finance. This shift minimizes the information imbalance and improves the chances for small and medium-sized enterprises (SMEs) to obtain the funds they need for day-to-day operations. Song et al. (2020) employ an integrated approach to analyze the crucial elements that enable small businesses and financial service providers (FSPs) to exchange information and enhance their financial performance in a business-to-business context. Research indicates that small and medium-sized enterprises (SMEs) possessing distinct operational capabilities and sufficient network integration can effectively address the challenge of information asymmetry. They achieve this by strategically presenting unregulated signals to financial service providers (FSPs) to distinguish themselves from other unqualified organizations. Furthermore, financial service providers (FSPs) will compensate for small and medium enterprises (SMEs) shortcomings regarding their structural and relational integration. The combined effect of both the operational capabilities and network embeddedness of SMEs will enhance the accessibility of working capital for SMEs.

2.6.5 Operations and finance

Conventional supply chain management methods (SCM) typically prioritize operational aspects while disregarding the financial aspect of the issue. Guillén et al. (2007) showcased a comprehensive strategy through a case study, maximizing the synergistic impact of operations and finances in supply chain management to foster integration across many business areas. The

results demonstrate the significance of developing comprehensive modeling tools for supply chain management (SCM), which can lead to higher overall profits and offer an additional understanding of the interplay between operations and finances.

Financial supply chain management and working capital management are gaining prominence as crucial strategies to enhance profitability in supply chains. Managers can exert control over financial performance and attain substantial cost reductions by actively overseeing payment terms and managing working capital needs—nevertheless, efforts to enhance financial success inherently limit and influence operational performance. Protopappa-Sieke & Seifert's (2010a) research explores the advantages of considering operational and financial factors when making decisions for the physical and financial supply chains. The authors devised a mathematical model that calculates the most advantageous quantity for purchasing orders, considering limitations on working capital and delays in payment. The authors examined the trade-offs associated with the frequently utilized financial and operational metrics, including service level, return on investment, profit margin, and inventory level. The results indicate the importance of payment delays and the reduction of operational expenses. Furthermore, augmentations in the working capital utilized in the system lead to a decrease in the overall operating costs, an increase in the general financial expenses, and a fall in the return on investment for working capital.

Financial supply chain and working capital management are gaining attention as efficient strategies for improving working capital levels and managing cash flows. Efficient working capital deployment in a multiproduct environment can enhance firm performance, generate substantial cost savings, and showcase risk-pooling advantages. Protopappa-Sieke & Seifert (2011) examined the connection between working capital and inventory choices for diverse product portfolios that are useful, inventive, and diversified. The authors examined the impact of demand correlation, lead time, payment delays, portfolio sizes, and service level constraints

on multiproduct portfolios. The authors utilized simulation to obtain managerial insights due to the dynamic nature of working capital. The findings confirm the significance of payment delays in determining a company's profitability.

Tanrisever, Reindorp, et al. (2015) propose a mathematical framework to combine, examine, and enhance the operational and financial processes in the supply chain of a major corporate client with a small or medium-sized supplier. The authors demonstrated the impact of reverse factoring on these organizations' operational and financial decision-making.

The financial supply chain, which operates alongside the movement of products and information, is present in all economic supply networks. Its connection with the physical supply chain is crucial and widespread, making it essential for integration. Silvestro & Lustrato (2014) constructed a physical and financial supply chain integration (SCI) model that adopts a process-oriented approach, including the viewpoints of both customers and suppliers. The model also investigates the involvement of banks in facilitating SCI, using a case study as an example. The results indicate that banks can assist buyers and suppliers by actively contributing to the factors that enable Supply Chain Integration (SCI), which include coordination, collaboration, information exchange, and information visibility.

The objective of operations management is to align the availability of resources with the demand for material flows. At the same time, corporate finance tries to align the availability of resources with the demand for monetary flows. The two processes of matching supply and demand are interconnected by managing real investments and revenues in a self-contained loop of resources. Zhao & Huchzermeier (2015) suggested a risk management paradigm for comprehensively integrating multidimensional operations-finance interface models. Ten aspects are examined to describe the conditions under which enterprises should integrate operations and finance.

2.6.6 Supply chain performance

An interrelationship exists between revenue growth, decrease in operating costs, efficiency in working capital, and efficiency in fixed capital, all contributing to improved shareholder value. Developing a proficient supply chain plan is crucial for attaining it (Christopher & Ryals, 1999). The balanced scorecard assesses and evaluates daily business operations based on four perspectives: financial, customer, internal business process, and learning and growth. Bhagwat & Sharma (2007) constructed a comprehensive scorecard by thoroughly examining the literature on supply chain management (SCM) performance metrics, supplemented by three case studies involving small and medium-sized firms (SMEs) in India. An equitable supply chain management (SCM) scorecard can be the basis for a strategic SCM system.

Hofmann & Locker (2009) investigated the development of a value-based performance measurement concept in supply chains. The research was based on a case study from the packaging industry. The value-based view establishes a clear connection between the operational activities of the supply chain and the generation of shareholder value, which is measured by the economic value added (EVA). The authors' proposed methodology establishes a clear connection between the operational key performance indicators and the ultimate measure of a company's ability to generate value through value drivers.

Supply chains directly impact the distinctiveness and pricing of a company's products and services and its vulnerability to risk. Johnson & Templar (2011) employed secondary financial data to investigate the correlation between supply chain and company performance by creating a consolidated measure for supply chain performance. The authors used well-established econometric methodologies to verify the proxy's accuracy. They utilized a sample frame of the annual reports of 117 publicly traded UK manufacturing enterprises from 1995 to 2004. The authors observed an increase in the proxy results due to the rise in the rate of return on capital employed and a change in the length of the cash-to-cash cycle. These are both

conventional indicators of enhanced supply chain management. Furthermore, there is a statistically significant correlation between the increase in the rate of change of the proxy and the increase in enterprise value. This suggests that enhancing supply chain management methods has a beneficial effect on overall company performance.

It indicates potential issues or concerns if businesses require credit beyond 45 days. Delaying payments to suppliers is a temporary strategy. The conflict between potential immediate benefits and eventual negative consequences is common in strategic deliberations. Pursuing profitability in the short term may not align with the long-term sustainability of businesses. There is a risk that firms may harm their suppliers, potentially leading to their collapse. The auto business, especially in the US, has been notorious for being one of the most blatant exploiters of suppliers over an extended period. The payment arrangements were modified, and the prices were significantly reduced. The outcome is that the supply industry is substantially more precarious in the United States than the manufacturers, with numerous groups either in or on bankruptcy protection. A significant peril is associated with major corporations' choice to delay payment (Milne, 2009). Manufacturers and distributors at the highest level of the supply chain frequently strive to minimize their inventory to conserve cash and shift inventory issues to lower levels of the pipeline. Although a temporary solution, destocking adversely affects numerous suppliers and further delays recovery.

2.6.7 Working capital management

Logistics and supply chain management highlight attaining the lowest total cost by effectively coordinating all supply chain elements. The cash-to-cash (C2C) metric is a crucial indicator as it connects money flow from purchasing materials from suppliers through manufacturing to the revenue generated from sales to customers. C2C holds significance from accounting and supply chain management standpoints (Farris & Hutchison, 2002).

Wang (2002) analyzed the correlation between liquidity management and operating

performance and the relationship between liquidity management and corporate value for companies in Japan and Taiwan. The author noted that there is a consistent negative correlation between the cash conversion cycle (CCC) and returns on assets (ROA) as well as returns on equity (ROE). Furthermore, this relationship is highly influenced by industry-specific factors. The findings suggest that actively aggressively managing liquidity improves operational performance and is generally linked to greater corporate values in both nations, regardless of variations in structural characteristics or a firm's financial structure.

Tsai (2008) quantifies the risks associated with cash flow in the supply chain of a business organization by calculating the standard deviations of cash inflows, outflows, and net flows for each period within a specified planning horizon. The author offers valuable perspectives on how conventional methods enhance the Cash Conversion Cycle (CCC). The author also demonstrates the advantages and endorses the optimal strategy for utilizing asset-backed securities (ABS) to fund accounts receivable to reduce the cash conversion cycle (CCC) and mitigate the risk of cash inflow. This is especially advantageous for small vendors with limited cash reserves and significant financing expenses.

Hofmann & Kotzab (2010) have devised and deliberated over a methodology centered around the supply chain for managing working capital. Two viewpoints have been analyzed: the individual firm viewpoint and the supply chain-focused viewpoint. The authors have examined their findings using a conceptual model and solved a simple linear optimization problem, with shareholder value added (SVA) as the primary performance metric.

Supply chains are frequently interconnected to such an extent that inefficient working capital management can result in financial issues at a single supplier and potentially even bankruptcy. Therefore, it is essential to consider all the partners involved in the supply chain before and after the company's operations when making decisions about working capital management. The cash conversion cycle (CCC) is a highly effective metric for evaluating a company's

performance. The findings demonstrate a notable inverse correlation between the CCC and return on capital employed (ROCE). Theo Grosse-Ruyken et al. (2011) argue that a thorough assessment of the optimal level of CCC (Cash Conversion Cycle) for effective supply networks needs to be carried out.

Boissay & Gropp (2013) demonstrate, through the utilization of an exclusive dataset of French enterprises, that firms experiencing limitations in obtaining credit and seeing sudden disruptions in liquidity are more prone to default on their obligations to suppliers. Companies with limited access to credit transfer a significant portion of these shocks to their suppliers. This aligns with the concept that companies offer liquidity insurance to one another, and this mechanism effectively mitigates credit limitations. The authors demonstrate that the sequence of defaults ceases when it encounters firms not subject to limitations or restrictions. Enterprises that can obtain external financing can transfer liquidity to credit-constrained firms within their supply chains.

Managing working capital (WC) significantly affects a company's liquidity. Furthermore, numerous correlation studies have consistently shown a strong association between WC and profitability. Moreover, the financial performance data of multiple manufacturing, trading, and service firms suggests a negative correlation between the components of working capital (inventory, accounts receivable, cash, bank deposits, and accounts payable) and the firm's net operating profitability (NOP). Bagchi (2013) uses a unique approach to this postulated relationship through statistical studies. The results provide a statistically significant confirmation of the causal relationship of WC.

Yazdanfar & Öhman (2020) employed a seemingly unrelated regression (SUR) model to analyze cross-sectional panel data encompassing 13,797 small and medium-sized Swedish enterprises (SMEs) operating in four industries. They present concrete proof that CCC has a significant impact on profitability. Furthermore, the characteristics of business size, age,

and industry affiliation considerably impact firm profitability. These findings suggest that managers have the potential to enhance strong profitability by improving their working capital management.

Supply chain finance and working capital management are crucial strategies for minimizing supply chain costs. Smaller suppliers may need more working capital to fund their operations and effectively meet the demands of their customers. Protopappa-Sieke & Seifert (2017) have constructed a model that comprehensively encompasses the essential financial and operational planning elements in a two-stage supply chain, incorporating robust and vulnerable participants. A member with a strong position can secure better financing rates, more favorable payment conditions, and shorter lead times compared to a member with a weaker position. The researchers examined two possibilities for allocating working capital.

- Each supply chain member possesses working capital in dedicated working capital allocation.
- In the joint working capital allocation scenario, the supply chain members collectively include a shared pool of working capital.

Evidence indicates substantial advantages when the participants in the supply chain collaborate in the allocation of working capital. The authors also demonstrate that increasing the duration of payment delays to a supplier located farther up in the supply chain leads to an increase in the overall expenses of the supply chain.

Financial obstacles amplify the expenses associated with funding operational needs and restrict trade credit's effectiveness in facilitating coordination within the supply chain. If the supplier incurs high costs when financing working capital, more than relying on delayed payment and transfer pricing may be needed to coordinate the supply chain effectively. Devalkar & Krishnan (2019) illustrate the necessity of additional mechanisms, in combination with trade credit terms, to synchronize supply chains. The study demonstrates that in situations where expensive

working capital restricts the ability of trade credit to facilitate coordination, implementing a reverse factoring program can alleviate financial obstacles and offer suppliers affordable credit to support their working capital needs. This, in turn, restores the effectiveness of trade credit in addressing moral hazard issues.

2.6.8 Overview of supply chain finance (SCF) solutions

Figure 2.3 depicts the universe of SCF solutions, encompassing 16 approaches. This includes six techniques in the AR (Accounts Receivable) and AP (Accounts Payable) areas and four ways specifically targeting inventory and fixed asset finance. Each solution allows for a tailored management of working capital, allowing for either an extension or reduction of average payment timings. The benefits include increased funding opportunities, fewer trade risks, reduced administrative costs, improved reporting capabilities, and enhanced supply chain partnerships. The below sub-sections summarize the details of the SCF solutions.

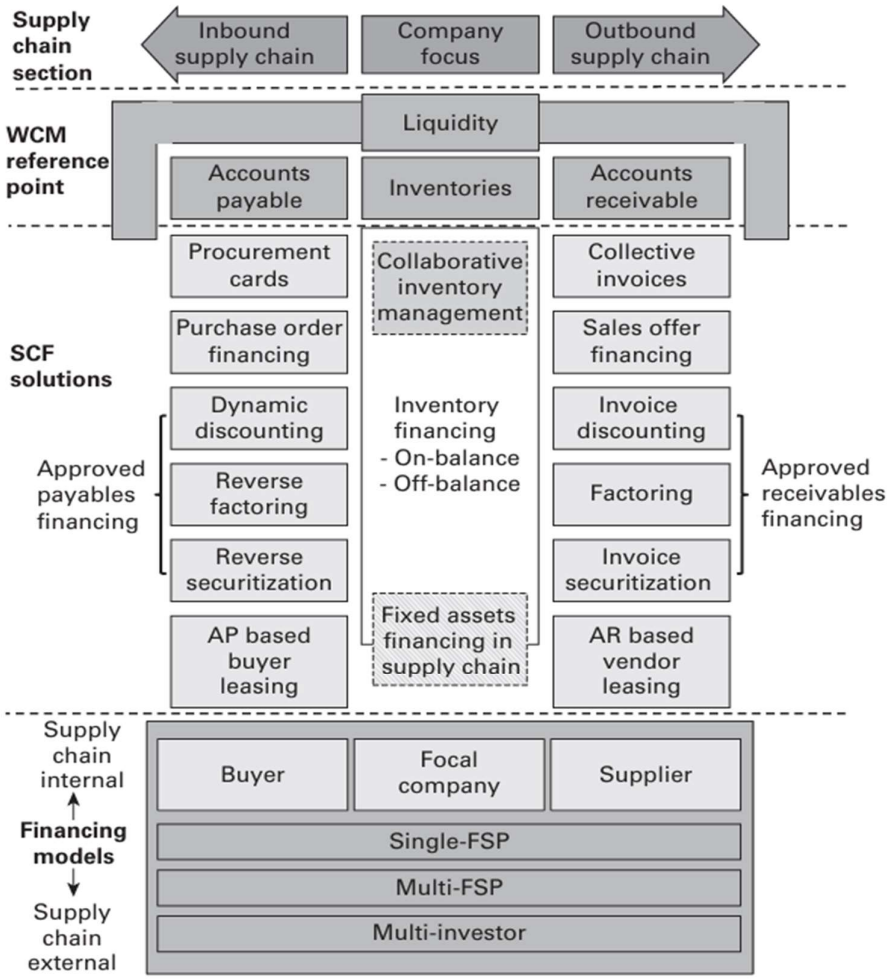

Figure 2. 3 Overview of SCF solutions (Source: Templar et al. 2020)

2.6.8.1 Payables financing: Procurement cards (P-cards)

A procurement card, often known as a P-Card, is a tool primarily used by buyers in a business-to-business (B2B) purchasing system. P-Card facilitates the connection between a buyer, suppliers, and a financial services provider (FSP) to manage transactions. It also enables the buyer to make payments according to a mutually agreed-upon frequency. Purchasing cards (P-Cards) allow organizations to consolidate payments and settle them at regular intervals, lowering the average time required to make a transaction. In addition, they prevent the necessity of a comprehensive purchase order or invoice procedure, circumventing the requirement to establish new suppliers in the buyer's systems and facilitating meticulous

itemized tracking. Purchasers make payments over 15 or 30 days, and the transactions are connected to a corporate accounting and expenditure system to facilitate comprehensive cost reporting. Suppliers incur a transaction cost, but the buyer gains the advantage of payment certainty.

2.6.8.2 Payables financing: Purchase order (PO) financing

The buyer, a financial service provider (FSP), and suppliers participate in a buyer-centric method to finance the delivery of goods. This is making a financial commitment or prepayment to the supplier before the delivery, diminishing the supplier's requirement for financing and related expenses. This buyer-focused strategy is especially advantageous during rapid growth or the introduction of new products when working capital for both sides is limited. The purchase order (PO) acts as security for the financial service provider (FSP), with the primary risks being the supplier's production performance and the buyer's capacity to make future payments. The buyer-centric strategy is especially appealing for items that demand significant capital investment and necessitate long-term, robust relationships.

2.6.8.3 Payables financing: Dynamic discounting

Dynamic discounting (DD) is a buyer-oriented strategy in which buyers and suppliers work together to modify payment terms flexibly. This system employs flexible payment lengths, where the discount diminishes proportionally as the standard settlement time approaches. Buyers, suppliers, and supply chain finance (SCF) platforms are the primary stakeholders. Dynamic discounting (DD) can provide mutual advantages by allowing suppliers to effectively handle their available funds, decrease their day's sales outstanding (DSO), and expedite their cash conversion cycle (CCC). From the buyer's perspective, dynamic discounting (DD) can enhance supplier loyalty by enabling companies to make payments early, minimizing the need for a predetermined sales discount.

2.6.8.4 Payables financing: Reverse factoring (RF)

Reverse factoring (RF) allows a buyer to provide financial support to suppliers based on the purchaser's credit rating. The SCF solution is focused on the buyer and involves three main parties: a buyer, suppliers, and one or more financial service providers (FSPs). The FSP enters into a contractual agreement with the buyer. Reverse factoring (RF) can enhance a buyer's liquidity by allowing the company to extend its days payable outstanding (DPO) while enabling the supplier to receive early payment for its invoices, thus reducing its days sales outstanding (DSO). Enhancing supplier loyalty is possible. Approved invoices or payables can be funded or paid by one or more FSPs. The rationale for selecting a multi-FSP (Financial Service Provider) solution is to avoid reliance on a single financial institution and to expand access to a broader array of financing options that geographical limitations or unique product characteristics may restrict.

2.6.8.5 Payables financing: Securitization

Initially employed to finance self-liquidating assets like mortgages, securitization quickly evolved into a widespread financing method encompassing various assets with consistent cash flows. These assets include corporate and sovereign loans, consumer credit, project finance, trade receivables, and individualized lending agreements, collectively called asset-backed securities (ABS). Funding is obtained through the financial markets using a securitization strategy. This enables firms to circumvent the need for bank loans, capital injections, or the direct issuance of bonds for their overall funding. Instead, credit can be extended through equity- or bond-like market mechanisms, relying on a single asset recorded on the balance sheet.

Within SCF (Supply Chain Finance), securitization has extended its reach to include bills, sometimes known as receivables, and, more broadly, all forms of working capital. The instrument employed is an irrevocable payment undertaking (IPU), a binding commitment by

a recognized corporate entity to make a predetermined payment on a specified date. Since receivables are generally the most significant individual asset category on the balance sheets of corporations, they are a prominent option for securitization. The assets intended for financing are commonly transferred to a special purpose vehicle (SPV), an independent fund explicitly established to retain the invoices as assets. The SPV subsequently offers these securities to individual and institutional investors in the capital market, typically packaged together based on similar maturity periods, risk levels, and with or without insurance coverage. Capital markets' price, transparency, and structure discipline should lead to the most optimal funding alternative for enterprises. Additionally, securitizing diminishes the particular capital exposure for the parties concerned, mitigates risks, and generates more streamlined prices with advantages for the entire trade community. With the rise of specialist FSPs with associated technology platforms, securitization financing can challenge a domain traditionally ruled by specialized banks and offer a more straightforward and flexible solution that suits all, including SMEs.

2.6.8.6 Payables financing: Account payables-based buyer leasing

AP leasing is a supply chain financing (SCF) method that prioritizes the buyer's needs. It involves the participation of a buyer, supplier, and lease business (sometimes a bank). AP-based buyer leasing seeks to decrease the initial capital expenditure needed for significant assets, typically industrial equipment, and can potentially permit "pay by use" agreements. The benefit lies in that the purchaser can promptly utilize the investment, expecting to generate profits to cover its cost. The payment may experience a delay and be divided into installments, allowing for the optimization of liquidity and cash flow. From the suppliers' perspective, financing can result in higher and earlier sales and prompt payment of accounts receivable by the financial service provider (FSP), hence minimizing the days sales outstanding (DSO).

2.6.8.7 Receivables financing: Collective invoices

Utilizing group invoicing for frequent deliveries to a buyer effectively minimizes the number of invoices and financial transactions, reducing associated administrative expenses and external transaction fees. Both buyers and suppliers must mutually agree and actively participate in modifying the procedures for placing orders, consolidating the purchases, and settling the invoices for all the deliveries within a specified timeframe.

If the agreement is for monthly billing and the goods that would have typically been delivered and invoiced at the beginning of the period are delayed, invoices will be postponed by a maximum of 30 days. The value will persist as inventory on the supplier's balance sheet until the invoice is issued; at this point, it will be recognized as accounts receivable. The buyer's balance sheet and accounts payable will be affected by matching and timing issues. Ultimately, the supplier's exposure to the risk of buyer insolvency may escalate due to reduced payment intervals. Due to the above reasons, this method is typically utilized for items of lesser value and among organizations with a well-established trade record.

2.6.8.8 Receivables financing: Sales offer financing (SOF)

Sales offer financing (SOF) solutions assist suppliers in accomplishing two primary objectives: stimulating product sales and providing customers with enhanced financial flexibility to facilitate their purchase. A provider can extend the repayment period or divide the total amount due into smaller installments. SOF refers to a supplier-centric Supply Chain Finance (SCF) solution that involves three primary participants: the supplier, one or more customers, and maybe a Financial Service Provider (FSP). Internally, the supplier is responsible for providing the funding, while externally, the company depends on a Financial Service Provider (FSP).

Extending the payment time might benefit suppliers by increasing the net price of the product. Extending a longer payment period may eliminate the need for suppliers to offer sales discounts to clinch the sale. Utilizing a Financial Service Provider (FSP) enables the supplier

to enhance their Working Capital Management (WCM) compared to an internally funded Sales order Financing (SOF) approach. The risk profile of the sale is altered as the possibility of default might persist over a more extended duration. Buyers can achieve a more consistent cash flow by utilizing Sales Order Financing (SOF) solutions since expenses can be spread out over a longer period. Extending the average days payable outstanding (DPO) can improve the buyer's working capital management (WCM).

2.6.8.9 Receivables financing: Invoice discounting (ID)

Invoice discounting (ID) often involves a supplier providing a discount to a buyer in exchange for prompt payment. For instance, if the usual payment term is 30 days, the customer can make payment within ten days and receive a 2 percent discount. This is an instance of self-financed supply chain finance (SCF). Suppliers can get funds in advance by selling their rights to outstanding receivables (AR) to a Financial Service Provider (FSP). Contrary to conventional factoring, receivables are not transferred to the Financial Service Provider (FSP) but are utilized simply as collateral to secure liquidity. The FSP acquires the rights to the remaining debt and offers financing upfront, based on a predetermined percentage of the total value. This financing includes a prearranged security margin agreed upon by the seller and the FSP. It is crucial to emphasize that the supplier retains control of the AR. The contract is a supplier-centric Supply Chain Finance (SCF) arrangement involving only the supplier and the Financial Service Provider (FSP).

The ID is typically employed to finance a component of a company's accounts receivable rather than individual invoices. The predetermined maximum amount is contingent upon many risk parameters and remains constant throughout the mandate, determined by the FSP's evaluation of the overall creditworthiness. The agreement typically incorporates a recourse claim on the supplier's additional assets. Consequently, the supplier remains responsible for the credit risk and must repay the Financial Service Provider (FSP) regardless of the buyer's ability to settle

their debt. Implementing an identification system allows a company to manage its working capital efficiently by ensuring that payments for receivables are made promptly and reducing the supplier's days sales outstanding (DSO). Since the FSP typically possesses recourse rights over the supplier, this instrument is ineffective in mitigating a company's risk exposure. Software platforms enable enterprises to easily access liquidity and streamline the payment process while mitigating risk for financial service providers by enhancing transparency.

2.6.8.10 Receivables financing: Invoice factoring (IF)

In invoice financing, a supplier transfers total ownership of invoice(s) to a financial service provider (FSP), which is different from invoice discounting (ID). Supplier-centric supply chain finance (SCF) often entails a contractual arrangement between a supplier and a financial service provider (FSP), sometimes referred to as a factor. This arrangement is similar to invoice discounting (ID) and covers entire portions of the supplier's accounts receivable (AR). The buyer often does not have a direct role in the contract but is generally aware of the factoring arrangement as they are responsible for making payment to the FSP instead of the supplier when it is due. The supplier is granted a reduced payment in advance, which is the outstanding amount minus the factoring fee. Through the sale, the FSP acquires ownership of the claims and assumes the responsibility of maintaining and collecting the remaining balance from the customer. Therefore, professional firms typically focus on the market for collecting outstanding debts and catering to a wide range of clients. Factoring provides suppliers with three primary benefits: optimizing working capital (WC), protecting against buyer default, and delegating collecting receivables.

Factoring enhances liquidity and facilitates the optimization of working capital. The financial institution expedites the payment of unpaid bills in return for a discount, reducing the time it takes to convert cash and decreasing the number of days it takes to collect sales revenue. The supplier only participates in invoice financing if the discount offered is lower than the cost

of alternative loan sources. The FSP assesses the likelihood of the customer base, which is usually larger and financially stable, defaulting on their payments. Based on this assessment, the discount rate can be more favorable than the supplier's weighted average cost of capital (WACC).

Moreover, the FSP, in its typical state, lacks any means to seek compensation from the supplier. Hence, the factoring solution reduces risk as it is safeguarded against buyers' payment default or delay.

Companies that utilize factoring for a substantial amount of their bills can reduce their selling, general, and administrative (SG&A) expenses by outsourcing cash collection processes. The FSP can handle supplier accounting and assess creditworthiness.

2.6.8.11 Receivables financing: Invoice securitization (IS)

Led by the supplier, invoice securitization (IS) enhances the liquidity of supplier-led invoice financing by packaging and selling accounts receivable on the capital market instead of to a single financial service provider. Nevertheless, to ensure that the potential is substantial and appealing to foreign investors, the quantities acquired typically surpass US$100 million, necessitating a significant accumulation of invoices from a solitary provider.

2.6.8.12 Receivables financing: Supplier-led leasing

Supplier-led or 'vendor' leasing refers to a strategy employed by suppliers of capital-intensive items, incentivizing sales by allowing consumers to finance their purchases through a lease agreement rather than making a one-time payment. The outcome is akin to buyer-led leasing, with the primary distinction being that the supplier suggests and enables the agreement. The finance can be sourced from either the supplier directly or through a leasing business, often known as a financial service provider (FSP). Several prominent multinational machinery corporations have established specialized units or departments overseeing leasing services.

2.6.8.13 Inventory Financing

Inventory financing is a supply chain finance (SCF) solution that may be categorized in three ways, each aligned with the buying company's balance sheet priorities.

Inventory can be funded by **collaborative** means among the supply chain participants (SC). In this "inside network internal financing" strategy, the financially most robust party, known as the focal company, with the lowest weighted average cost of capital (WACC), provides funding for the inventory of its supply chain partners. Collaborative inventory management can be achieved by working with suppliers in the inbound supply chain or with customers in the outbound supply chain.

Off-balance sheet inventory financing involves utilizing a third-party institution as an interim owner to facilitate the financing process. In the context of external finance from sources outside the network, logistic service providers (LSPs) can provide that role. The accounting approach is a crucial concern for off-balance sheet solutions.

Companies can finance their inventory through secured credit transactions without surrendering economic ownership to third parties, known as **on-balance sheet** inventory financing. This strategy, known as "inside network external financing," can be utilized to finance either the company's inventory or that of its customers or suppliers.

2.6.8.14 Inventory financing: Collaborative inventory management

Supply chain participants strive to minimize the overall inventory and costs associated with capital locked in by optimizing inventory and transferring working capital to the business with the most favorable financing costs. The analysis relies on the conceptual framework proposed by Hofmann & Kotzab (2010), which suggests that adopting a collaborative working capital management (WCM) strategy can yield advantages for the different entities within a supply chain (SC). The theory acknowledges that assessing the cash conversion cycle (CCC) and its constituent parts in terms of time, often measured in days, is inadequate as the durations also

need to be assigned a monetary value. The weighted average cost of capital (WACC) is suggested as an appropriate measure for valuing these ranges. The assessment of the time invested in inventory indicates that a company with a higher cost of capital incurs more significant expenses for an equally lengthy cash-to-cash cycle (C2C) than a company with a lower cost of capital.

2.6.8.15 Inventory financing: Off-balance sheet inventory financing

Off-balance sheet inventory financing involves transferring operating goods and logistics ownership and responsibility to an external third party while obtaining inventories' financing. Typically, in off-balance sheet inventory financing arrangements, the primary participants include a purchaser, a supplier, and a logistics service provider (LSP). Depending on the contractual framework, a financial service provider (FSP) may also be involved. Typically, the solution is utilized for tradeable goods with a readily available value or completed products where a purchaser has already been found. Due to its lack of marketability, work-in-progress (WIP) inventory is not a viable option for off-balance sheet solutions. Off-balance sheet inventory solutions offer advantages to all parties involved in the transaction. The LSP can position itself as a comprehensive service provider to potential clients, expanding its variety of products to become a one-stop destination for all inventory-related services.

Furthermore, cultivating customer relationships is enhanced, leading to potential gains from further orders. Suppliers, however, can improve their liquidity by receiving payment early, reducing the days sales outstanding (DSO), and thereby shortening the cash conversion cycle (CCC). Moreover, including a purchase promise, typically a crucial agreement component, reduces the supplier's risk. The buyer gains significant advantages from this transaction, such as cost reduction resulting from decreased storage and logistical expenses. Furthermore, the buyer will see a substantial liquidity increase by reducing the amount of cash locked in inventory. The reduction in the days of inventory outstanding (DIO) results in a corresponding

decrease in cash to cash (C2C), leading to the optimization of working capital (WC).

2.6.8.16 Inventory financing: On-balance sheet inventory financing

The objective is to produce cash using a secured loan backed by the company's inventory. Unlike the off-balance sheet option, inventories are retained on the buyer's balance sheet and solely function as collateral for a loan agreement. Typically, it is employed for marketable commodities or finished goods already assigned to a customer. The key participants in the transaction consist of the borrower, a financial service provider (FSP), a third-party warehouse or logistics provider, and a collateral management company that serves as the custodial entity to verify the value of products and offer storage facilities. The primary benefit for the supplier in this situation is readily apparent, as the company can improve its liquidity position by utilizing collateral on its balance sheet. The main risks involve the timely sale of inventory to repay the outstanding loan and any quality or damage issues that could reduce the value of the inventory, hence decreasing the collateral amount. Nevertheless, these potential hazards might be alleviated by the utilization of inventory insurance. In the event of borrower insolvency or illiquidity, the FSP must be able to sell the inventory (collateral) at its projected market value.

2.7 Relevance of management theories for the study

The use of theory aids in selecting research questions and justifies their significance. Empirical results have meaning because of the underlying theory. Estimating the causal relationships between independent and dependent variables throughout data collection is another benefit of theory. Theory compels us to apply logical thinking and go deeper into the explanation. Empirical research without theory risks becoming a process of doing many experiments and models and reporting any statistically significant findings (Haveman et al., 2019). Theory can affect the development of results because it permits generalization from specific examples. With a theoretical understanding, academics and practitioners can realize their full potential.

2.7.1 Overview of Agency Theory

According to the literature, the risk-sharing dilemma occurs when cooperating parties have divergent views on risk. Agency theory specifically addresses the standard agency relationship, wherein a party (the principal) assigns tasks to another (the agent), who then completes them. In general, interactions that resemble the fundamental agency structure of a principal and an agent who behave cooperatively but have different objectives and attitudes toward risk fall under the purview of agency theory (Eisenhardt, 1989). A generic theory of the principal-agent relationship, which can be applied to buyer-supplier, employer-employee, lawyer-client, and other agency interactions, is the focus of principal-agent researchers.

The following factors increase the likelihood of agent opportunism:

(a) a high degree of goal conflict between principals and agents (e.g., owners and managers, managers and professionals, suppliers and buyers);

(b) a sufficient degree of outcome uncertainty to activate the theory's risk implications (e.g., new products, young, small businesses, industries that have recently undergone deregulation); and

(c) jobs that aren't programmed or team-based make it challenging to judge behaviors.

Agency theory is instrumental when dealing with challenging contracting issues. The positivist stream has focused chiefly on explaining the governing systems that address the agency problem from a theoretical standpoint. The positivist stream's identified governance mechanisms are encapsulated in two statements.

Outcome-based contracts help prevent agent opportunism. Because both parties receive payment for the same behaviors, it is said that these contracts increase the similarity between the goals of principals and agents. This indicates that both the principal and agent have fewer conflicts of interest.

Information systems also prevent agent opportunism (Sternberg et al., 2023). The claim is that

information systems discourage agent opportunism because they make the agent aware that they cannot deceive the principal and instead let them know what the agent is truly doing.

2.7.2 Overview of Bounded Rationality

Given the incredibly intricate nature of the decision-making processes that businesses and customers must complete, optimization goes beyond human cognitive capacities. Rationality is subject to cognitive constraints imposed by human computing and reasoning ability. The division of cognition and decision-making is the cause of rationality's motivational bounds (Selten, 1990). A three-level theory of decision-making is proposed in the chain store paradox study. This hypothesis proposes three possible mental processes that could lead to distinct decisions. The three procedures function at various levels: 1. The habitual level; 2. The imaginative level; and 3. The logical level. The decision emergence perspective is a related theory of boundedly rational decisions. The decision-emergence approach holds that conscious deliberation examines the benefits and drawbacks of several options without always leading to a definitive suggestion.

2.7.3 Overview of Contingency Theory

According to the situational approach, the best management strategy or concept is contingent upon the circumstances at any given moment (Luthans & Stewart, 1977a). One way to conceptualize the situational approach is open systems thinking, while the universalist approach is closer to closed systems thinking. There is a conceptual difference between universalist and situational methods. The universalist/closed-system conceptions are more straightforward to use in practice while ignoring situational factors that may be important but difficult. The situational method adopts a more conceptually realistic and complicated open systems perspective, making practical implementation more challenging. Put differently, the situational approach sacrifices practical application to obtain higher conceptual validity, which is best achieved with a contingency approach.

The process of determining and creating valuable connections between management, performance, and environmental variables is known as the contingency approach (Hofer, 1975). A solid organizational structure is a prerequisite for developing a broad contingency theory of management. The social system's participants define the aims and objectives in light of pertinent resource and environmental constraints. The impact of environmental factors will grow in importance for efficient management as the rate of change and the corresponding level of complexity continue to rise. A contingency strategy for management should be more crucial due to the growing environmental effect. This definition highlights several significant concepts critical to creating an all-encompassing contingency theory of management.

The contingency strategy consists of two main steps, which are:

1. The first step involves categorizing the variables and combinations of variables that will significantly impact the content of business strategies and defining the critical values for each variable from a strategic standpoint.
2. The second step is finding the kinds of solutions that are commercially viable for every unique combination of strategically important environmental circumstances.

At the very least, by enhancing the strategic decisions these organizations make, contingency should assist in raising the productivity of both large and small firms (Danese, 2011). Naturally, this would have a direct positive impact on society's total output.

2.7.4 Real Options Theory

Myers (1977) first used the phrase "real option" to describe the idea that businesses can be thought of as a combination of real assets and real options, which are defined as "opportunities to purchase real assets on possibly favorable terms." According to real-option logic, businesses might postpone investing or make a tiny investment while making decisions under uncertain circumstances. By doing so, they can minimize downside risk by obtaining the ability to profit from prospective future opportunities while minimizing current financial obligations.

Real-option logic aims to aid managers in making more informed decisions when confronted with uncertainty. Real options reasoning considers the manager's capacity to modify future investments to reduce potential losses and control uncertainty. Businesses may opt for a "wait and see" or "invest and see" approach when confronted with uncertainty, as real options logic suggests. When managers adopt a "wait and see" approach, they initially delay investing until deciding whether to proceed immediately, abandon it, or continue waiting. When a corporation embraces an "invest and see" approach, it implies that it will initially make a little investment and then decide whether to raise it, discontinue it, or continue waiting (Ipsmiller et al., 2019). Management researchers are excited about real-option logic as they feel it will improve performance. Academics have analyzed this problem connected to performance from three separate viewpoints. One aspect of this research examines the worth of the options that a company may get or retain. These studies indicate that having a collection of real options or making investment decisions based on tangible opportunities enhances a company's total worth. The second viewpoint centers on the financial ramifications (corporate performance) of implementing a real option choice, while the third section delves into individual performance.

2.7.5 Overview of Resource-Based View of the firm (RBV)

Resources and products are two sides of the same coin for the company. While most formal economic tools operate on the product-market side, the traditional idea of strategy is expressed in terms of the firm's resource position (strengths and weaknesses). Anything considered a firm's strength or weakness is referred to as a resource. Formally speaking, assets semi-permanently linked to a corporation, both tangible and intangible, could be considered its resources at any one time (Wernerfelt, 1984). A resource's overall attractiveness—defined as its ability to sustain a resource position barrier—is merely a prerequisite for a particular firm's interest in it; it is not a sufficient one. Firms will suffer if they choose their battles poorly and everyone chases after the potentially lucrative resources, leaving only a select few able to

win each. Diversified companies' growth prospects can be viewed differently as portfolios of resources instead of products. Although the two frameworks may point to different growth paths, optimal management of a resource portfolio and optimal management of a product portfolio are equivalent in theory.

2.7.6 Overview of Resource Dependency Theory (RDT)

Understanding an organization's ecology, or the context in which its conduct occurs, is essential to comprehending its behavior. Although practitioners are limited by their setting, they can take action to lessen environmental dependence and uncertainty according to resource dependency theory (RDT). RDT acknowledges the impact of external factors on organizational behavior. The idea of power, or control over essential resources, lies at the center of these activities. Organizations frequently try to increase their influence over others while also seeking to lessen the power that others have over them (Hillman et al., 2009).

The resource dependence perspective and inter-organizational relations essentially argue that: 1) organizations are the fundamental units for comprehending intercorporate relations and society; 2) these organizations are not autonomous but rather are confined by a network of interdependencies with other organizations; 3) interdependence, when combined with uncertainty about the actions of those with whom the organizations are interdependent, creates an environment in which survival and continued success are uncertain; 4) as a result, organizations take steps to manage external interdependencies, although these steps are bound to be partially unsuccessful and result in new patterns of dependence and interdependence; and 5) these patterns of dependence produce inter-organizational relations.

The RDT viewpoint on inter-organizational interactions investigates how establishing such links aids in an organization's acquisition of resources to lessen interdependence and uncertainty. Multi-network inter-organizational dependencies exist. This shifts the reliance on resources from local to "multiplex" dependency. Organizations can use a network of inter-

organizational links to obtain resources and power.

If there are several significant dependencies, RDT has not indicated which are more critical than the others. Increased understanding of managing dependencies and the appropriate tactics would result from combining RDT's knowledge of the multiplexity of dependencies with theoretical insights regarding stakeholder relevance. A critical conceptual role in the evolution of theory providing direction for strategic decision-making in the face of uncertainty is played by real options theory.

2.7.7 Overview of Stakeholder Theory

The stakeholder theory aims to explain and guide the existing corporation's organizational structure and methods. In pursuit of this goal, it sees the company as an organizational structure that serves as a vehicle for a wide range of individuals to achieve various objectives that could be more perfectly aligned (Donaldson & Preston, 1995). Stakeholder theory adopts a more complex perspective, acknowledging that economic connections have cooperative and competitive aspects. Managers must reevaluate how to handle these semi-competitive or semi-cooperative interactions as cooperation becomes increasingly crucial with players previously believed to be beyond the firm's bounds. One important source of long-term competitive advantage is a sustainable stakeholder relationship. Numerous research studies on stakeholder management have demonstrated that meeting the requirements of a firm's stakeholders enhances that performance.

Stakeholder theory and the resource-based view (RBV) reconciliation provide a viable way to advance our knowledge of strategic management. It offers management researchers and practitioners a two-part guidance (Freeman et al., 2021). Building long-lasting connections with stakeholders is critical for three reasons: first, they make it possible for a company to operate; second, they are essential to the company's survival and development; and third, it is just morally correct. The firm's resource-based perspective is a robust framework for creating

long-lasting stakeholder relationships and assisting a firm in succeeding.

2.7.8 Overview of Transaction Cost Economics (TCE)

Governance is the overarching concept, and transaction cost economics is how to breathe operational content into governance and organization. "The three principles of conflict, mutuality, and order must be inherent in the ultimate unit of activity." A transaction is this unit." Since governance establishes order so there is less conflict and more mutual gain, the common triple of conflict, mutuality, and order is comparable to the governance concept employed here (Williamson, 1979). Moreover, the transaction serves as the fundamental analytical unit. The essential dimensions of transactions for minimizing transaction costs are their complexity, the distinctiveness of the asset, and the disruptions they are vulnerable to. The three aspects of transactions that have been most useful in helping to comprehend the regulation of contractual relationships.

Three features of digitally-mediated transactions are highlighted as we look at the role of TCE in the digital economy: (1) reputation mechanisms that help parties to a transaction overcome asymmetric information; (2) the amount of private or personally identifiable information that is communicated either before or during the transaction; and (3) the possibility of a digitally mediated transaction being non-pecuniary (i.e., free).

The transaction becomes more complex as assets become more specialist and challenging to redeploy. The rationale for this is that participants in market-based transactions could act opportunistically and exploit their trade partners to divide up rent resulting from the transaction's intricate and specialized nature (Nagle et al., 2020).

All other things being equal, vertical integration becomes more likely as asset specificity and transaction complexity rise. Additionally, the transaction is considerably more likely to be structured inside the company when asset specificity and a high level of uncertainty are combined. Physical, human, site, and temporal specificity are just a few examples of the various

forms that asset specificity can take.

In many situations, electronically mediated transactions also entail the transfer of personal data between the buyer and the seller in addition to the money exchange. Digital traces are left behind by these digitally mediated transactions, including information about the purchase price, the time of day, the payment method, and the prices of other items that are also up for grabs. This creates a record that can be helpful to both the buyer and the seller, potentially lowering interpretive uncertainty.

The core tenet of TCE theory is transactions, which contends that how transactions are organized affects how economic activity is collected and how a firm is defined. That being said, more and more transactions are going digital. Transactions that used to be expensive in the real world are frequently provided for free or almost free in the digital world. Due to the prevalence of digitally mediated transactions and the availability of digital trail information about the parties involved, each party can establish a reputation, easing some of the worries associated with asymmetric information.

Although there are a few other well-known management theories, the ones covered above are relevant to our study. Table 2.3 below summarizes the key aspects of the theory and how they specifically relate to our research.

Table 2.3 Theory applicability to our research

Theory	Summary of the theory	Applicability to current research
Agency theory	1. Different goals 2. Conflicts of self-interest between principal and agent 3. Information asymmetry is linked to the power of lower-order participants	1. The essence of agency theory is in the inherent conflict of goals that arises when individuals with divergent desires collaborate. 2. Firm-centric profitability approaches, power-based relationships

		3. Challenging credit environment for smaller players
Bounded rationality	1. Human capabilities of computation and cogitation impose cognitive limits on rationality.	1. It is challenging to decide the best course of action and variable interaction effects, which are situational and firm-specific.
Contingency theory	1. The most effective management concept or technique depends on the circumstances at a particular time. 2. The contingency approach recognizes and cultivates functional connections among environmental, management, and performance variables. 3. Identify and categorize the factors and groups of variables that will substantially impact the content of business plans. Determine the strategic importance of each of these variables and indicate their respective values. 4. Determine the economically viable options for each distinct set of strategically critical environmental variables. 5. Contingency may enhance the efficiency of both large and small enterprises by optimizing the strategic decisions these organizations make.	1. Moderation by class of firms 2. Basis for the research constructs 3. The basis for the selection of the Operational variables 4. Design of Experiments (DoE) outcomes 5. Design of Experiments (DoE) outcomes
Resource based View (RBV)	1. If everyone goes for the potentially attractive resources and only a few can 'win' in each	1. Absence of shared vision and Value chain risks
Resource dependency theory (RDT)	1. It is essential to grasp the circumstances in which that conduct occurs to comprehend the conduct of an organization.	1. Moderation by class of firms 2. Moderation by class of firms and power-based relationships

	2. Organizations strive to diminish the influence that others have over resources, frequently aiming to enhance their control over others. 3. The concept of RDT recognizes the mutual influence between organizations and their environment as a factor that contributes to the success of a corporation.	3. Four (Comprehensive) construct finalization
Real options theory	1. Real options pertain to the strategic alternatives accessible to an organization that has the potential to influence its future profitability and worth. The theory is essential for advancing knowledge since it offers a structured framework that aids in making strategic judgments in situations that lack clarity.	1. Design of Experiments (DoE) application when multiple dependencies/needs exist
Stakeholder theory	1. Organizations have stakeholders. 2. An instrumental approach is essentially hypothetical; it says, in effect, "If you want to achieve (avoid) results X, Y, or Z, then adopt (don't adopt) principles and practices A, B, or C."	1. Need for a shared vision. 2. Link to Design of Experiments (DoE) Rationale
Stakeholder theory and RBV	1. Extensive studies on stakeholder management have consistently demonstrated that a firm's performance is enhanced when it actively addresses the requirements and concerns of its stakeholders. 2. Stakeholder theory adopts a more sophisticated perspective, acknowledging the presence of both collaborative and adversarial aspects in economic interactions.	1. Value chain-based relationships 2. Value chain-based relationships

Transaction cost economics (TCE)	1. The ultimate unit of activity must contain the three principles of conflict, mutuality, and order. In that, governance is the means to infuse order, thereby mitigating conflict and realizing mutual gain. 2. Critical dimensions of transactions are complexity, the condition of asset specificity, and the disturbances to which a transaction is subject. 3. The regularity of digitally facilitated transactions and the availability of digital records on the parties involved establish reputations for each party. This, in turn, helps to address the concerns arising from unequal access to information. 4. The ability for a digitally mediated transaction to be non-pecuniary (i.e., free)	1. Do the transactions ensure mutual gain in a firm-centric environment? 2. Credit environment, Plant Property Equipment (PPE), MSME aspects 3. Enablers for SCF adoption 4. Combat the challenges of SCF adoption

2.8 Problem statement

Businesses do not operate in isolation. Multiple stakeholders support and influence them in a variety of ways. Businesses need easy access to capital to maintain an uninterrupted operating cycle. Working capital is essential for the efficient operation of a company. Trade credit has traditionally been one of the most prevalent forms of external financing for meeting working capital requirements (Peterson & Rajan, 1997). In a capital-constrained environment, it is difficult for supply chain counterparties to extend trade credit, which can result in financial disruptions. After the 2008 financial crisis, liquidity availability became a challenge, which resurfaced after the global impact of COVID-19. The market's liquidity crunch severely affects smaller enterprises. It is now a question of business survival or continuity for most of them.

With vast global supply chains comes the possibility of disruptions.

Recent experiences (2021) of global supply chain disruptions (Suez Canal Chaos and Challenges in Supply Chains of Medical Devices) and changing demographic compositions indicate a tendency to develop regional clusters to meet expected demand with minimal disruptions. Increased regional activity levels necessitate the importance of regional supply chains. This enhanced role for regional supply chains requires more significant involvement from the region's firms. India is presently in a crucial stage of national development. It is time to expand the role of regional firms in nation-building activities, considering geopolitical conditions and the Make in India initiative.

India is a vast nation with a substantial domestic market. There are approximately 63 million micro, small, and medium-sized enterprises (MSMEs) in India, of which 2.5 million have registered on the Government of India portal (https://udyamregistration.gov.in). Approximately 88% of registered MSMEs operate in the micro-segment and require a robust fiscal stimulus with concessional working capital loans (Government of India, 2021) to maintain business operations. Improved MSME performance contributes to increased productivity levels in India. Productivity growth enhancements increase national output, directly translating to a higher GDP. This increased productivity instantly affects rising exports (Mukherji & Pandey, 2014), reducing trade deficits. Given their position (extremely upstream) in the supply chain networks, MSMEs' cash conversion cycles (CCC) are highly vulnerable. The combination of liquidity-constrained MSMEs and high cash conversion cycle days is a natural formula for the source of financial risk in the supply chain, which ultimately significantly impacts shareholder wealth.

Supply Chain Finance (SCF) is a concept designed to assist in meeting the working capital needs of otherwise credit-starved firms in a more collaborative setting within the boundaries of operating partners. Understanding the roadblocks and delineating the guiding principles for

greater SCF adoption for the Indian auto industry are current topics of discussion.

2.9 Summary of research gaps

Supply Chain Finance is a vast subject with many research implications. Based on the review of the existing literature, the author identified the following research gaps:

- The European region conducts most of the supply chain finance research, followed by the United States and China. Very few studies were conducted on Indian geography.
- Previous research has focused on lending methods (transactional and relationship-based) and supply chain finance instruments (trade credit, factoring, and reverse factoring, to mention a few). However, the level of awareness and adoption of the Indian enterprises regarding SCF solution options needs further attention. It becomes significant when viewed from the perspective of a developing economy (such as India).
- In previous research, much emphasis was laid on dyadic (supplier-buyer) and triadic (supplier-buyer-lender). A gap exists in exploring the interdependent (cumulative) effects of influencing variables on firm performance in an SCF environment.
- Very few studies have been conducted to evaluate the comprehensive benefit of the complete supply chain network (including various classes of firms). These studies will instill confidence in the supply chain community and promote the widespread adoption of SCF.
- Numerous studies focused on the impact of the cash conversion cycle (as a proxy) to evaluate supply chain finance adoption. However, there is a deficiency in assessing the effects of the components of liquidity management and their connection to the firm's overall value creation.
- Numerous studies have been conducted to comprehend the influence of supply chain risk on firm performance. More evaluation of the impact of SCF adoption levels on supply chain risks and performance volatility needs to be done.

As a part of the current research, we are addressing the following gaps:

- Gaps related to extending the coverage of the influencing on the profitability beyond working capital areas only
- Gaps concerning this specific area of research for the Indian context of the auto industry
- Gaps related to extending the research beyond dyadic or triadic relationships and include various classes of Indian auto firms.
- Gaps related to the comprehensive benefit estimation for the value chain participants due to SCF adoption

2.10 Research aims and objectives

The present research seeks to examine the current state of supply chain finance in the Indian auto industry, as well as the effect of its adoption on the profitability of auto value chain enterprises.

The objectives are described as follows:

1. To understand the **influence of significant variables on the enterprise profitability** for various classes of Indian auto firms.
2. To systematically analyze the **significant variables' effects and their corresponding levels** on profitability improvement for various classes of Indian auto firms in an SCF environment
3. To assess the **financial and operational impact** of sharing supply chain surplus within the network with greater adoption of SCF for the Indian auto industry.

The relationship mapping between the research gaps and objectives is enclosed in Figure 2.4 below.

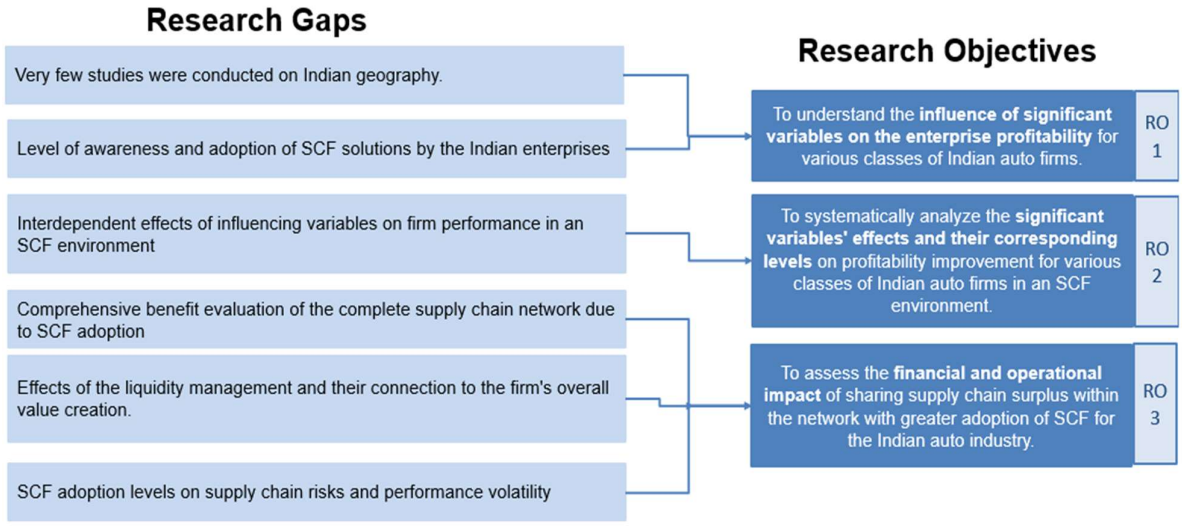

Figure 2. 4 Relationship between research gaps and objectives

The research questions and accompanying hypotheses for the finalized objectives are included in chapters 5, 6, and 7, respectively.

2.11 Scope of the research

The automobile industry is one of the most significant contributors to India's economic development and is highly integrated into global value chains. This sector's development received substantial government support, which allowed it to carve out a niche among India's manufacturing industries. Manufacturers are catching up on modernization, digitization, and automation to meet customers' future needs (such as electric vehicles) and remain ahead of the competition (Miglani, 2019).

Historically, the automobile manufacturing industry in India has been vertically integrated. After Maruti began operations in 1983, the subcontracting of components from component suppliers flourished. Consequently, the automotive industry's value chain began to accommodate component suppliers. The number of suppliers increased during the 1980s and 1990s but declined in the 2000s (Uchikawa, 2011). Dash & Chanda (2020) outline the dominance of small and medium enterprises in India's automotive industry. India is a formidable player in the component manufacturing industry, but it confronts stiff competition

from its Asian rivals. The author also described the impact of the industry's constraints in terms of scale, low levels of investment, poor research and development, and mediocre technology on the global performance of the Indian industry.

In light of the preceding discussion, the scope of this study is restricted to the Indian automotive industry. The study encompassed 280 firms spanning different sizes based on their revenues. These firms make up original equipment manufacturers (OEMs) and various tiers (tier-1, tier-2, etc) of automotive firms. While firms in other sectors play a similarly important role in nation-building, this is not the focus of our current investigation. Additionally, the impact of SCF adoption on improving the sustainability practices of the Indian auto industry is left for the scope of future research.

2.12 Significance of the research

Researcher's point of view: This research will be a modest first step toward assessing the current state of SCF adoption among Indian auto firms and will also contribute to exploring the conflicting objectives of the SCF ecosystem players, which can be systematically addressed to increase SCF adoption. This is a first-of-its-kind empirical research for Indian auto firms and can be a foundation for further studies.

Industry's point of view: The research's findings will help practitioners comprehend the importance of focusing on the targeted areas based on firm size and striving to achieve the optimal levels of the contributing performance levers to achieve superior profitability.

Policymaker's point of view: These research findings assist policymakers in strengthening the economy by facilitating the effective adoption of supply chain finance. This has enormous potential to enhance domestic manufacturing capacity and considerably increase the manufacturing's contribution to India's gross domestic product.

Investor's point of view: Foreign direct investment (FDI) in India's automobile industry has been modest. Poor profitability levels and component players in unregistered spaces may

be contributing factors. With increased SCF adoption, business outcomes will inevitably improve. This can have a significant impact on investment in the Indian automobile industry.

Broader MSME community point of view: The author is confident that the effective adoption of supply chain finance will result in increased profitability and business sustainability. These results encourage the larger MSME community that is presently unregistered to register. Subsequently, a larger MSME community will reap the benefits of the structural and policy enhancements implemented by India's government.

Chapter 3: Research Design and Methodology

Preview: Section 3.1 provides a summary of the current research design. Sections 3.2 and 3.3 discuss the approach followed for developing the conceptual framework from the literature review. Section 3.4 summarizes the rationale behind the formulation of research constructs. Section 3.5 presents the linkages among the research objectives. Section 3.6 summarizes the data scoping and sources, followed by section 3.7, which discusses the data's validity and reliability. Section 3.8 summarizes the steps adopted to identify the variables for the research, followed by section 3.9, which summarizes the data variables considered for the research. Section 3.10 summarizes the data completeness assessment. Section 3.11 briefly summarizes the methodologies adopted to address the research objectives.

3.1 Research design

As part of the current research, the author identified the gaps in the existing literature and finalized the research objectives. The author constructed the conceptual framework as a compass for the remainder of the study. It was determined that the "organization" would serve as the unit of analysis for the study and identify credible data sources to investigate the research objectives. The crucial variables for evaluation were extracted and summarized from the data for descriptive inferences.

3.2 Conceptual framework

"A conceptual framework explains, either graphically or in narrative form, the main things to be studied—the key factors, variables, or constructs—and the presumed relationships among them" (Ravitch & Riggan, 2017). The conceptual framework serves as the work's overarching argument, explaining why it is worthwhile and how it should be accomplished. A literature review, which is a process of learning from the work of others, is used to construct and support the argument. Creating a conceptual framework helped the author to prioritize variables and selectively identify specific relationships within the research. Personal interests and goals,

identity and positionality, topical research, and theoretical frameworks all fall within this framework, with the literature review serving as the primary process through which all of these elements are forged into a compelling and convincing argument. Figure 3.1 shows the research activity flow, the components of which are discussed in the subsequent sections.

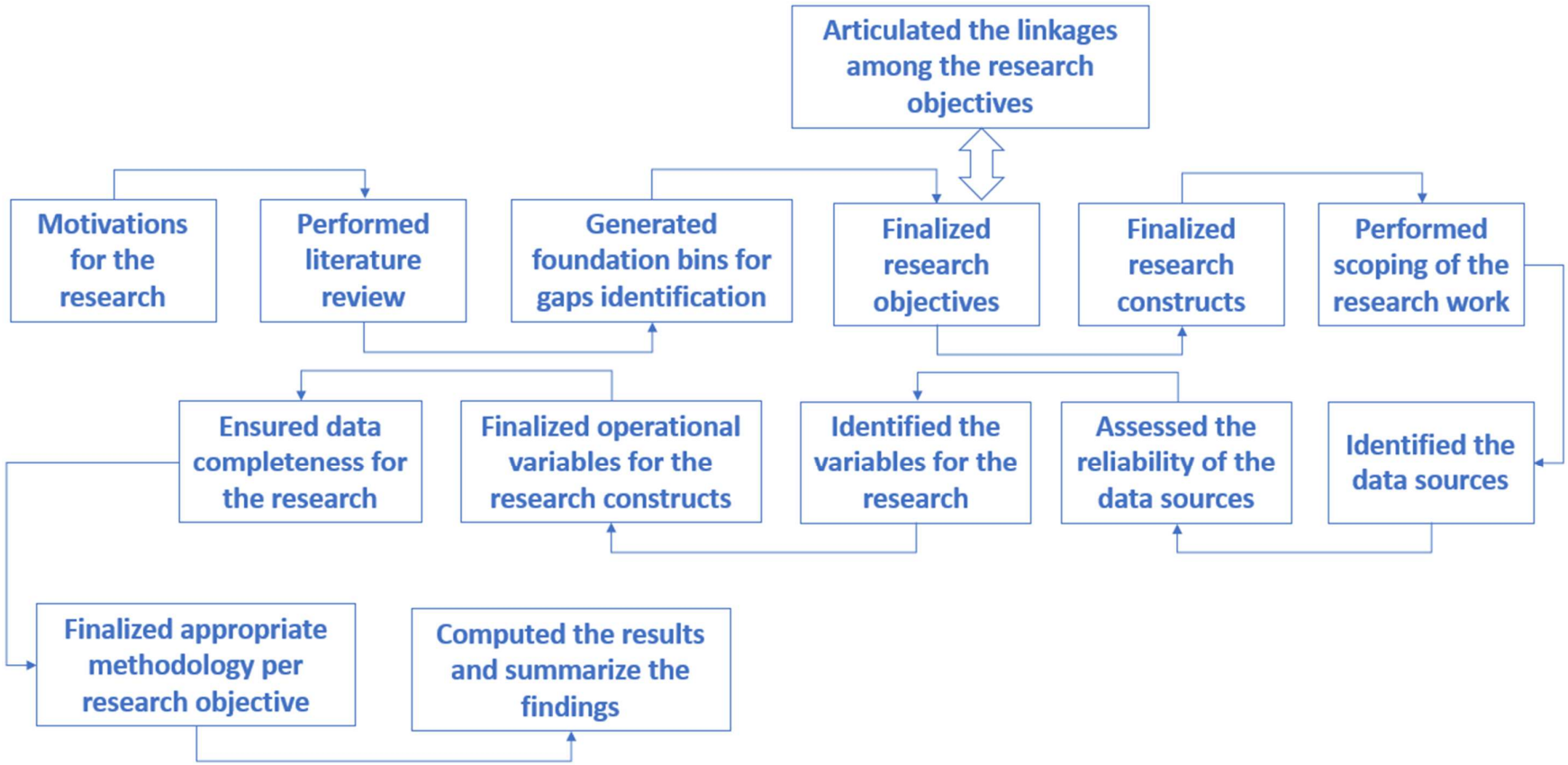

Figure 3. 1 Research activity flow diagram

3.3 Elements of conceptual framework

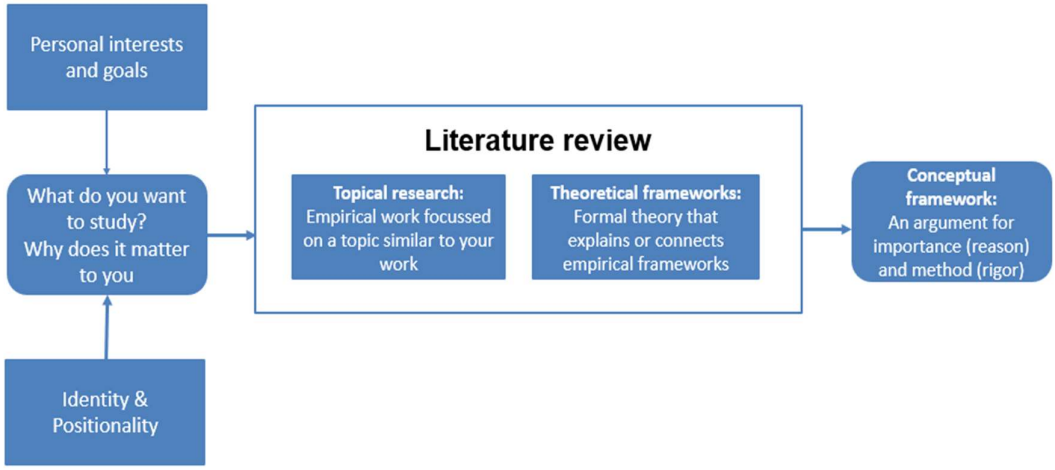

Figure 3. 2 Elements of the conceptual framework (Source: Ravitch & Riggan, 2017)

Figure 3.2 shows the elements of the conceptual framework. The researcher is motivated to ask questions and pursue knowledge by their pursuits. In the current study, the author's prior work experience in the auto industry, India's ambition to achieve carbon neutrality by 2070, and the decline of registered auto entities motivated him to investigate the reasons for the mass exits of firms from the industry. A thorough examination of the existing topical literature (journals, books, government policies, consulting reports, and case studies) enabled us to comprehend what had been accomplished in the past. Concise research of theoretical frameworks—formal theories and interrelationships between theories—aided the author in populating the bins, as represented in Figure 3.3, which served as the basis for the conceptual framework.

Figure 3. 3 Foundation bins for developing a conceptual framework

The foundation bins facilitated the formulation of "Why should the research be conducted?" and "How should it be conducted?" The author drew the following conclusions from their examination of the foundation bins concerning the research questions:

- Previous studies focused mainly on dyadic relationships in supply chains.
- The primary focus of historical studies has remained on working capital management.
- A limited set of variables is considered for analysis in the historical studies.
- There is little or no comprehensive evaluation of the profitability of the entire value chain.
- No work for the Indian context exists in the previous literature.

3.4 Finalization of research constructs

In addition to the extensive literature review, the framework is also supported by the work done by Christopher & Ryals (1999), who described the determinants of shareholder value as summarized in Figure 3.4. This allowed the author to depart from some of the prevalent approaches to understanding the factors that affect firms' profitability and value chains. For a

value chain to operate efficiently and profitably, all its participants must share a common vision and be profitable.

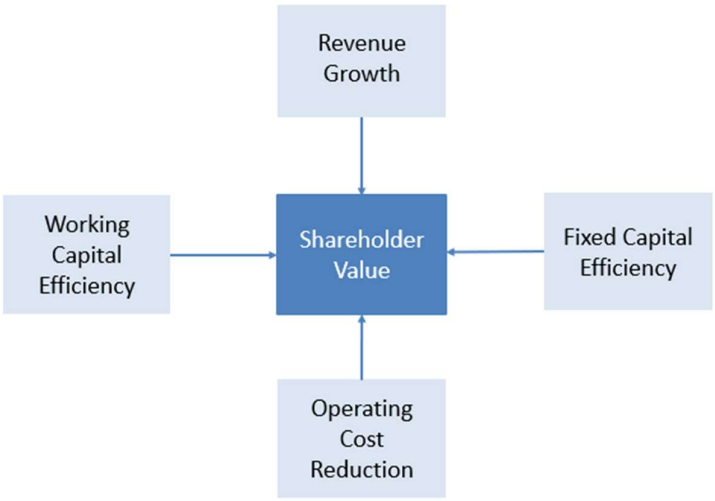

Figure 3. 4 Drivers of shareholder value (Source: Christopher & Ryals, 1999)

The author referred to the work done by Whetten (1989) to understand the building blocks of framework development:

What: What factors, variables, constructs, and concepts should be included in explaining the phenomena of interest? How can we guarantee the inclusion of the appropriate factors, considering both comprehensiveness (i.e., the inclusion of all significant aspects) and parsimony (i.e., the removal of those that contribute nothing to our understanding)?

How: After identifying appropriate factors, the subsequent inquiry is: How are the constructs related to the research objective? What is their relationship among them?

Why: What fundamental psychological, economic, or social dynamics support the choice of factors and the suggested cause-and-effect connections?

The primary goal of the investigation is to assess the state of Supply Chain Finance (SCF) for various classes of Indian Auto firms. An appropriate adoption of SCF creates a win-win scenario for all the players in the value chain and can potentially contribute to the chain's profitability levels. The natural choice of our research is to explore the influencers of the

profitability levels moderated by the Class (size) of the firm. Figure 3.5 summarizes the method of contextualizing the moderating effect of the Class of the firm in identifying the areas of influence leading to better performance indication.

Figure 3. 5 Contextualizing the concept of moderation to the research objective

The author finalized four broad constructs (Kerlinger, 2017) that represent the areas that influence the firm's profitability, with the firm Class as the moderating variable. Consideration is given to operational variables for the finalized constructs (Corporate Finance Institute, 2019). The author is confident that the operational variables served a dual purpose as metrics for performance evaluation and research objectives. Figure 3.6 summarizes the research construct.

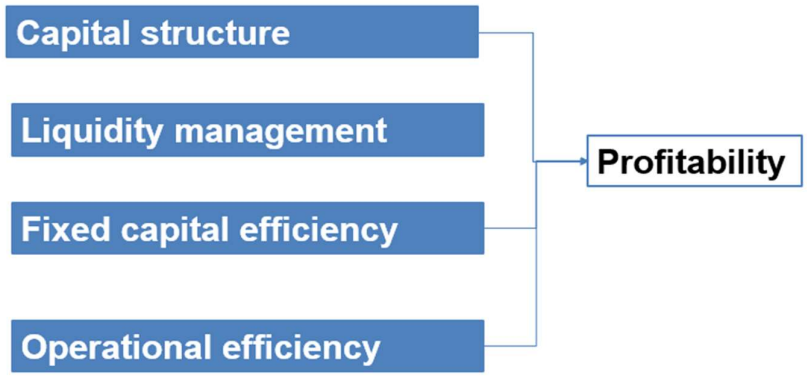

Figure 3. 6 List of influencing research constructs

3.5 Linkages among research objectives

The linkages among the research objectives are enclosed in Figure 3.7. In summary, the study's first objective was to identify significant variables by firm Class that influence profitability. Then, the author determined the degree of the factor effects and the optimal level of each factor

in the variables to attain the desired level of profitability by firm Class as part of the second research objective. Throughout the exercise, the significance of SCF has been emphasized to accomplish the desired levels of financial performance and a shared vision. As a result of achieving the final research objective, the author estimated the extensive benefits to the entire value chain from realizing a shared vision and adopting SCF at the appropriate levels.

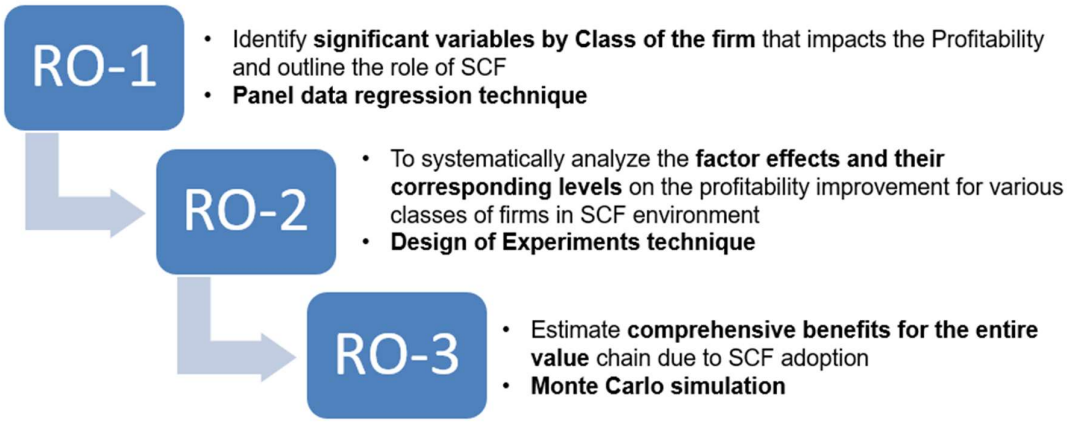

Figure 3. 7 Linkages among research objectives

3.6 Scoping and data sources

Figure 3.8 summarizes the scope of the research. The unit of analysis for our study is "organization." Therefore, the author collected and analyzed variables at the organizational level. The Indian automotive industry is considered to be the scope of our research. The author analyzed secondary data (financial reporting data) from the Centre for Monitoring the Indian Economy (CMIE, 2021). It is a prominent provider of business information. The CMIE has compiled the most comprehensive database (ProwessIQ) on the financial performance of companies enrolled with the Ministry of Corporate Affairs, Government of India. To date, thousand and ninety (1,090) automobile companies are registered with the Ministry of Corporate Affairs. The registration dates of these companies ranged from 1901 to 2020. The author used ten-year data from the ProwessIQ database (FY 2012–FY 2021) to comprehensively capture the present operating conditions. Of the 1,090 companies initially

considered, 311 reported consistent sales data for the entire data range (FY 2012–FY 2021), representing 30% of the total companies. However, based on reported average sales and reported average assets (property, plant, and equipment (PPE)), the size disparity among companies is immense. Hence, the author considered firms with a maximum revenue of INR 2,500 Crores to finalize the sample (280 companies) for the study.

Dimension	Description
Source	ProwessIQ database of Centre for Monitoring Indian Economy Pvt. Ltd (CMIE) for the secondary data (financial information)
Scope of the study	Automotive Industry of Indian Geography
Time period considered	2012-2021
Total firms for the study	280[1]
Class of firms	Based on revenue ranging from (1.73 CR INR to 2,500 Cr INR)
Control variables	Sales growth of the firm and GDP growth

Note:
1-Considered firms with a maximum revenue of INR 2,500 Crores

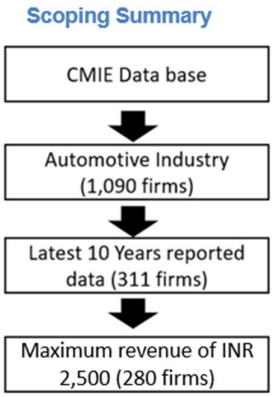

Figure 3. 8 Research scope summary

Using traditional financial reporting data in the current study offers three distinct advantages.

- India's government-approved standard accounting procedures are used to compile publicly accessible data.
- Data accuracy is ensured as enterprises submit information to the Government of India.
- Publicly available accounts and their associated terminology enable us to analyze and explain differences in the operating conditions of the companies using a common business language.

3.7 Data validity and reliability

The author assessed the internal validity threats to evaluate the study's validity (M. M. Mark & C. S. Reichardt, 2001).

History: The author gathered the information for all companies from the database they file at the end of each fiscal year. The author ensured the data before and after COVID-19 for the evaluation to rule out the possibility that COVID-19 affected the estimated effect sizes.

Maturation is the possibility that a company will undergo natural processes over time. As control variables, the sales growth of each company and the GDP development of the Indian economy are included in the evaluation.

Attrition refers to the potential loss of study participants. The author addressed this issue by assuring that each year's data contained a consistent sample size.

Instrumentation: When a change in a measuring instrument leads to an incorrect conclusion regarding the effects, instrumentation poses a validity threat. Such a situation is ruled out in this study, as the firms' financial reporting conforms to the applicable generally accepted accounting principles.

Selection refers to the potential for effect magnitude variations. The author addressed this problem by ensuring that distinct classes/groups of businesses are evaluated based on size. (revenue).

According to the preceding discussion, the author has comprehensively ruled out any threats to the internal validity of their study. The author believes this study's outcomes are externally valid because they are generalizable to a large degree.

3.8 Steps to identify the variables for the research

Identifying and characterizing variables is an essential and fundamental step in empirical research. Variables in a research study refer to the qualities or attributes that can vary and are subject to measurement. Table.3.1. provides the sequential procedures for identifying a set of variables in our research (Kerlinger, 2017):

Table 3.1 Steps to identify variables for the research

Criteria	Steps followed
Definition of the research problem	• Explicitly stated the research problem. • Delineated the primary emphasis of the research and the study's specific objectives.
Literature review	• Performed a comprehensive examination of the existing literature about the research subject. • Summarized the variables that have been previously identified and examined in the studies.
Hypotheses formulated for the study	• Formulated hypotheses or research questions based on the research objective and literature review. This guidance helped to identify variables.
Finalization of the independent and dependent variables	• Identified the independent variables - ones that are manipulated or controlled • Identified the dependent variables - ones that are assessed or observed as outcomes • Reviewed the literature, industry information, management consulting reports, and Governmental focus areas to finalize the appropriate variables.
Measurement of the variables' data	• Provided a precise and explicit explanation of the methods used to measure or change each variable. • Mentioned the techniques, devices, or procedures to gather data on each variable.
Selection of the control variables	• Considered potential confounding variables that could influence the association between the independent and dependent variables. • Accounted for these variables to help guarantee that extraneous causes do not influence the observed correlation.
Categorization of the variables	• Distinguished between various categories of variables, including categorical variables (nominal or ordinal) and continuous variables (interval or ratio). This is crucial for determining suitable statistical analyses.
Test and refine	• Performed a pilot test to detect potential concerns (Missing data, extreme values, etc). This step helped the author with the operationalization of variables. • Applied appropriate data imputation techniques to finalize the data set for the study.

3.9 Data variables considered for the research

Table.3.2. provides a list of the variables identified for assessing the research questions. The author has meticulously finalized the independent variables for the considered constructs. These variables are popular in the industry for measuring business performance. As these variables are

standard in the auto industry for performance reporting, articulating our research findings using a common language is feasible.

Table 3.2 Variables identified for assessing the research questions

Construct considered	Variable considered
Capital structure	Debt to equity ratio (times)
	Short-term borrowings
Liquidity Management	Quick ratio (times)
	Gross working capital cycle (days)
	Debtor days (days)
Fixed Capital Efficiency	Gross fixed assets utilization ratio(times)
	Sales / Net fixed assets
Operational Efficiency	Finished goods turnover (times)
	Raw material expenses as % of Sales
	Purchase of finished goods as % of Sales
	Power, fuel & water charges as % of Sales
Profitability	Return on total assets

Table. 3.3. summarizes the variables considered, along with their definitions and inferences. In addition, we included sales growth (derived from financial reporting data) and GDP growth (World Bank data) as part of the data to control for any other variables that could affect the firm's performance.

Table 3.3 Variable definitions and inference

Acronym	Variable	Variable inference	Data type
ROA	Return on Assets	Measures how management's efficiency is in generating profits from the assets	Continuous
DD.	Debtor days	The average number of days the company has to wait to obtain payments from its customers	Continuous
QR.	Quick ratio	Defined the ability of a company to meet its short-term liabilities	Continuous
GWC	Gross working capital cycle days	Length of time the company takes in converting its inventories into cash	Continuous
DTE	Debt to equity ratio	Measures the company's total debt to the equity deployed	Continuous
STB	Short-term borrowings	Type of loan obtained to support a temporary personal or business capital need.	Continuous
FGT	Finished goods turnover	Indication of the pace at which the company sells the finished goods over a period	Continuous
RM_Sales	Raw material expenses as % of sales	The expense for purchasing raw materials divided by the total sales generated as a %age	Continuous
PUR_Sales	Purchase of finished goods as % of sales	The expense for purchasing finished goods divided by the total sales generated as a %age	Continuous
PFW_Sales	Power, fuel & water charges as % Sales	The expense for power, fuel, and water divided by the total sales generated as a %age	Continuous
FA_Util	Gross fixed assets utilization ratio	The ratio indicates the ability of a company to generate net sales from its fixed assets.	Continuous
Sales_FA	Sales / Net fixed assets	Amount of net sales revenue generated by investing one rupee/dollar/Euro in the fixed asset	Continuous
SALES_GR	Sales growth	Measures the growth in the company's net sales in the current period in comparison to the previous period	Continuous
GDP_GR	GDP growth	Measures the growth in the country's output (GDP) in the current period in comparison to the previous period	Continuous

3.10 Data completeness assessment

A 10-year data set for 280 companies yielded 2,800 records per variable. The author evaluated data completeness before executing descriptive statistics on the class-wise data sets. The missing data was minimal. However, before generating descriptive statistics, the author used appropriate data imputation methods (Reddy Sankepally et al., 2022) to fill in missing values. The resultant data set is balanced panel data. Table.3.4. summarizes the percentage of complete data for each variable considered in the data set. The data completeness is exceptionally high, except PUR_Sales (purchase of finished goods as a percentage of sales). The author used the median value of the respective variables to impute missing data. The variable purchase of finished goods as a percentage of sales contains the most repeated value, which is zero. The author filled in the missing values with zero, assuming the company made no purchases of finished products.

Table 3. 4 Data imputation summary

Variable	Total records	Available records in the data	% Completeness of the data	Imputation technique used
ROA	2,800	2,759	99%	Median
DD	2,800	2,759	99%	Median
GWC	2,800	2,759	99%	Median
QR	2,800	2,800	100%	-
DTE	2,800	2,719	97%	Median
FGT	2,800	2,528	90%	Median
FA_Util	2,800	2,758	99%	Median
Sales_FA	2,800	2,800	100%	-
RM_Sales	2,800	2,760	99%	Median
PUR_Sales	2,800	811	29%	Mode
STB	2,800	2,406	86%	Median
PFW_Sales	2,800	2,699	99%	Median

3.11 Research methodology

This thesis utilizes three distinct methodologies to accomplish its three research objectives. The panel data method is applied to comprehend the significant variables influencing the profitability of each class type. The Design of Experiments (DoE) method is applied to the

identified significant variables to understand the factor effects and their corresponding levels and further determine their optimal operating ranges for achieving the intended profitability levels per class type. Simulation estimates the value-unlocking opportunity across the supply chain that can result from accomplishing a shared vision among supply chain participants and adopting supply chain finance (SCF) appropriately.

3.11.1 Panel data analysis technique

Regression and time series analysis are essential applied statistical techniques for analyzing data. Regression analysis is a subset of multivariate analysis in which multiple measurements are collected for each company. It is common practice in regression analysis to analyze data from a cross-section of businesses. In contrast, time series analysis allows us to observe the trend of the performance variable over time. To employ time series methods, we typically limit our focus to a few companies that have accumulated numerous observations over time. Existing research uses this method when measuring the cross-section of the same firm at different times, i.e., through observations of the same businesses over time (Sarafidis et al., 2020).

Panel data analysis is a statistical technique that is a combination of regression and time series analysis. We observe firms over time with longitudinal data as opposed to regression data. Unlike time series data, numerous firms can be collected and analyzed with longitudinal data. Monitoring a large cross-section of firms over time enables us to investigate both dynamic and cross-sectional aspects of a given problem. The main advantages of longitudinal data over purely cross-sectional or time series data are the ability to study dynamic relationships and model the differences, or heterogeneity, between subjects (H. Xu et al., 2007). Two primary categories of panel data exist:

i. All individuals or entities are observed for the same periods in a balanced panel. This indicates no observations are missing for any unit across all periods.
ii. In an asymmetrical panel, some individuals or organizations may not have observations

for all periods. This may result from attrition, missing data, or data collection began at different times for distinct units.

In numerous applications involving longitudinal data, the primary objective of the analysis is to determine the effect of an exogenous explanatory variable on a response while controlling for other variables, including omitted variables. Users are interested in whether estimators of parameter coefficients deviate significantly from zero. This is also the primary motivation for most studies involving regression analysis; this is not surprising given that many longitudinal data models are special cases of regression models. Because longitudinal data are accumulated over time, we can also predict the future value of a particular subject's response (Frees, 2004). The panel data analysis helped finalize the significant variables that impact the profitability achievement for various classes of firms in scope.

3.11.2 Design of Experiments (DoE)

Design of Experiments (DoE) is a systematic and structured approach to planning, conducting, and analyzing experiments or tests to obtain valid and reliable results with the least effort, time, and resources. DoE is utilized extensively in numerous disciplines, including science, engineering, manufacturing, and business, to optimize processes, improve product quality, and make data-driven decisions (Montgomery, 2013).

The results of a Design of Experiments (DoE) method can vary depending on the specific aims and objectives of the research (Durakovic, 2017). The following are a few key outcomes and advantages associated with DoE:

- Determines which variables have a statistically significant impact on the response variable and which do not. This information enables various firms to allocate resources to the most influential factors and disregard less significant ones.
- Determine the optimal combination of variables or factors to produce the desired result. Our current research investigates this feature to determine the optimal combination of

significant variables per class type to achieve the desired performance level.

The method outlines the relationships between factors and responses. It facilitates a deeper comprehension of the underlying mechanisms by revealing how alterations to one or more factors influence the outcome. This aspect assists the management of various firms in understanding the sensitivity of the significant factors to the desired performance indicator.

3.11.3 Simulation

A business simulation is a digital exercise that imitates real-world business situations and procedures. Business simulations facilitate decision-making, problem-solving, and strategic planning in a controlled, risk-free environment. Business simulations can be tailored to reflect the unique characteristics and difficulties of a specific industry, company, or market (Barnaby et al., 2021). This allows organizations to customize the experience to meet their particular requirements. Simulations can be utilized to evaluate various scenarios and their prospective outcomes, thereby assisting individuals and organizations in preparing for future challenges and uncertainties. Typically, simulations produce data that can be analyzed to gain insight into decision-making patterns, performance trends, and the efficacy of various strategies. Simulations offer a secure setting for experimentation. Participants can evaluate strategies with no financial or organizational repercussions. Simulations may be designed for a single participant or a group of participants who may compete or collaborate (Kulkarni & Sivaraman, 2013). Typically, multiplayer simulations lend an additional layer of realism and complication. In the current study, the author modeled firms from multiple classes as part of the simulation exercise. They evaluated the influence of SCF adoption on financial performance and computed the benefits for the value chain players.

Based on the discussion in the preceding sections, Figure 3.9 summarizes the conceptual framework summary.

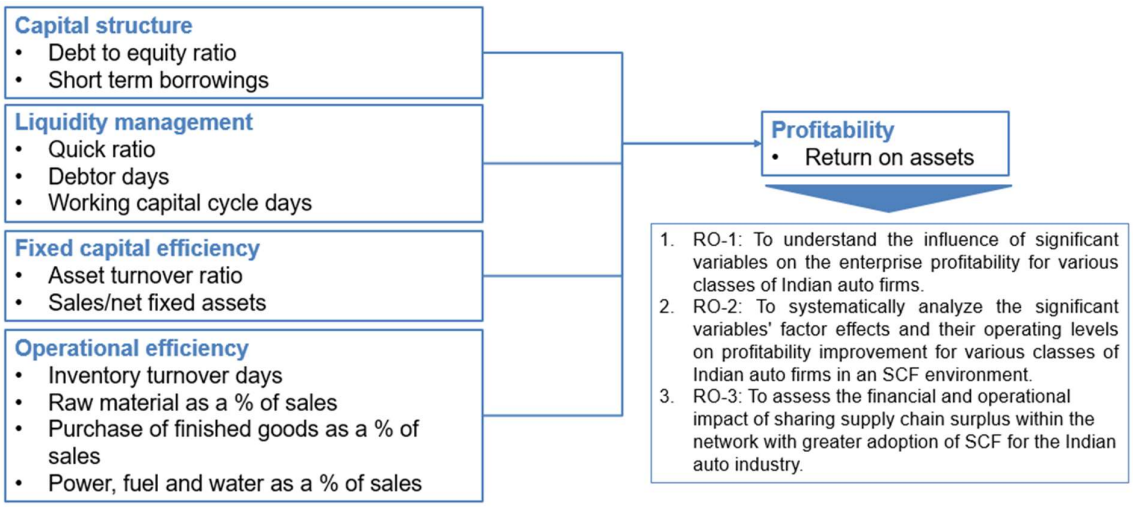

Figure 3. 9 Conceptual framework summary

Chapter 4: State of Supply Chain Finance For Micro, Small And Medium Enterprises of India

Preview: Section 4.1 examines the importance of micro, small, and medium companies (MSME) in India's economic development and their difficulties in maintaining sufficient liquidity. Section 4.2 explores the participants in supply chain finance (SCF) solutions and the benefits of implementing them for micro, small, and medium enterprises (MSMEs). Section 4.3 summarizes the extent to which SCF (Supply Chain Finance) has been used in the Indian automotive industry, using statistical findings. Section 4.4 outlines methods to expedite the widespread implementation of Supply Chain Finance (SCF) among India's Micro, Small, and Medium Enterprises (MSMEs). Section 4.5 provides the final findings and potential areas for future investigation.

4.1 Introduction

India is a sprawling country with a significant domestic market. India currently has approximately 63 million Micro, Small, and Medium Enterprises (MSMEs), of which 2.5 million are registered on the Government of India webpage (https://udyamregistration.gov.in). Around 88% of the registered micro, small, and medium companies (MSMEs) operate within the micro-segment. According to the Government of India Report for 2020-21, these enterprises need a robust financial boost in discounted working capital loans to ensure they have enough money available for their operations. Productivity growth enhancement leads to the expansion of national output, which is directly associated with a rise in GDP. Increased productivity has a direct impact on the growth of exports, leading to a reduction in trade imbalances (Mukherji & Pandey, 2014). MSMEs are very vulnerable to risks associated with their cash conversion cycles (CCC). The financially constrained micro, small, and medium enterprises (MSMEs) and the prolonged duration of converting cash into other assets provide

a substantial financial hazard throughout the supply chain, ultimately affecting the value of shareholders' investments (Hendricks & Singhal, 2003a). Supply Chain Finance (SCF) is a cooperative approach that addresses the working capital requirements of credit-constrained Micro, Small, and Medium Enterprises (MSMEs). It offers a mutually advantageous arrangement for all parties, including sellers, buyers, lenders, and technology companies.

According to Alora & Barua (2019), several barriers resulted in lower-than-expected supply chain finance adoption rates (SCF) among micro, small, and medium firms. The present significance of the matter rests in understanding the barriers and defining the fundamental principles to promote broader adoption of SCF. The Covid pandemic has posed substantial challenges for businesses but has also accelerated the adoption of digital technologies.

4.2 Literature review

Supply chain designs are characterized by three concurrent streams: the transportation of goods and services, the sharing of information, and the allocation of financial resources. In addition to these primary streams, secondary streams, such as value and risk, are present throughout the supply networks. Governments, financial institutions, and regulatory agencies exert equal levels of influence throughout the whole supply chain. Significant focus has been placed on improving the effectiveness of supply chain operations' physical and informational components. However, the financial activities remained separate from the physical process of delivering goods (Hofmann & Belin, 2011). In the past, business professionals evaluated the effectiveness of supply chains separately. As people gained a better awareness of the impact of efficient supply networks on managing working capital, the significance of thoroughly comprehending supply chains and financial indicators became evident.

Enterprises have redirected their attention from internal operations to managing complex supply networks due to the globalization of trade and its subsequent growth. The global need for enough financial resources to administer the company effectively and ensure seamless

execution has become prevalent. The emergence of Supply Chain Finance (SCF) as a concept can be ascribed to the variable reliability of supply chain partners and the differing levels of accessibility to loans in their respective operating countries.

The interest of SCF stems from the considerable possibility of diverse benefits inside supply networks. The main advantage of utilizing SCF solutions is consolidating all essential parties (sellers, buyers, lenders, and technology providers) onto a single platform. The main goal of SCF is to focus on the efficient coordination of working capital, financial transactions, and information sharing across various entities within supply chains. In addition, organizations that adopt Supply Chain Finance (SCF) also enjoy multiple benefits, including lower costs per unit of purchased goods, a more reliable supplier network, fewer supply disruptions, extended payment terms, reduced production costs, decreased days of sales outstanding, improved business continuity, and the ability to secure trade credit or financing at more favorable rates (Chakuu et al., 2019).

Figure 4.1 depicts the interactions among several constituents in the SCF system. The study by Gelsomino et al. (2016) offered valuable perspectives from many stakeholders involved in the supply chain financing (SCF) process, such as buyers, suppliers, lenders, and technology providers. The study focused on understanding their opinions regarding the implementation of SCF solutions. A wide array of supply chain finance (SCF) options may be customized to fulfill the financial requirements of both purchasers and vendors. Financing methods include reverse factoring with suppliers, inventory finance, asset-based lending, pre-approved invoice financing, purchase order financing (pre-shipment), and dynamic discounting with suppliers (Templar et al., 2020).

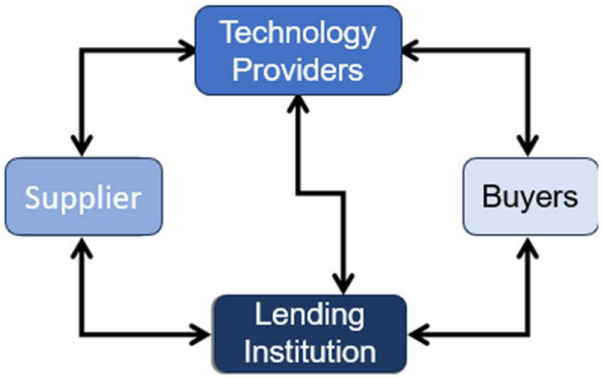

Figure 4. 1 Typical market players involved in an SCF solution

Organizations worldwide are considering the necessity of reevaluating their global supply chain footprints due to the increasing disruptions in supply chains generated by lengthy and complex supply chains. The operating scenarios of the Supply Chain Finance (SCF) would undergo substantial changes due to the shifting footprints of the supply chain.

McKinsey Global Institute (2019) highlights three imminent factors that will impact global value chains:

i. **Changing consumption patterns:** By 2030, it is estimated that developing countries will represent over 50% of global consumption.

ii. **Enhanced regionalization:** The COVID-19 pandemic and the current Suez Canal incident will compel multinational firms to thoroughly evaluate the overall expenses and hazards associated with their location choices in the future, leading to a greater emphasis on regionalization. It will facilitate increased movement of goods within a region, allowing developing economies to decrease their reliance on imported materials and instead prioritize the development of indigenous solid supply networks.

iii. **Enhanced service progression:** The growth rate in services trade has exceeded that of goods trade by almost 60% in the last ten years, with a particular emphasis on telecommunication and information technology services, business services, and intellectual property costs.

The modifications dramatically affect global trade, and local manufacturing networks rely significantly on micro, small, and medium enterprises (MSMEs) for a significant contribution. India's Cash Conversion Cycle (CCC) is 63 days, making it one of the lengthiest in Asia. Furthermore, the nation exhibits the highest proportion of overdue B2B bills, with an average of 52.8% attributed to domestic and international sources. According to a survey conducted by Atradius (2017), Indian suppliers, whether local or cross-border, have lengthier payment delays than other firms in the Asia Pacific area. The delays affect the planned cash flows and influence the suppliers' strategies for managing working capital. Suppliers resort to acquiring short-term loans in the absence of positive cash flows, exacerbating the decline in profitability.

Alora & Barua (2019) have highlighted the substantial challenges MSMEs encounter when applying SCF solutions to address working capital issues. Indian micro, small, and medium companies (MSMEs) in the industrial sector have considerable financial and information technology barriers that impede the implementation of supply chain finance (SCF).

- Most micro, small, and medium enterprises (MSMEs) in India operate under a proprietary business model. Given the prolonged periods of high CCC (Cash Conversion Cycle) days, MSMEs (Micro, Small, and Medium Enterprises) are already facing financial constraints. Therefore, investing in anything other than essential delivery commitments appears impractical.
- A significant obstacle is the limited interest in digital investments resulting from a lack of financial adaptability.
- Moreover, the excessively procedural nature of the interaction with banks and NBFCs deprives MSMEs of the opportunity to handle their finances independently, undermining their enterprises' sustainability.

India is defying expectations by making substantial progress in adopting digital technologies among large companies, as McKinsey & Company (2019) reports. India's current position in

the digital adoption index is 17th, with a score of 32. By comparison, South Korea tops the list with a score of 75. From 2014 to 2017, India witnessed a substantial surge of 90% in the digital adoption index. Generally, larger corporations have a distinct concentration and abundant financial means to carry out digital initiatives.

However, there is a notable disparity in the level of digitalization among various industries, including prominent Indian corporations. McKinsey's research indicates that the median index value for the industrial, trade, and transport industries indicates minimal digital adoption. The Indian MSME sector demonstrates a notable concentration in the three areas above, suggesting insufficient digital capabilities. Moreover, MSMEs exhibit a significant level of fragmentation with their limited degree of digital engagement. As a result, the incorporation of SCF into the MSME sector through FinTech providers is restricted. The present situation presents a significant difficulty in overseeing and fostering growth, resulting in considerable untapped potential in MSMEs that might directly affect the economy.

4.3 Analysis of the state of SCF adaption for Indian MSMEs

Effective management of working capital ensures smooth business operations. Companies can efficiently manage their working capital by maintaining steady cash inflows and enhancing operational efficiency. Organizations see CCC as a proxy for evaluating the condition of working capital management. Shortening the duration of the Cash Conversion Cycle (CCC) results in enhanced strategies for handling working capital.

The formula below demonstrates that CCC represents the duration required to turn sales into cash. The concept includes the monetary value owed to suppliers, measured as Days Payable Outstanding (DPO); the monetary value tied up in inventory storage, measured as Days Inventory Outstanding (DIO); and the anticipated funds from debtors as accounts receivables, measured as Days Sales Outstanding (DSO).

CCC= DSO+DIO-DPO……(1)

The formula for the Cash Conversion Cycle (CCC)

The Cash Conversion Cycle of 120 companies in the automotive industry, which are listed on the Indian Stock Exchange, was calculated based on their annual reports for the fiscal year 2019-20. These companies encompass different supply chain tiers, such as original equipment manufacturers (OEMs), Tier-1, and Tier-2. The author categorizes firms into OEMs, Tier-1, and Tier-2 based on their sector expertise (sample classification).

- Original Equipment makers (OEM) encompass passenger cars, commercial vehicles (trucks), farm equipment, and two-wheeler makers.
- Tier-1 suppliers are categorized as firms that provide shock absorbers, sheet metals, and springs.
- Suppliers of bearings, castings, and forgings for auto ancillaries are categorized as Tier-2 suppliers.

As the author explored the lower tiers of the supply chain (Tier 3 and beyond), he observed a drop in the scale of operations and a significant growth in the prevalence of micro, small, and medium enterprises (MSMEs). The author formulated a hypothesis to examine the relationship between the different levels of the supply chain and the cash conversion cycle (CCC) to ascertain the degree to which the adoption of supply chain finance (SCF) is affected.

- H0: The depth of tiers in the supply chain has no impact on the CCC, which remains the same.
- Ha: CCC is different for different tiers in the supply chain.

An ANOVA test is conducted on the three samples to analyze the variations in the CCC (Cash Conversion Cycle) among the OEM, Tier-1, and Tier-2 samples.

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
OEM	13	207.572394	16	3,100
Tier-1	44	2132.332867	48	3,007
Tier-2	63	4075.510625	65	3,044

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	27,319	2	13659.70871	4.49875	0.013	3.07376
Within Groups	355,251	117	3036.334443			
Total	382,571	119				

Figure 4. 2 Single factor ANOVA test results

Fig 4.2 summarizes the outcome of the Single-factor ANOVA test.

- The variance of the three samples is observed to be comparable.
- The F_{STAT} for 2 and 117 degrees of freedom is 3.1.
- The F value from ANOVA (4.49) > F_{STAT} (3.1) and
- $p < 0.05$, resulting in the rejection of the null hypothesis.

Organizations may optimize their cash conversion cycle and cash flow by enhancing inventory management, capitalizing on supplier relationships, and implementing efficient processes. By and large, inventory management is purely an organizational affair. However, external parties are involved in the receivables and payables management. As shown in Figure 7.5, the percentage of firms in distress is broadly consistent among class 2 to class 5 firms, indicating a compelling need for collaborative liquidity management. Studies by Seifert & Seifert (2011) also point to a mutually beneficial scenario for buyers and suppliers in an SCF-adopted scenario. In a scenario where supply chain finance (SCF) is more widely adopted, the average number of days it takes to convert cash into inventory, process it, and convert it back into cash (CCC days) would have been similar across different levels of the supply chain.

Nevertheless, the mean Cash Conversion Cycle (CCC) shows a rising trend from Original Equipment Manufacturers (OEM) with an average of 16 days, to Tier-1 suppliers with an average of 48 days, and Tier-2 suppliers with an average of 65 days. This ANOVA analysis highlights the susceptibility of working capital management at the lower levels of the Indian automotive industry's supply chain. The preceding statistics indicate that Indian MSMEs have low SCF adoption levels. The samples, including original equipment manufacturers (OEMs) and both tiers, exhibit noticeable discrepancies in the average cash conversion cycle (CCC) duration, suggesting a substantial potential for implementing supply chain finance (SCF) and enhancing working capital for micro, small, and medium companies (MSME). Reducing the duration of the CCC (Cash Conversion Cycle) can generate cost efficiencies across the whole supply chain, leading to decreased product pricing. The benefits might be transmitted to end users or used to increase the firm's profitability.

The author analyzed the debt and equity information in their annual reports to assess the variances in the overall capital structures of the 120 companies mentioned. Additionally, the author explored the potential association between these capital structures and the extent to which the companies have adopted SCF (Sustainable Competitive Advantage) practices. Figure 4.3 summarizes the median proportion of debt and equity in the OEM, Tier-1, and Tier-2 financial structures. Due to the high Cash Conversion Cycle (CCC), enterprises in the lowest tiers of the supply chain may probably depend on debt to fund their operating needs when Supply Chain Finance (SCF) is not accessible, as seen by the more significant proportion of debt. These business practices have a detrimental effect on the company's financial stability and pose a danger of potential disruptions in the supply chain for the entire network.

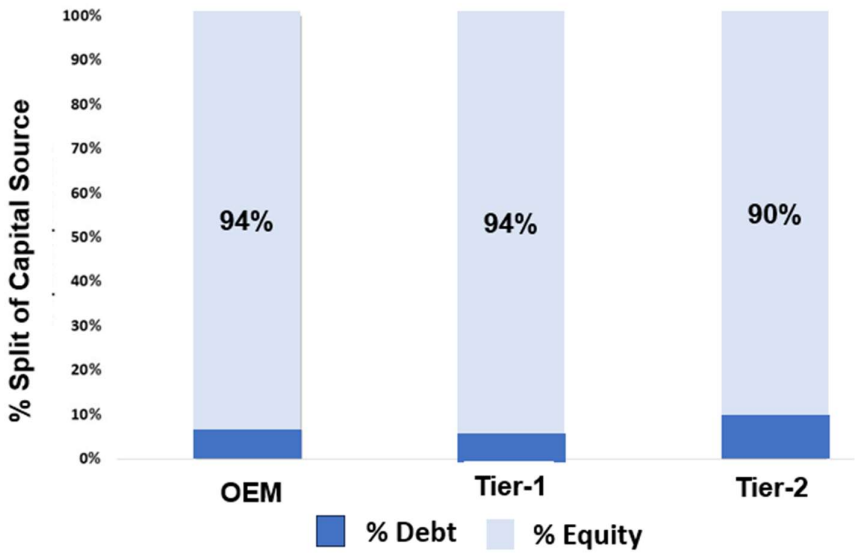

Figure 4. 3 Composition of debt and equity for the sample firms

Implementing Supply Chain Finance (SCF) in critical industries will resolve the financial challenges that Micro, Small, and Medium Enterprises (MSMEs) encounter in acquiring working capital and promoting economic growth.

4.4 Strategies to fast-track the coverage and adoption of SCF for Indian MSME

Approximately 96% of India's Micro, Small, and Medium Enterprises (MSME) are not enrolled on the Government of India portal; therefore, it does not fall within the purview of Supply Chain Finance (SCF) jurisdiction. The primary goal of supporting the application of Supply Chain Finance (SCF) should be to enhance the inclusion of Micro, Small, and Medium Enterprises (MSMEs) inside the SCF framework. The COVID-19 epidemic has forced enterprises to push their boundaries, resulting in a notable advantage: the swift progress of digitalization efforts in various sectors. Implementing the TReDS platform was the primary trigger for the broader initiative. TReDS is a well-established system that aims to simplify the process of invoice discounting for micro, small, and medium firms (MSMEs). It achieves this by connecting these enterprises with several lenders and facilitating timely payment for their

invoices from corporate clients. We suggest taking the following essential strategies to enhance the coverage and acceptance of MSMEs for supply chain finance (SCF) and take advantage of development opportunities in India.

Raising awareness: Providing a registration tool kit connected to a distinct identification number is essential to facilitate comprehension of MSME facilities. Utilizing GST numbers and unique identifiers for goods and service tax can be a practical initial step. The transaction data associated with the GST number can be used for in-depth research and subsequent activities.

Enhanced role for TReDS: The TReDS platform serves as a hub where buyers and sellers can trade invoices and initiate the operation of the SCF machine. The integration of TReDS can be achieved by incorporating compatible APIs into any Supply Chain Finance (SCF) platform provided by a FinTech provider.

Comprehensive SCF platform: Figure 4.4 concisely represents a suggested comprehensive SCF platform. The platform is designed to function modularly, addressing the diverse requirements of ecosystem partners. Exploration of the modular elements of the platform can be conducted based on the individual requirements of the buyers, providers, and lenders. Upon receipt of an invoice from the seller, the lender utilizes the underwriting module to evaluate the risk associated with the transactions between the buyer and supplier. This assessment is conducted by analyzing both internal and external data sources. In addition, analytics teams utilize modeling techniques to assess the risk and determine the appropriate discount factor for the invoice amount provided to the suppliers. As previously stated, these features are designed to function entirely in a modular manner and can be used as required. The platform comprises many I.T. providers that cover infrastructure and application development. It offers tailor-made solutions to the buyer-supplier community for carrying out transactions. Additional institutions, such as industry associations, governmental regulatory authorities, and dispute

resolution organizations, are included in the platform ecosystem to offer essential assistance. The service pricing becomes more affordable as the platform gains support and acceptance from the ecosystem community. It provides broader coverage of Micro, Small, and Medium Enterprises (MSMEs), leading to increased acceptance of Supply Chain Finance (SCF).

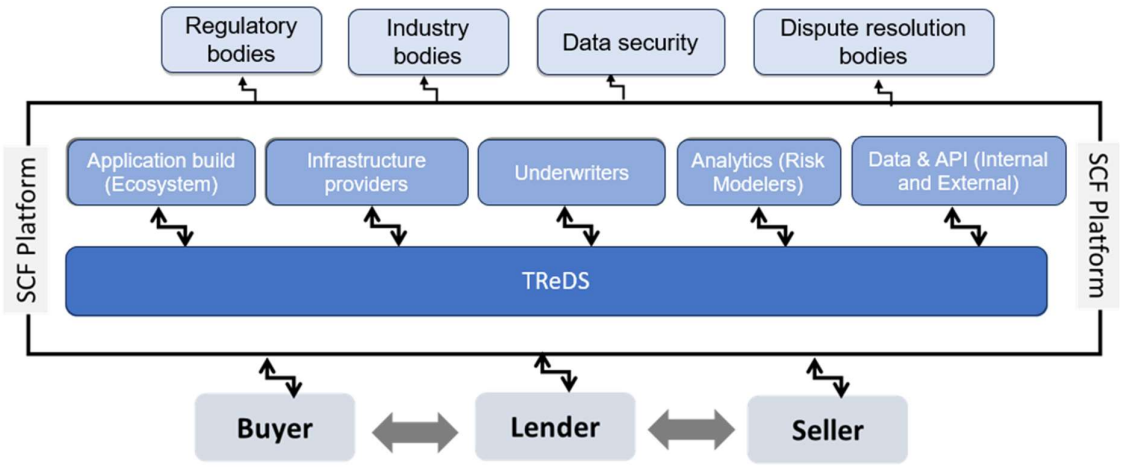

Figure 4. 4 Proposed view of comprehensive SCF platform

Figure 4.5 summarizes the value that the ecosystem players would derive from adopting the SCF platform.

Security and Privacy: The platform must ensure robust security measures and stringent data protection protocols for the partners involved in information exchange and financial transactions.

Value proposition: To achieve better platform adoption, it is crucial to clearly and effectively communicate the benefits that each participant in the ecosystem will gain from it. Figure 4.5 provides a concise overview of the value assigned to each actor concerning the acceptance of the solution.

Extension to cross-border flows: The platform should provide the capability to easily integrate additional parties, such as freight forwarders if there is a requirement to expand the platform for cross-border operations. Once the essential parties are registered on the platform,

MSMEs may be confident that they will receive their money in an export situation.

Inclusion of services: The majority of the discussion revolves around the movement of tangible products. Furthermore, the platform must be able to support services in addition to physical commodities, as the need for cross-border services is growing.

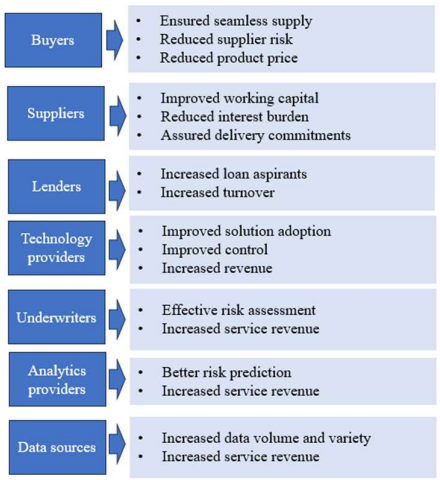

Figure 4. 5 The value proposition for SCF platform players

Single point of contact: The platform would function as a centralized hub for the prospective MSME, catering to its requirements. Enabling integration with the MSME systems should facilitate the establishment of a comprehensive workflow to ensure a smooth flow of information and finance.

Platform Pricing: Financial issues significantly influence the adoption of a platform. Several micro, small, and medium enterprises (MSMEs) have limited production capacities that may appear economically unfeasible due to the fixed investments required for Information Technology. Implementing transaction-based pricing for platform utilization will enable smaller firms to meet the volume requirements.

Modularity: Over time, the quantity of services provided on these business platforms will experience a significant increase. This allows for the adaptability of selecting and utilizing the platform's services according to the specific requirements of MSMEs.

4.5 Conclusions

Indian MSMEs face substantial challenges in adopting SCF due to financial and technological hurdles. Only a tiny fraction, approximately 4%, of MSMEs are officially registered, which means that the vast majority, around 96% of MSMEs, remain unexplored in terms of their potential to drive economic growth. Projections of worldwide patterns suggest a substantial change in consumption levels, estimated to be over 50%, in developing nations. The latest research validates the limited use of Supply Chain Finance (SCF) among Indian Auto Micro, Small, and Medium Enterprises (MSMEs). The primary focus is to expand the inclusion of Micro, Small, and Medium Enterprises (MSMEs) in the registered network while assuring sufficient operating capital availability for their firms. Simultaneously, it is imperative to promptly address technological obstacles to enhance the use of supply chain finance (SCF) by micro, small, and medium enterprises (MSMEs). The author's proposed one-stop platform will undoubtedly enhance the ecosystem of SCF and guarantee higher levels of transparency and acceptance.

SCF has focused on the manufacturing industry because of the urgent challenges of managing working capital. Expanding the approach to the services sector within MSME has significant advantages. Subsequent investigations should prioritize examining the broader effects on pricing, risk, and profitability in supply chain networks when adopting SCF.

Chapter 5: Benefits of Supply Chain Finance Adoption For The Indian Automotive Supply Chain Firms: An Empirical Evidence

Preview: Section 5.1 describes the financial challenges of the micro, small, and medium companies (MSME) of India, motivations to take up the study, and associated research questions. Section 5.2 covers the appropriate literature supporting the identified research questions and summarizes the hypotheses for the study. Section 5.3 outlines the conceptual framework, data sources, and their reliability for the study. Section 5.4 describes the insights from the collected data. Section 5.5 covers the details of the panel data regression study and the inferences from the analysis. Section 5.6 outlines the study's implications and presents the recommended decision framework for practitioners. Section 5.7 concludes the chapter.

5.1 Introduction

Within the value chain, enterprises' hierarchies are known as "tiers" regarding material flow. Upstream tiers provide supplies to downstream tiers. Once an organization reaches higher tiers (farther from the end consumer), it becomes the ultimate recipient of a payment within the value chain. This technique inadvertently hampers the organization's financial flow, leading to a rise in outstanding receivables. The median proportion of accounts receivable to revenue in industrialized nations ranges from 14% to 33%. (Seifert & Seifert, 2011). Historically, the primary focus has been on decreasing the duration of the cash conversion cycle (which includes receivable days, inventory days, and payables days) within a single company without considering the potentially disastrous consequences for the entire supply chain (Randall & Farris, 2009). As per the stakeholder theory (Donaldson & Preston, 1995), nurturing value-chain relationships is critical for improving firm performance. The negative consequences of such systems that prioritize individual firms become more severe as the length of the value chain rises. Considering the evolving global landscape and the demanding sustainability goals, is the current practice viable in the long term?

McKinsey Global Institute (2019) predicted that the global consumption landscape will change significantly. They calculated that by 2030, developing nations would contribute more than fifty percent to global consumption. According to Biswas (2022), Asia Pacific (APAC) is predicted to account for 42% of the world GDP by 2040, with India's share expected to rise from 3.3% in 2021 to 7.4% by 2040. India benefits from an advantageous position due to its robust domestic demand, and the automotive industry becomes even more critical in light of the promise to achieve net-zero emissions. Although the Indian auto component sector has shown strong development in the past, it performs less favorably than its Asian competitors regarding macro variables (Dhawan et al., 2018). Smaller component businesses encounter persistent financial and operational challenges due to their limited capacity to produce revenue within the value chain (Klapper, 2006). Given these circumstances, is the Indian automobile sector capable of capitalizing on the surge in demand, enhancing its operating practices, and augmenting its contribution to the Gross Domestic Product (GDP)?

A few pertinent research questions in this context based on the guidance provided by Whetten (1989) are:

RQ-1: What is the reason for the difference in the profitability performance for different classes of firms in the Indian auto business? Does the performance improve with the increase in the firm's class?

RQ-2: What factors influence the profitability performance of various firms? Are they similar?

RQ-3: What is the degree of influence of significant factors on the profitability performance of various classes of firms? Do they vary with the class of firms?

RQ-4: How can the firms of various classes cooperate and prosper simultaneously in the given operating environment and benefit the value chain?

A lot of research exists on the relationship between the size of the firm and its financial

performance. To achieve profitability, Baumol (1959) discusses the unique advantages of larger companies over smaller ones in terms of investment and operational flexibility. Stekler (1964) confirmed an inverse relationship between the firm's size and profitability. These observations are further verified by (Samuels & Smyth (1968) and Treacy (1980). The data on the year of incorporation of registered auto firms in India, as registered by the Ministry of Corporate Affairs, Government of India, indicates a notable decrease, which aligns with the research findings (CMIE, 2021).

Nevertheless, this pattern goes against common intuition as the worldwide automotive sector prepares for the impending revolution of electric vehicles (EVs). The annual revenue of automakers in India varies significantly depending on their range. There is a significant difference in income and financial performance. The choice of strategies to unlock the value required for enhanced profitability differs among companies. A universally applicable approach would undoubtedly be inappropriate in these circumstances.

Luthans & Stewart (1977) contend in their contingency theory that the situational approach can potentially enhance the financial performance of diverse businesses. The situational approach posits that the optimal management strategy or concept is based on the exact conditions at any given moment. Most previous studies on performance evaluation have concentrated on the focal firm or, at most, on dyadic connections (focal business and supplier) through case-based analyses or surveys. Only a limited number of research have conducted comprehensive empirical assessments using financial data.

The study aims to analyze the effects of critical variables on the financial performance of different classes of companies. The author regarded return on assets (ROA) as the primary metric for assessing financial performance. The author finalized ROA as the performance metric based on its comprehensive and universally applicable nature. In contrast to other financial performance measurements, such as return on equity, ROA is less susceptible to

manipulation through debt leverage (Deloitte, 2013). The field of operations management often employs the Return on Assets (ROA) to assess firms' effectiveness (Ambulkar et al., 2023).

5.2 Literature review

A significant negative relationship exists between a company's profitability, accounts receivable, and inventory days (García-Teruel & Martínez-Solano, 2007). Firms can obtain increased cash flow predictability, decreased risk-related expenses, and enhanced working capital by effectively converging their physical and financial supply chains (Protopappa-Sieke & Seifert, 2010b).

5.2.1 Payment terms and trade credit financing

According to Tanrisever et al. (2015), large companies usually have far cheaper funding costs than their suppliers. Furthermore, the focal corporations within the supply chain typically have the power to negotiate payment terms with their suppliers, particularly small businesses. This practice is carried out along the entire value chain, even with the smallest-sized suppliers. Consequently, smaller companies in the supply chain extend trade credit (Peterson & Rajan, 1997) to their larger customers.

Furthermore, smaller firms have significant accounts receivables since they are positioned further upstream in the value chain (Wetzel & Hofmann, 2019). They can withstand the effects of longer payment terms by transferring them as increased costs in goods supplied (Aberdeen-Group, 2006). Prudent management of current assets and liabilities is crucial for liquidity management in smaller firms, specifically Micro, Small, and Medium Enterprises (MSMEs) in India. The discussion leads to our first research hypothesis:

H-1: The factors corresponding to capital structure decisions affecting the firm's financial performance (profitability) vary by the class of the firm.

5.2.2 Working capital management and source of funds

Access to affordable external capital is both limited and essential for the efficient operation of

firms (Lekkakos & Serrano, 2016). Companies can decrease dependence on external equity and bank credit funding by implementing effective working capital management (WCM) techniques (Pratap Singh & Kumar, 2014). Many companies have explored methods to improve their working capital management, optimize cash flow, and free up trapped funds. Historical research focused solely on improving the cash-to-cash cycles of focal firms, which had a detrimental effect on other participants in the supply chain (Martin & Hofmann, 2019). Smaller businesses face challenges acquiring working capital from various sources to fund their operations (Song et al., 2016b). Suppliers face higher credit rates due to their restricted access to cash, low credit history, and insufficient financial performance indicators. According to a previous study by Aberdeen-Group (2006), the cost of financing is estimated to make up 4% of the product's overall value. Larger corporations' extension of the payment period negatively impacts the financial flexibility of smaller enterprises. Smaller enterprises gradually grow more vulnerable to external disturbances amid financial crises. When making decisions about managing working capital, it is crucial to consider the interests of both the suppliers and customers in the supply chain. Top-tier companies rigorously oversee and control their working capital throughout the supply chain (Gomm, 2010). The discussion leads to our second research hypothesis:

H-2: The factors corresponding to liquidity decisions affecting the firm's financial performance (profitability) vary by the class of the firm

5.2.3 Cost of funds and Supply Chain Finance (SCF)

The disparity in funding costs between smaller companies' internal and external sources may be significant due to market imperfections in the capital markets. As the gap increases, they will incur a higher external financing premium and refrain from investing in the supply chain. Inadequate investments in suitable technology lead to the firms' below-average capacity to fulfill their downstream supply obligations.

In their study, Hendricks & Singhal (2003) analyzed how disruptions affect the operational performance of two distinct types of firms. The study revealed that organizations that publicly disclosed disruptions experienced subpar operational performance, as indicated by operating income, return on assets, return on sales, inventory growth, and sales growth. Insufficient investment from smaller suppliers might result in detrimental consequences in subsequent supply chain stages (Tanrisever et al., 2015). Supply Chain Finance (SCF) is a highly effective technique for accomplishing these goals and benefitting all parties involved. Small and medium-sized firms have found that supply chain finance, as demonstrated by Gomm (2010) and Lekkakos & Serrano (2016), can free up over 10 percent of the supplier's working capital. The discussion leads to our third research question:

H-3: The factors corresponding to the fixed capital efficiency decisions affecting the firm's financial performance (profitability) vary by the class of the firm

5.2.4 Cash conversion cycle and operating performance

Y.-J. Wang (2002) investigated the relationship between liquidity management and operating performance. The findings revealed a negative link between the cash conversion cycle and both return on assets (ROA) and return on equity (ROE). According to the research, firms have the potential to enhance their profitability by reducing the duration of their cash conversion cycle. Supply chain management can significantly influence the financial performance of a business in three key areas: profitability, liquidity, and productivity or asset utilization (Christopher & Ryals, 1999). The discussion leads to our fourth research question:

H-4: The factors corresponding to the operational efficiency decisions affecting the firm's financial performance (profitability) vary by the class of the firm

5.2.5 Relevance of Supply Chain Finance (SCF)

In theory, SCF focuses on managing working capital, financial flows, and information transfer between organizations within supply chains (Pfohl & Gomm, 2009). Several researchers have

recognized the need to maintain consistency in the supply chain's financial and tangible information flows. Johnson & Templar (2011) examined the connections between operations and finance and provided detailed insights into the efficient management of supply chains concerning working capital. Hofmann & Belin (2011) have elucidated the role of supply chain financing (SCF) in aiding smaller enterprises in fulfilling their working capital requirements.

Implementation of SCF results in a mutually beneficial outcome for all parties involved, including sellers, buyers, lenders, and technology providers. The use of SCF yields a multitude of corporate advantages. Implementing Supply Chain Finance (SCF) solutions resulted in a 13% reduction in customers' working capital and a 14% reduction in suppliers' working capital, as Seifert & Seifert (2011) reported. Studies have shown that the adoption of SCF (Supply Chain Finance) in India is relatively low. As per More & Basu (2013), the most crucial difficulty Indian enterprises face is the lack of a shared vision among supply chain partners. Moreover, smaller Indian enterprises pointed out certain hindrances that were the main reason for the SCF adoption rates falling short of expectations (Alora & Barua, 2019).

The objective of our study is to determine the precise set of influential variables (regressors) that impact the profitability of enterprises based on their size and to quantify the extent of their influence on financial performance. This research is pertinent as it examines explicitly the Indian automotive industry and aims to fill the existing gaps in research about the priorities of Indian automotive companies. This activity aims to establish a cohesive and shared vision for the supply chain among the partners concerned.

5.3 Research design and methodology

The focal point of our study is the "organization" as the unit of analysis. Hence, the author collected and analyzed attributes at the organizational level. The author analyzed secondary financial reporting data from the Centre for Monitoring the Indian Economy (CMIE, 2021). The CMIE has created an extensive database that contains detailed information about

the financial performance of companies registered with the Ministry of Corporate Affairs, Government of India.

Using traditional financial reporting data offers numerous advantages.

- Indian government-approved standard accounting procedures.
- The accuracy of data is guaranteed.
- Data terminology allows us to analyze and articulate the findings using a shared corporate language.

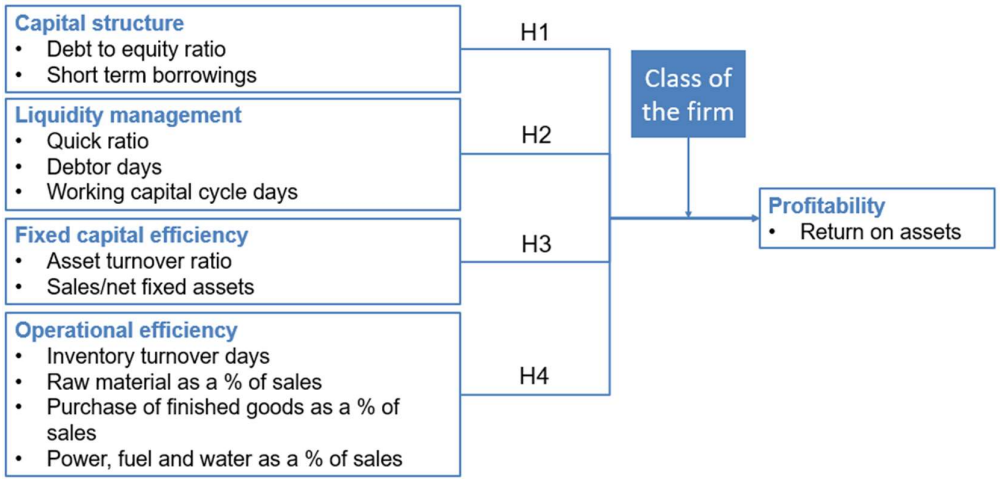

Figure 5. 1 Proposed conceptual model

Figure 5.1 depicts the conceptual framework proposed. The author discussed the steps followed to identify the list of the variables for the research in section 3.8. Table 3.2 in Chapter 3 presents a concise overview of the variables concerning the finalized research constructs. These variables are popular in the auto industry for performance reporting.

Figure 5. 2 Summary of the firms considered in scope

Figure 5. 2 summarizes the scoping details. One thousand ninety auto firms have been officially registered with the Ministry of Corporate Affairs in India between 1901 and 2020. The author employed the most recent ten-year data (FY 2012–FY 2021) to reflect the current operational conditions thoroughly. Of the companies, 30% (311 out of 1,090) provided consistent sales data throughout the entire data range from FY 2012 to FY 2021.

Micro, small, and medium enterprises (MSME) refer to smaller firms within the Indian auto industry. The classification of enterprises as MSMEs, based on a Government of India (2020) gazette announcement of June 1, 2020, is summarized in Table 2.1

However, based on reported average sales and average assets (property, plant, and equipment (PPE)), the size disparity among companies is immense. Hence, the author considered firms with a maximum revenue of INR 2,500 Crores from the data as a criterion. A final sample of 280 companies was analyzed to assess the operating environment differences with reasonable accuracy.

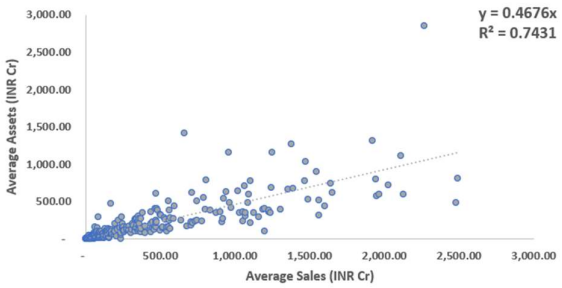

Figure 5. 3 Relationship between average sales and average assets

Figure 5.3 demonstrates a strong linear correlation between the average sales generated and the average assets owned by the firms under investigation, as indicated by the R-square value of 74%. Therefore, the author considered only the average sales value to categorize the companies into separate groups and analyze the moderating effects. However, the data being viewed (280 entities) includes only two micro businesses according to the sales criteria set by the Government of India. To assess the disparities in the operating environment, the author

manually categorized the firms into categories specified in Table 5.2. This was done as a preliminary step towards clustering the firms into appropriate groups. Class 1 and 2 denote the category of Micro, Small, and Medium businesses (MSME).

Table 5. 1 Classification of firms for assessment

Average sales (Turnover)- INR Cr (1)	Class name (2)	Number of firms (3)	Size of the class (Total) (4)
0-50 - (Micro and Small firms)	Class 1	38	380
50-250 - (Medium firms)	Class 2	103	1,030
250-500 - (Large firms)	Class 3	54	540
500-1000 - (Extra-large firms)	Class 4	41	410
1000-2500 - (Largest firms)	Class 5	44	440

The author listed the sample size for each firm class in Table 5.1. A ten-year dataset for 38 firms (Class 1) contains 380 records (Column 4 of Table 3.) The samples considered for the evaluation satisfy the minimum sample size criteria (Charan & Biswas, 2013).

5.3.1 Description of the variables

Table. 3.3 of Chapter 3. summarizes the variables considered, their definitions, and inferences. We included sales growth and GDP growth (World Bank Data, 2021a) as part of the data to control for any other variables that could affect the firm's performance.

5.3.2 Assessment of validity

The details of the data validity are enclosed in section 3.7 of Chapter 3. The author has comprehensively ruled out any threats (History, Maturation, Attrition, Instrumentation, and Selection) to the internal validity of their study as per the approach recommended by M. M. Mark & C. S. Reichardt (2001). The author believes this study's outcomes are externally valid because they are generalizable to a large degree.

5.3.3 Heterogeneity of the classes

The author chose to classify the firms into various classes based on specific revenue ranges, as shown in Table 5.2. Parametric tests such as ANOVA cannot be used in this case as ANOVA assumes homogeneity of variances, meaning the variances in different groups should be similar. As this assumption is not true based on the descriptive statistics, the F-test in ANOVA may become invalid. Therefore, the author utilized a non-parametric statistical test known as the Kruskal-Wallis test (Hole, 2011) to assess the heterogeneity of the classes.

For our case, the definition of the hypotheses is as follows

H_o: There is no difference among the samples

H_a: There is a difference among the samples

The degrees of freedom df: k-1; k= number of groups. In our case, df=5-1=4

The Chi-square value for an alpha level of 0.05 with df 4 is 9.48733

The decision rule rejects the null hypothesis if the computed Chi Square value (H) exceeds the critical Chi-square value of 9.48733.

The formula for the computation of the Chi-Square (H) value is below

$$H = \left[\frac{12}{N(N+1)} * \Sigma \frac{Tc^2}{n_c}\right] - 3*(N+1) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

N is the total number of participants (all groups combined). We have 2,800 participants.

T_c is the rank total for each group.

n_c is the number of participants in each group.

The computed H value is 2,479.5

The author rejected the null hypothesis because the computed Chi Square value (H) exceeds the critical Chi Square value. Hence, we can confirm that there are differences among the samples.

5.3.4 The rationale for the design

Cross-sectional data analysis elucidates the extent of the influence of the independent variable on the dependent variable at a particular moment. Nevertheless, these evaluations do not offer any understanding of the fundamental durability of the relationship. A complete understanding of the shift is essential to determine whether the impact is long-lasting or temporary. Panel data methods are particularly well-suited for situations when measurements of the same firm's cross-section are taken at different points in time. (Hans-Jürgen Andreß, 2017). We sought to comprehend the influence of identified variables across a sample of firms' profitability over ten years.

This study has ten periods (t = 1, 2,..., 10) and 280 firms (i = 1, 2,..., 280). There will be 280 x 10 = 2,800 observation units using panel data.

The utilization of panel data methodology indicates the presence of heterogeneity (which is validated in section 5.3.3) among the firms included in the dataset. Failure to adjust for heterogeneity in either time-series or cross-section data studies poses a significant danger of generating biased conclusions (Badi H. Baltagi, 2021).

A generic equation to analyze firms with panel data is as follows:

$Y_{it} = bX_{it} + h_i + l_t + e_{it}$ .....(2)

Y_{it} = Dependent variable (Return on Assets) of firm i in year t

X_{it} = Independent variable firm i in year t

b = Coefficient

h_i = Unobservable heterogeneity (assumed constant for firm i in year t)

l_t = Time-specific effect (assumed constant for any given t for a firm i)

e_{it} = Error term

Below is the regression equation (3) for the basal model. The results are summarized for five scenarios representing various firm sizes. For clarity, we removed the constant and error

components from the generic equation.

$ROA = b_1DD + b_2QR + b_3GWC + b_4DTE + b_5STB + b_6FGT + b_7RM\_Sales + b_8PUR\_Sales + b_9PFW\_Sales + b_{10}FA\_Util + b_{11}Sales\_FA + b_{12}SALES\_GR + b_{13}GDP\_GR$……(3)

5.4 Data summary and inferences

5.4.1 Data completeness assessment

Over ten years, a dataset of 280 enterprises provided 2,800 records for each variable. Before doing descriptive statistics on the individual class data sets, we assessed the level of data completeness. The amount of missing data was negligible. Table 3.4 of section 3.10 summarizes the data completeness % for each variable included in the dataset. The data completeness is remarkably excellent, except PUR_Sales (the proportion of finished items purchased concerning sales). Before generating descriptive statistics, the author employed suitable data imputation techniques (Reddy Sankepally et al., 2022) to address missing values. The author used the median value of the corresponding variables to fill in the gaps in the data. The variable representing the proportion of finished items purchased concerning sales exhibits the highest frequency of the value Zero. We substituted the absent data with zero, assuming the company did not acquire any completed products. The resulting dataset is a balanced panel dataset.

5.4.2 Summary of descriptive summaries

The descriptive statistics of Classes 1 through 5 are given in Appendix A1. The listed summaries offer a broad overview of the disparities in the statistics, thereby aiding in understanding the distinct operational circumstances of different classes of firms.

5.4.3 Inferences from descriptive summaries

In Figure 5.4, the author summarized each class's average, median value, and measure of dispersion (standard deviation) for return on assets (ROA). The average return on assets (ROA) for Class 1, which consists of micro and small enterprises, is negative. However, the median

ROA number is 1.16. The median ROA values for Classes 2, 3, and 4 are similar. The median Return on Assets (ROA) score for Class 5 is significantly higher than that of the other classes. Class 1 (Micro and Small) enterprises with low ROA values demonstrate subpar financial performance. Furthermore, Class 1 exhibits the highest standard deviation for ROA across all the classes, but Classes 2 through 5 indicate a consistent decrease in standard deviations. This observation of a more significant standard deviation also reveals the variation in the return on assets (ROA) performance across class 1, suggesting a more pronounced discrepancy in the operating conditions.

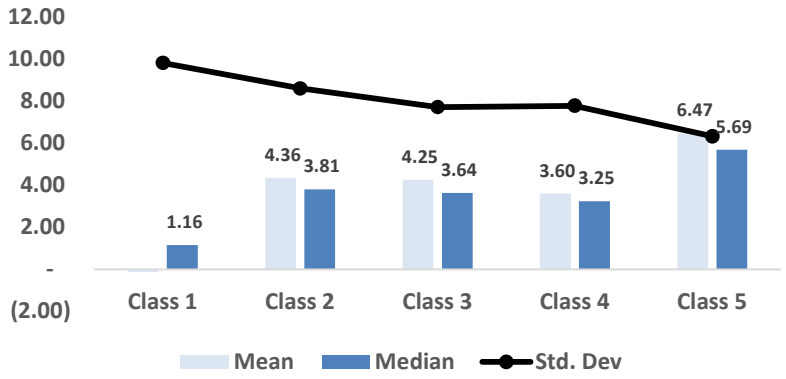

Figure 5. 4 Comparison of return on assets across various classes

The debt-to-equity ratio declined from 0.99 for class 1 to 0.33 for class 5, with the median value as the reference point. This signifies that the proportion of debt in investment is significantly higher in Class 1 firms than in Class 5 firms. Smaller firms are heavily burdened by this strategy, compelling them to accumulate debt at higher interest rates. Likewise, the median value of money borrowed for a short period increased from 32.85 million rupees for firms in class 1 to 486.05 million rupees for firms in class 5. The observations above validate small enterprises' challenges in acquiring immediate financial resources to meet their working capital needs (H-1).

The median debtor days value declined from 64.46 to 45.46 days when comparing class 1 and 5 firms. This trend indicates that firms classified as Class 1 experience a prolonged waiting period before receiving payment for their goods. Consequently, these firms must secure loans at higher interest rates to sustain their operations. The median quick ratio value rose from 0.64 days for class 1 firms to 0.75 days for class 5 firms. Class 1 enterprises' liquidity position is precarious as their current assets, excluding inventory, are insufficient to cover their current liabilities. The noteworthy observation is the decrease in the number of days for the Gross working capital cycle, from 161.26 days for Class 1 to 96.15 days for Class 5. Furthermore, the dispersion of the variables reduces as we advance from enterprises in class 1 to firms in class 5. These inferences indicate that the operational conditions varied among various categories of companies (H-2).

The median fixed asset utilization ratio declined from Class 5 firms (2.79) to Class 1 firms (1.81), suggesting that the operating strategies of the smaller firms are inefficient. The measurement of sales per net fixed asset is a concrete example supporting the previous observation. The median sales value per net fixed asset declined from Class 5 firms (461.99) to Class 1 firms (320.28). Furthermore, the variable's standard deviation for Class 1 firms, which is 1,968.18, is much higher than the standard deviation for Class 5 firms, which is 537.01. This suggests considerable disparities in performance between the two classes. Smaller firms are less profitable due to lower operating efficiencies and a lower sales ratio to net fixed assets (H-3).

The median turnover ratio for finished goods is similar for all firms. Businesses classified as Class 1 experience a median payment delay of 64.46 days, with a standard deviation of 70.12 days (measured as debtor days). This practice either increases the time it takes for Class 1 firms to convert their cash into revenue or creates financial difficulties for the suppliers that provide goods and services to these firms. Similarly, the variability in raw material purchases, measured

by the standard deviation as a proportion of sales, declined from 0.92 for firms in Class 1 to 0.12 for firms in Class 5. The decrease in standard deviation affirms the reliable purchasing power of the larger enterprises within the auto value chain (H-4).

5.4.4 Pearson's correlation analysis

The author constructed correlation matrices to analyze multicollinearity among different types of dependent and independent variables. The summary of the correlation matrix can be found in Table 5.2. A threshold of +/- 0.75 is used to account for the presence of multicollinearity among variables. The class-wise correlation matrices may be found in Appendix A1.

Table 5.2 Summary of Pearson correlation matrix

Class	Summary of correlation analysis run
Class 1	According to the author, the matrix for the Class 1 data showed no discernible collinearity.
Class 2	The author observed significant collinearity between the Gross Fixed Asset Utilization Ratio (FA_Util) and Sales per Net Fixed Assets (SA_FA) in Class 2 data.
Class 3	The author observed significant collinearity between the Gross Fixed Asset Utilization Ratio (FA_Util) and Sales per Net Fixed Assets (SA_FA) in Class 3 data.
Class 4	The author observed significant collinearity between the Gross Fixed Asset Utilization Ratio (FA_Util) and Sales per Net Fixed Assets (SA_FA) in Class 4 data.
Class 5	The author observed significant collinearity between the Gross Fixed Asset Utilization Ratio (FA_Util) and Sales per Net Fixed Assets (SA_FA) in Class 5 data.

Based on the observed consistent collinearity between the gross fixed asset utilization ratio (FA_Util) and sales per net fixed assets (SA_FA) across the class of firms, the author abandoned further analysis of sales per net fixed assets. Gross Fixed Asset Utilization Ratio (FA_Util) is the variable that represents the Fixed capital efficiency construct.

5.5 Results of panel data regression

5.5.1 Selection of appropriate technique for panel data

This study may involve individual (group) effects, time effects, or both in the panel data being evaluated. Fixed effect and random effect models help analyze such results. Panel data models provide methods for dealing with heterogeneity and examining fixed and random effects in the data (Hun Myoung Park, 2011). A fixed effect model analyzes the variation of intercepts within a specific group or period. In contrast, a random effect model studies the changes in variance components among people or periods. The random effects model postulates that individual non-time-changing and unobservable components are uncorrelated with independent variables. Conversely, the fixed effects model postulates that these two variables are correlated with independent variables. The prevailing scholarly literature (Rüttenauer & Ludwig, 2023) generally advocates for utilizing fixed effects rather than random ones. Consequently, the author employed a fixed effects model, accounting for both firm and year-fixed effects.

5.5.2 Endogeneity tests

The author employed the fixed effects model to produce preliminary regression findings using class-specific panel data. However, there is a potential for an endogeneity concern. "Endogeneity" refers to the association between the explanatory factors and the error term in a regression analysis (Roberts & Whited, 2013). If important explanatory factors are omitted from the regression analysis, a fundamental principle of ordinary least squares (OLS) regression may be violated. This violation would result in a correlation between the error term and the explanatory variables, leading to endogeneity. It could also arise from the influence of one or more explanatory factors on the dependent variable, which is influenced by the dependent variable. Failure to account for endogeneity can lead to incorrect conclusions from the regression findings (Abdallah et al., 2015). Initially, the author employed (EViews, 2022) and the business context to evaluate the explanatory factors' endogeneity across all the classes.

The summary of the endogeneity test is comprehensively presented in Table 5.3. For instance, the evaluation of endogeneity shows that debtor days (DD) display endogeneity for class 1, labeled as "Yes." In contrast, the identical variable, debtor days (DD), does not show endogeneity for class 4, marked as "No." Similarly, the gross working capital cycle days (GWC) do not exhibit endogeneity for class 1, denoted as "No," whereas the identical variable displays endogeneity for class 2, marked as "Yes."

Table 5. 3 Summary of endogeneity test run

Variable	Class 1	Class 2	Class 3	Class 4	Class 5
DD	Yes	Yes	Yes	No	Yes
GWC	No	Yes	Yes	Yes	Yes
QR	No	No	No	Yes	No
DTE	No	No	No	No	No
FGT	No	No	No	No	No
FA_Util	Yes	Yes	Yes	No	Yes
RM_Sales	No	No	No	No	No
PUR_Sales	No	No	No	No	No
STB	No	Yes	No	No	No
PFW_Sales	No	No	No	No	No

Yes: Presence of endogeneity; No: Absence of endogeneity

5.5.3 Strategy to overcome endogeneity and final regression results

To tackle the endogeneity problem, the author employed the two-stage least squares (2SLS) methodology using EViews (2022). This estimation technique necessitates the inclusion of external exogenous variables, also known as instrument variables, in addition to the variables already examined in the regression analysis (Mogstad et al., 2019). To account for the observed endogeneity, the author incorporated more instrumental variables. The complete list of these variables is included in Appendix A1. The author took appropriate measures to ascertain the linear connection between the hypothesized instrumental variable and the dependent and suspected endogenous variables. The author examined instrument variables that exhibit a significant association to ensure the results' reliability. The author derived the regression model's independent and additional instrumental variables from the same dataset.

Table 5.4 Panel data analysis results summary (2012-2021)

Variables	Class 1	Class 2	Class 3	Class 4	Class 5
Constant		0.00* (7.87)	0.00* (10.98)	0.00* (20.97)	0.00* (23.25)
DTE		0.00* (-0.21)		0.01* (-0.44)	0.04* (-0.66)
STB		0.00* (-0.01)			0.1** (-0.00)
QR	0.02* (1.03)		0.1** (1.17)	0.00* (6.31)	
GWC		0.02* (-0.04)		0.00* (-0.07)	0.00* (-0.07)
DD	0.03* (-0.05)	0.1** (-0.02)	0.01* (-0.07)		
FA_Util	0.00* (1.39)	0.00* (0.53)	0.00* (2.73)		0.00* (1.10)
FGT				0.06** (0.00)	
RM_Sales		0.00* (-1.93)	0.00* (-12.10)	0.00* (-19.76)	0.00* (-21.74)
PUR_Sales	0.00* (-31.82)		0.00* (-8.73)		
PFW_Sales			0.00* (-79.40)	0.00* (-106.70)	0.00* (-69.88)
SALES_GR			0.01* (-2.78)	0.00* (3.52)	
GDP_GR					
Adjusted R Square	0.43	0.58	0.70	0.67	0.60
Prob (F-Statistic)	0.000	0.000	0.000	0.000	0.000

Coefficient value in parenthesis; * 95% Significance level; ** 90% Significance level; Coefficients rounded to two decimals

The panel data regression results after removing the endogeneity issue using the 2SLS method are enclosed in Table 5.4. Panel data models typically exhibit lower adjusted R-square values than time series models. A limited number of independent variables can account for the variation in the dependent variable in a standard regression model for a particular organization. The identical collection of independent factors will account for significantly less variability when comparing the same dependent variable to different firms (William Gould, 2003)

5.6 Discussion and implications

5.6.1 Discussion

Effective liquidity management is crucial for the long-term viability of a business, particularly for micro and smaller enterprises in the class 1 category. The variables Quick Ratio (QR), Debtor Days (DD), Fixed Asset Utilization (FA_Util), and Purchase of Finished Goods as a Percentage of Sales (PUR_Sales) exert a substantial influence on the Return on Assets (ROA) of Class 1 firms. The quick ratio offers a glimpse into the financial stability of the company's activities. Additionally, it serves as a measure of the business's financial state. Class 1 firms have a median quick ratio of 0.64, suggesting that their current liabilities exceed their current assets. Panel regression analysis reveals a positive correlation between the quick ratio (QR) and return on assets.

Moreover, the median value for debtor days (DD) is 64.46. According to the regression model, a decrease of one day in debtor days (DD) leads to a 0.05 unit rise in return on assets (ROA). The regression results demonstrate a positive correlation between ROA and fixed asset utilization. To enhance their Return on Assets (ROA), organizations classified as Class 1 should prioritize the financial components of their operations.

The variables that significantly impact the return on assets (ROA) for Class 2 (Medium Enterprises) differ from those that substantially impact Class 1. This is mainly because of the differences in the business environment in which these firms operate and the corresponding flexibility that each class of firm has to improve their return on assets. For Class 2 firms, the debt-to-equity ratios (DTE), gross working capital cycle days (GWC), short-term borrowings (STB), and raw materials as a percentage of sales (RM_Sales) are also important, along with the quick ratio (QR), debtor days (DD), and fixed asset utilization (FA_Util). The median value of raw materials as a percentage of sales (RM_Sales) is 0.56. A decrease of one unit in the ratio of raw materials to sales (RM_Sales) leads to a 1.93 unit rise in return on assets (ROA). Class 2 firms differ from Class 1 firms because financial and operational variables influence them, whereas Class 1 firms are only affected by financial variables.

The significance of the financial and operational aspects increases as we move towards larger enterprises (Classes 3, 4, and 5). The factors that affect the return on assets (ROA) differ for different categories.

Firms classified as Class 3 and above exhibit robust cash reserves and employ highly effective strategies for managing their working capital. This situation protects and ensures the companies' Return on Assets (ROA) remains stable even in difficult operating conditions. Class 1 and Class 2 firms, mainly micro, small, and medium enterprises (MSMEs), face a fragile financial status due to the variability in operating conditions.

The Debtor Days (DD) is an essential characteristic for all classes except Class 4 and 5. This discovery suggests that smaller enterprises, particularly those that serve as deep-tier suppliers, have a more significant amount of outstanding payments owed to them, which in turn hampers their capacity to attain a higher return on assets (ROA). Discriminatory business practices have led to different operating conditions for diverse classes of enterprises, particularly impacting MSMEs and smaller-sized corporations. Small firms face a disadvantage in obtaining financing

at reasonable rates and maintaining sufficient liquidity due to the lack of fair competition. Supply chain finance (SCF) has the potential to reshape the business and credit environment effectively. Research suggests that implementing supply chain finance (SCF) will yield advantages for various stakeholders.

5.6.2 Theoretical implications

Initially, as a contribution to the contingency theory, we ascertain the essential business levers that should be prioritized for different types of firms in the present operational climate. The study provides valuable insights for firms in many industries to enhance their financial performance by tailoring their efforts to their demands. By utilizing these findings, firms may make informed decisions that lead to improved financial outcomes. Furthermore, the author makes a valuable contribution to the current body of research on stakeholder theory. The ecosystem partners within the value chain can achieve simultaneous prosperity by adopting a shared vision for the value chain rather than focusing just on individual firm strategies. The heightened utilization of supply chain finance could help the value chain members.

Furthermore, the author verifies the correlation between exceptional financial performance and the implementation of efficient operations management strategies. There is currently a lack of research in the literature that specifically addresses the challenges small firms face in developing countries, with a particular emphasis on India. The author wants to fill this deficiency in our ongoing research.

5.6.3 Managerial implications

The regression findings from the panel data analysis provide a concise summary of the variables that significantly impact the accomplishment of Return on Assets (ROA). The importance of variables that improve the financial performance of a specific group of companies suggests a strong moderating impact on the group's classification. The analysis also questions the prevailing approach to liquidity management in the Indian auto value chain,

where dominant corporations take advantage of smaller firms by imposing favorable conditions (Liebl et al., 2016).

The author developed a decision framework that can be handy for various classes of firms. Practitioners from different classes of firms can concentrate on specific areas that greatly influence their business performance. For example, practitioners in Class 1 can focus on enhancing their financial practices while ensuring that the current performance levels in other operational domains are upheld. Practitioners can significantly benefit from a decision guide as it offers a systematic method for making complex decisions. It provides a transparent, uniform, and empirically supported method for making decisions, which can significantly improve the quality and efficacy of professional decisions.

Table 5.5 summarizes a decision guide that practitioners from different classes might use to improve organizational performance.

Table 5.5 Decision guide for practitioners

Variable	Class 1	Class 2	Class 3	Class 4	Class 5
DTE		Decrease		Decrease	Decrease
STB		Decrease			Decrease
QR*	Increase**		Increase**	Increase**	Increase**
GWC		Decrease		Decrease	Decrease
DD	Decrease	Decrease	Decrease		
FA_Util*	Increase**	Increase**	Increase**	Increase	Increase
FGT				Increase	
RM_Sales*		Decrease**	Decrease**	Decrease**	Decrease**
PUR_Sales	Decrease		Decrease		
PFW_Sales			Decrease	Decrease	Decrease

* Applicable for a majority of the classes of firms ** High-impact variable

Increases in Quick ratio (QR), improvement in fixed asset utilization (FA_Util), and decrease in raw material costs as a percentage of sales (RM_Sales) are applicable for the majority of the classes of firms.

- Improving the solvency of the organization is critical. The importance of the Quick ratio (QR) further supports the observation.
- Improving the efficacy of fixed capital is crucial for all types of businesses. The results for Fixed asset utilization (FA_Util) demonstrate this.
- Improving operational efficiency is essential for all classes of firms. The results for Raw materials as a percentage of sales (RM_Sales) show this.

This result highlights the significance of standard best practices for businesses, regardless of classification. It is also evident from the results that practitioners must use different levers for various classes of firms to achieve the expected performance. For Classes 2, 4, and 5 firms, Capital structure changes, namely the reduction in the Debt to Equity (DTE) proportion, substantially impact Return on Assets. The impact of these decisions is negligible for firms in Classes 1 and 3. Variables related to liquidity management, namely Quick ratio (QR), Gross working capital cycle days (GWC), and Debtor days (DD), have a significant impact on the Return on Assets for most firm classes. Liquidity management, as the lifeblood of business operations, is the most ubiquitous topic in all classes. Improving the liquidity of a larger company at the expense of a smaller company will inevitably expose the entire value chain to supply chain risk. Adopting Supply Chain Finance (SCF) solutions gives all value chain participants adequate liquidity management opportunities.

In summary, for micro and small firms (Class 1), improvement of the quick ratio and fixed asset utilization had the most significant impact on return on assets, whereas for medium-sized firms (Class 2), reduction of raw material expenses as a percentage of sales and improvement of fixed asset utilization was crucial. Improvement in quick ratio, fixed asset utilization, and reduced raw material expenses as a percentage of sales significantly impacted ROA for Class 3 firms. Improvement in quick ratio and reduced raw material expenses as a percentage of sales significantly impacted ROA for Class 4 and 5 firms.

5.7 Conclusions

India has the potential to significantly contribute to the global economic development narrative due to its extensive domestic consumption. It is necessary to strengthen the domestic ecology to exploit this opportunity fully. In light of this, the author tried to understand the disparities in the operational circumstances of different types of companies, which could hinder the growth of the domestic automobile sector. The hypotheses were assessed using data inferences and panel data regression.

Given the differences in operational conditions, a universal strategy may not help companies achieve exceptional financial performance. According to the contingency theory, every company requires tailored measures to enhance its financial performance. The author conducted a study examining the impact of several independent variables on a company's profitability (ROA). The author investigated 280 firms over ten years and conducted panel data regression to identify relevant variables that can improve the financial performance of each class of enterprise. The validation results of the hypotheses are presented in Table 5.6.

Table 5.6 Summary of hypotheses validation

Hypothesis	Observation	Validity of hypothesis
H-1	The variables for the hypothesis DTE and STB show variance across the classes in the data inferences. Variables are significant in the panel data regression. The coefficient value varies across the classes to enhance ROA.	Yes
H-2	The variables for the hypothesis QR, DD, and GWC show variance across the classes in the data inferences. Variables are significant in the panel data regression. The coefficient value varies across the classes to enhance ROA.	Yes
H-3	The variable for the hypothesis FA_Util shows variance across the classes in the data inferences. Variables are significant in the panel data regression. The coefficient value varies across the classes to enhance ROA.	Yes
H-4	The variables for the hypothesis FGT, RM_Sales, PUR_Sales, and PFW_Sales show variance across the classes in the data inferences. Variables are significant in the panel data regression. The coefficient value varies across the classes to enhance ROA.	Yes

The recommended practice of reducing debt-to-equity ratio (DTE) levels to increase return on assets is consistent with the findings of empirical studies (Nazir et al., 2021; Erdogan et al., 2015; Kant, 2018). Recommendation regarding the restricted use of short-term borrowings (STB) to avoid excessive debt payment draws strength from the observations (Baum et al., 2007; Laura Raisa, 2015; Yazdanfar & Öhman, 2015; Yisau Abiodunt, 2013). The strategic way of managing Debtor days (DD) is critical to all classes. The author's inference is also consistent with the findings of (Hermawan et al., 2023). A higher fixed asset utilization ratio (FA_Util) contributes to operational efficiency. This observation correlated with the results of (Kant, 2018). Effective working capital management is critical to maintaining flexibility in operations and avoiding potential profitability leakages. This observation also confirms the findings of Aldubhani et al. (2022). The findings of the study empower companies to make more informed strategic

choices for their organizations, leading to enhanced financial outcomes. The study supports stakeholder theory by emphasizing the importance of a collective vision for the value chain rather than a strategy centered just on the enterprise. This method facilitates the simultaneous prosperity of all participants within the ecosystem. As far as the author is aware, no existing literature on Indian geography specifically focused on the auto industry, which plays a significant role in attaining carbon neutrality. These studies can help practitioners concentrate on particular aspects to improve performance.

Chapter 6: Optimizing Factor Levels Leading To Profitability Enhancements In A Supply Chain Finance Environment: Insights From The Indian Auto Industry

Preview: Section 6.1 emphasizes the significance of the Indian auto industry in achieving the dual objectives of growth and compliance with carbon emission norms. The section also outlines the motivations for the study and associated research questions. Section 6.2 covers the appropriate literature supporting the identified research questions and summarizes the hypotheses for the study. Section 6.3 outlines the elements of the research methodology and discusses the conceptual framework, data sources, and the significance of the method adopted for the research. Section 6.4 describes the process of finalizing significant variables and their levels for taking up the Design of Experiments (DoE) study. The section also discussed the critical inferences from the DoE run and their applicability in improving the ROA. Section 6.5 covers the conclusions of the study, validation of the hypotheses formed, and the implications.

6.1 Introduction

The growth and development of global supply chains have been driven by various significant reasons, such as trade liberalization, cost-effectiveness, market demand, and expansion, as stated by Unctad (2013). Although global supply centers offer advantages (Tsay et al., 2018), they also bring about intricacies and hazards (Novoszel & Wakolbinger, 2022). Throughout the many phases of the COVID-19 epidemic, businesses have encountered threats to their supply chains and difficulties in their operations (Graves et al., 2022). To address these concerns, international manufacturers will encounter heightened political and competitive pressure to augment their local manufacturing capabilities, boost employment rates within their respective nations, and minimize or eradicate their dependence on sources that are seen as precarious (Shih, 2020).

Undoubtedly, these efforts would result in implementing a more regional sourcing strategy (Simchi-Levi & Haren, 2022). Chopra S & Sodhi M.S (2004) explored various approaches to mitigate and handle the detrimental consequences of supply chain risks. However, the existing research in operations management has concentrated on the focal organization's perspective, neglecting the broader ecosystem or value chain perspective (Munir et al., 2020). This pattern aligns with the concepts of the agency theory, which states that when two parties with opposing aims and differing risk attitudes collaborate, it leads to conduct that prioritizes the firm's interests (Eisenhardt, 1989).

The economic influence of the Asia Pacific (APAC) region is anticipated to increase due to a shift in the global landscape. According to Biswas (2022), it is expected that by 2040, the APAC area will contribute over 42% of the total world GDP. This growth will be mainly fueled by the ongoing economic development of China, India, and the eleven Southeast Asian countries that makeup ASEAN. India is recognized as one of the most rapidly expanding economies in the world. The country's growth potential is attributed to its youthful and growing population, ongoing economic reforms, rising urbanization, and the growth of its middle class (International Monetary Fund, 2023). Currently, India aims to achieve both economic expansion and environmental sustainability. India has established a target of attaining net-zero emissions by 2070 to comply with international sustainability standards. India's aspirations hinge on mitigating carbon emissions in the transportation and energy domains (Government of India, 2022b). In this context, the Indian automotive sector has two critical responsibilities: 1) increasing the manufacturing sector's contribution to India's GDP and 2) developing the potential to help India achieve its goal of becoming a net-zero nation by 2070 (Government of India, 2022a).

An initial analysis of the profitability parameters of Indian auto sector companies presents a problematic scenario. Undoubtedly, larger enterprises in the Indian automobile sector

have higher profitability than smaller firms, consistently maintaining high performance over time (CMIE, 2021). Indeed, a significant proportion of micro-enterprises in India lack registration. The median ratio of current assets to total assets for these MSMEs is 56%. The author noted a substantial decline in the annual registration of businesses with the Ministry of Corporate Affairs (MCA) under the Government of India (CMIE, 2021). Although maintaining strong financial performance is crucial for a firm to stay afloat, adopting a self-centered and non-cooperative approach by the focal firms might lead to smaller firms exiting the industry. A few pertinent research questions largely unexplored in the Indian context based on the guidance provided by Whetten (1989) are:

RQ-1: Why is there massive variation in the performance levels of firms of various sizes?

RQ-2: How do firms of varying sizes finalize the focus areas to achieve enhanced profitability?

RQ-3: What is the level of augmentation in profitability with targeted approaches by firms of various sizes?

There is a lack of research that specifically addresses the improvement of performance aspects in small-sized enterprises (based on revenue) compared to larger firms worldwide, and there is no existing literature on this topic for the Indian setting. Within this framework, we assess the disparities in the prevailing operational circumstances across various companies (categorized by their revenue) in the Indian automotive sector and identify the distinct aspects that impact the financial performance of each category. Based on the general contingency theory.

Luthans & Stewart (1977b) assert that the situational approach can potentially improve the financial performance of different firms. The situational approach suggests that an ideal management concept or strategy is contingent upon the prevailing circumstances. The author implemented this theory component by categorizing firms into five unique

groups according to their revenue. Following the contingency management theory, the author has identified some essential constructs for developing a comprehensive situational approach. The endeavor is comprised of two primary stages: (1) concluding the variables that have a significant influence on the impact of business strategies and (2) identifying the strategies that are economically feasible for each distinct set of strategically significant environmental conditions.

The author examined the financial performance impact of various classes of firms and the role of significant parameters influencing the same using 2800 firm-year observations. In particular, we look at the effect of return on assets (ROA). ROA is selected because it is a universal and comprehensive performance metric. ROA is less susceptible to manipulation than other financial performance measures, such as return on equity, which can be manipulated through debt leverage. ROA involves multiple asset categories (property, equipment, and people). These assets are challenging to alter (Deloitte, 2013). The ROA is also widely used in the operations management literature for assessing company performance (Ambulkar et al., 2023).

6.2 Literature review

Growth without profitability does not impress the stakeholders. Profitability and growth influence shareholder value (Varaiya et al., 1987). Multiple studies in the past have focused on larger, small, and medium businesses to explore if firm size is a significant determinant of profitability. Fiegenbaum & Karnani (1991) argued that smaller firms, especially in capital-intensive industries with less profitability, should use their size to exploit the flexibility in delivering output in line with fluctuating demand requirements and turn that into a competitive advantage. Serrasqueiro & MaçÃs Nunes (2008) examined the relationship between profitability and firm size for Portuguese small and medium enterprises and confirmed a positive relationship, indicating a more remarkable

ability of larger-sized firms to cope with the market changes. Lee (2009) examined a sample of more than 7,000 publicly-held US firms between 1987 and 2006 and confirmed a positive firm size-profit relationship. Doğan (2013) investigated the effect of firm size on profitability using data from 200 companies from the Istanbul Stock Exchange (ISE) between the years 2008-2011 and confirmed a positive relation between size indicators and profitability of firms, indicating that the firms have higher profitability as their size expands. Yisau Abiodunt (2013) examined the effect of firm size on the profitability of manufacturing firms in Nigeria over ten years and confirmed the positive impact of firm size on profitability. Gaio & Henriques (2018) did a comparative analysis of the profitability between large enterprises (LE) and small and medium enterprises (SME) in Europe and suggested that LE is, on average, more profitable than SMEs. Yadav et al. (2022) examined the correlation between firm size, growth, and profitability for nearly 12,001 unique non-financial listed and active firms from 1995 to 2016 for 12 industrial and emerging Asia–Pacific economies. The author indicated that the firm size and profitability are significant for China, India, Israel, and Thailand and insignificant for the other selected Asia–Pacific economies.

This section summarizes contingency theory from the profitability (ROA) achievement perspective and presents our hypotheses.

6.2.1 Profitability (ROA) and contingency theory

Despite growing skepticism surrounding the universality assumption, a situational perspective, dependent on the circumstances at a particular time, is considered the most effective management concept or technique. Situational and universalist approaches are conceptually distinct (Luthans & Stewart, 1977b). The universalist constructs are more straightforward to apply in practice but disregard potentially significant and complicated situational variables. The situational approach is more conceptually realistic but complex,

making practical application much more difficult (Choi et al., 2023). The contingency approach has a situational orientation but is more exacting and stringent. Identifying and developing functional relationships between environmental, management, and performance variables is the definition of the contingency approach.

Christopher & Ryals (1999) outlined four essential drivers of shareholder value in Figure 6.1. The recommended method considers shareholder value from the perspective of the focal company. How does this affect a value chain where multiple companies operate under buyer-supplier arrangements? Does the level of interaction among various drivers impact shareholder value generation? Does this strategy apply to businesses of all sizes (revenue)? The author found no evidence in the literature for such queries.

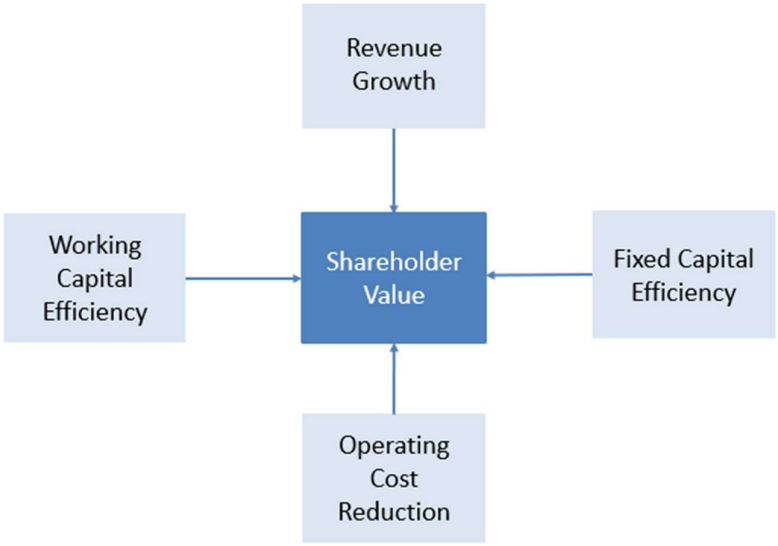

Figure 6. 1 Drivers of shareholder value (Source - (Christopher & Ryals, 1999))

Numerous performance dimensions influence an organization's return on assets. A subpar asset return could result from excelling in one performance dimension at the expense of another. A balanced approach is required to achieve a sustainable return on assets. The author aimed to ascertain the applicability of the framework above to firms of different sizes and investigate possible interactions among the performance variables.

To evaluate the same, the author has finalized four constructs, two from the financial domain and two from the operational field, to comprehend the impact on profitability achievement for distinct classes of businesses in a balanced way. The financial constructs are concerned with the structure of financing the business (capital structure) and its ability to manage working capital (liquidity management). In contrast, the operational constructs concern asset utilization (fixed capital efficiency) and operations management (operational efficiency). Below is a critical analysis of the broad impact areas.

6.2.2 Impact of capital structure on profitability (Financial construct)

The principal sources of financing for a business are debt, preferred equity, and common equity (Van Horne & Wachowicz, 2008). An effective capital structure seeks to maximize the firm's value while minimizing the total cost of capital. Under perfect capital markets, a company's value is unrelated to its capital structure (Modigliani & Miller, 1958). Firms can achieve optimal capital structure by striking a trade-off between the tax-free benefit of debt and the distress cost of debt, as outlined by the Trade-off theory (Cekrezi, 2013), to maximize the firm's value. Myers & Majluf (1984) described the pecking order by which firms prioritize their funding sources, beginning with internal financing or retained earnings, then debt issuance, and lastly, equity as a last resort to meet their funding needs. In a real-world scenario, however, not all firms in the value chain have the freedom to exercise their pecking orders to design capital structure decisions, as external factors influence them.

Due to the power imbalance in the supply chain relationships (Howorth & Westhead, 2003), the focal firms exert their influence by prescribing favorable trade terms to the smaller firms in the value chain. Such a practice results in a situation in which small suppliers finance their large consumers via trade credit. Trade credit is particularly prevalent in underdeveloped nations with underdeveloped financial markets (World Bank

Report, 2018). Typically, large corporations incur significantly lower financing costs than their suppliers (Tanrisever et al., 2015). Smaller companies face liquidity issues due to increased financing costs. Smaller firms pass on the additional financial costs to their downstream larger firms through an excessive cost of goods sold (Aberdeen-Group, 2006). Such practice often happens when the payments of smaller firms are delayed due to unfavourable trade terms enforced by larger firms (Wetzel & Hofmann, 2019). In conclusion, the inability to effectively choose a proper capital structure for their enterprises leads to performance issues and makes the entire value chain riskier. Thus

6.2.3 Impact of liquidity on profitability (Financial construct)

Businesses must prioritize effective liquidity management (Goodhart, 2008) to avoid insolvency due to inadequate financial performance. Liquidity is a crucial financial indicator that measures a company's ability to fulfill its short-term obligations without incurring unfavorable losses (Jenkinson, 2008). Since the primary purpose of a business is to generate profits, financial analysis places a greater emphasis on profitability than liquidity (Panigrahi, 2013). Zygmunt (2013) emphasized the significance of liquidity and argued that it results in higher profitability. As a result, liquidity and profitability trade-offs are regarded as the two corners of a straight line, as advancing in one direction necessitates sacrificing the other (Saluja & Kumar, 2012). Brealey et al. (2012) state that profitability ratios consist of net profit margin, return on assets (ROA), return on equity (ROE), and payout ratio. Coughenour & Deli (2002) provided empirical evidence suggesting that organizational form affects liquidity management practices.

Better liquidity management reduces external financing requirements (Pratap Singh & Kumar, 2014). The restriction on the availability of external funding has played a more significant role in improving liquidity management for smaller enterprises (Lekkakos & Serrano, 2016). Most previous research focused on firm-specific liquidity management

(Martin & Hofmann, 2019), ignoring its detrimental effect on more minor value chain participants. Smaller businesses need help securing working capital to manage their operations' liquidity (Song et al., 2016b). The firm's profitability may be affected by both excessive and insufficient liquidity (Wetzel & Hofmann, 2019). Due to their low-performance history, smaller companies must pay higher credit rates. A collaborative environment that considers the business interests of upstream and downstream value chain partners can reduce disruptions. Along the supply chain, world-class companies closely monitor and manage their working capital (Gomm, 2010).

6.2.4 Impact of fixed capital efficiency on profitability (Operational construct)

Fixed asset efficiency is the extent to which a business utilizes its fixed assets (e.g., buildings, machinery, and equipment) to generate revenue and attain profitability (return on assets). Asset turnover measures the firm's ability to generate revenues from its assets, whereas profit margin measures its control over the costs incurred to generate those revenues. The asset turnover rate, which reflects the firm's asset utilization, and the profit margin, which reflects the firm's operational efficiency, are partially the result of the firm's strategy (Fairfield & Lombardi Yohn, 2001). Larger firms can increase fixed capital investment opportunities, resulting in greater profitability, unlike smaller firms constrained by financial constraints (Baumol,1959). Yadav et al. (2022) investigated the relationship between firm scale, profitability, and growth. The negative size-profit and positive growth-profit correlations indicate that profits initially increase as a company grows. Nonetheless, over time, gains in profit rates diminish for larger firms, suggesting that large size fosters inefficiency; consequently, firms should be of the optimal size. Hall & Weiss (1967) concluded that the size of a company is associated with large profit margins. A proxy indicator of market dominance, a capital requirement barrier,

significantly impacts profitability. Inferior economies of scale will disadvantage smaller businesses. Any substandard utilization of operating fixed assets would have disastrous effects on business performance. Thus

6.2.5 Impact of operational efficiency on profitability (Operational construct)

Baik et al. (2013) theorized that firms that increase their efficiency would manifest greater profitability in the present and future. Changes in efficiency are positively associated with current and future returns. According to the (Imhanzenobe, 2019) findings, the relationship between operating expenses, asset turnover, and ROA was negative and significantly positive, respectively. The relationship between the cash conversion cycle and the return on assets is negative. Wang (2002) proposed that organizations could increase profitability by shortening the cash conversion cycle. The inability to contain risks within the value chain can negatively impact the operational performance of businesses (Hendricks & Singhal, 2003a).

Most prior research centered on the individual firm instead of the value chain. In addition, the impact of profitability on the particular entity is evaluated in pockets, one factor at a time (OFAT), with all other factors held constant. OFAT is the simplest method for determining the effect of one variable on the response variable. However, it does not consider possible interactions between other variables and the response variable. Such an approach does not assess the simultaneous impacts of significant variables (Czitrom, 1999) on return on assets (ROA). Using the Design of Experiments (DoE), the author attempted to identify and develop functional relationships to achieve the ROA as recommended by the contingency theory.

6.2.6 Design of Experiments (DoE)

Design of experiments (DoE) is a method that entails designing and conducting experiments to investigate multiple factors and their interactions efficiently. DoE involves modifying numerous factors using carefully designed experimental layouts, such as factorial designs, fractional factorial designs, and response surface layouts. The Design of Experiments (DoE) provides researchers with statistical tools and techniques to extract meaningful information about main effects, interactions, and optimal operating conditions (Montgomery, 2013). While OFAT is a simplified and more intuitive method, DOE offers greater efficiency, robustness, and the capacity to capture interactions between factors.

The DoE method has been used widely in the industry in multiple areas, specifying the direction and magnitude of the relationships. Bagchi (2013) concluded the impact of a company's current assets and liabilities on its profitability. Mitra et al. (2016) utilized DoE techniques to determine an automobile's optimal suspension and steering geometry parameters to increase ride comfort while maintaining an optimal level of road holding. Deng et al. (2020) used the DoE methods to conduct a techno-economic evaluation of a newly developed technique for recovering rare earth elements by identifying the primary factors that influence the profitability of the process. Scotto D'apollonia et al. (2004) applied DoE methods to vehicle external aerodynamics to better understand complex geometric parameter effects and coupling.

6.3 Research design and methodology

The current research question is related to the Indian auto industry. Therefore, "organization" is regarded as the unit of analysis for the research. The author acquired and analyzed secondary data (financial data reported by the organization) from the Centre for Monitoring the Indian Economy (CMIE, 2021), a prominent business information provider.

Examining secondary financial reporting data in research offers several notable advantages:

- The data may be compared across firms because they are compiled using standardized accounting techniques certified by the Indian government.
- The firms have reported the data to the Government of India. Hence, using the data to develop actionable insights is highly dependable.
- Since the data and its corresponding terminology are accessible to the public in a standardized manner, it is more convenient to convey the research findings to businesses using a shared business language.

6.3.1 Data set, class, and hypotheses finalization

The author discussed the data scoping in section 3.6. The author assessed the internal validity threats to evaluate the study's validity (M. M. Mark & C. S. Reichardt, 2001). The details of the assessment are enclosed in section 3.7. According to the discussion, the author has comprehensively ruled out any threats to the internal validity of their study. The author believes this study's outcomes are externally valid because they are generalizable to a large degree.

Based on the final set of 280 firms, the author manually classified the firms into five buckets, as shown in Table 6.1. below for the study. The research inferences are drawn based on the class of the firms. Hence, ensuring the heterogeneity of the classes is required. The author employed appropriate techniques to assess the classes and confirmed the heterogeneity. The details of the tests and the outcomes are enclosed in section 5.3.3.

Table 6. 1 Classification of firms for assessment

Average sales (Turnover)- INR Cr (1)	Class name (2)	Number of firms (3)	Size of the class (Total) (4)
0-50 - (Micro and Small firms)	Class 1	38	380
50-250 - (Medium firms)	Class 2	103	1,030
250-500 - (Large firms)	Class 3	54	540
500-1000 - (Extra-large firms)	Class 4	41	410
1000-2500 - (Largest firms)	Class 5	44	440

The sample size for each firm class is listed in Table 6.1. A ten-year dataset for 38 firms (Class 1) contains 380 records (Column 4 of Table 6.1). The samples considered for the evaluation satisfy the minimum sample size criteria (Charan & Biswas, 2013).

As the operational environment differs for different classes of firms, business practices must be tailored to ensure profitability (ROA). A specific factor (variable) can directly impact the profitability of a class or firm and also a confluence of the factors leading to profitability improvements. The primary objectives of the research are to comprehend the significant factors influencing the profitability of various classes of firms and determine the optimal level of factor interaction effects to enhance profitability.

This leads to the following hypotheses:

H1: For each firm class, the main factor effect of significant factors influences the ROA.

H2: For each class of firm, the interaction effects among significant factors influence the ROA

6.3.2 Variable selection and data completeness assessment

Identifying the variables for the analysis is crucial in empirical research. The author discussed the steps to determine the appropriate variables in Table 3.1 of section 3.8. The author included the summary of the variables along with their inference in Table 3.2 of section 3.9. Ensuring data completeness is of paramount importance in data-intensive research. The author assessed the data completeness and utilized appropriate imputation techniques to fill in the missing data to generate balanced panel data. The details of the assessment are included in Table 3.4 of section 3.10.

The author created correlation matrices for distinct dependent and independent variables classes to comprehend multicollinearity. A threshold of +/- 0.75 considers the multicollinearity effect among variables.

Table 6.2 Summary of Pearson correlation matrix

Class	Summary of correlation analysis run
Class 1	The author did not observe any significant collinearity in the matrix for Class 1 data.
Class 2	The author observed significant collinearity between Gross Fixed Asset Utilization Ratio (FA_Util) and Sales per Net Fixed Assets (SA_FA) in Class 2 data.
Class 3	The author observed significant collinearity between Gross Fixed Asset Utilization Ratio (FA_Util) and Sales per Net Fixed Assets (SA_FA) in Class 3 data.
Class 4	The author observed significant collinearity between Gross Fixed Asset Utilization Ratio (FA_Util) and Sales per Net Fixed Assets (SA_FA) in Class 4 data.
Class 5	The author observed significant collinearity between Gross Fixed Asset Utilization Ratio (FA_Util) and Sales per Net Fixed Assets (SA_FA) in Class 5 data.

Appendix A1 enclosed contains the details of the class-wise correlation matrices. The summary is presented in Table 6.2. Based on the observed consistent collinearity between the gross fixed asset utilization ratio (FA_Util) and sales per net fixed assets (SA_FA) across the class of firms, the author abandoned further analysis of sales per net fixed

assets. Gross Fixed Asset Utilization Ratio (FA_Util) is the variable that represents the Fixed capital efficiency construct.

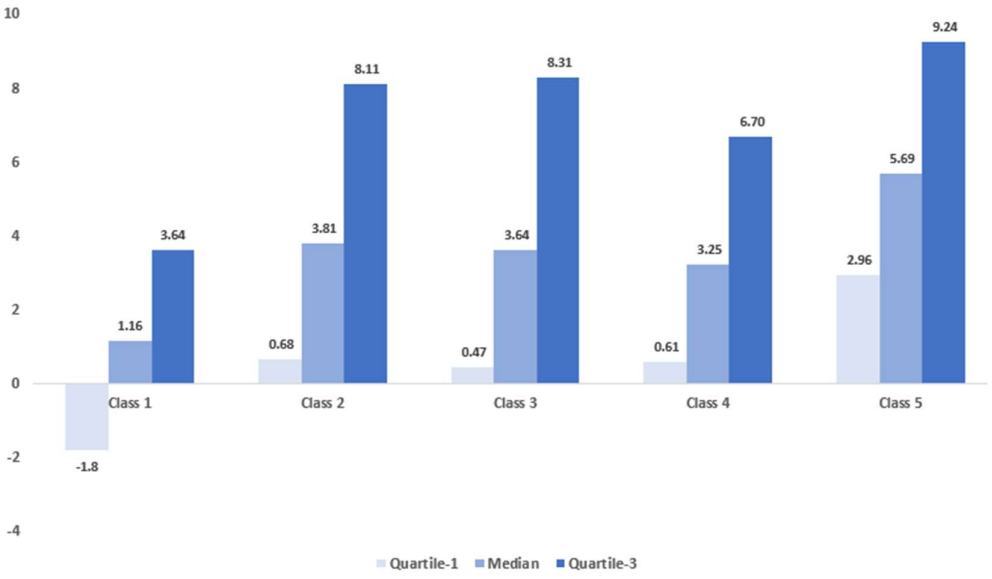

Figure 6. 2 Comparison of return on assets across various classes

The author plotted the Quartile-1, median, and Quartile-3 return on assets (ROA) for each class of firms in Figure 6.2 to assess the profitability range across the class types. The Quartile-1 ROA for Class 1 is negative, while the median value is 1.16. Comparable median ROA values exist for Classes 2, 3, and 4. Class 5 has a median ROA value significantly higher than the other classes. Class 1 companies with a low ROA have substandard financial performance. The firms' persistently subpar financial performance may endanger their survival. Further details of the class-wise descriptive summaries are included in Appendix A1.

6.3.3 Need for panel data method

Due to the inherent nature of the class behavior (as observed primarily from the differences in the ROA), the variables affecting the return on assets per each class may differ. To understand the same, the author assessed significant variables that might impact

the return on assets per class. Typically, regression data analysis explains the magnitude of the effect (impact of the independent variable) on the dependent variable at a given time. However, such insights provide no evidence regarding the underlying stability of the relationships when the data is considered to span multiple periods. Determining whether the effect's magnitude is permanent or transient is essential. Panel data methodologies are optimal when a cross-section of the same company is measured at different times (Hans-Jürgen Andreß, 2017).

The panel data methodology implies heterogeneity among the firms in the data set. When heterogeneity is not controlled in either time-series or cross-section data analyses, there is a substantial risk of obtaining biased results (Badi H. Baltagi, 2021).

A generic equation to analyze firms with panel data is as follows:

$Y_{it} = bX_{it} + h_i + l_t + e_{it}$ .....(2)

Y_{it} = Dependent variable (Return on Assets) of firm i in year t

X_{it} = Independent variable firm i in year t

b = Coefficient

h_i = Unobservable heterogeneity (assumed constant for firm i in year t)

l_t = Time-specific effect (assumed constant for any given t for a firm i)

e_{it} = Error term

Below is the regression equation (3) for the basal model. The results are summarized for five scenarios representing various firm sizes. We removed the constant and error components from the generic equation for clarity.

$ROA = b_1DD + b_2QR + b_3GWC + b_4DTE + b_5STB + b_6FGT + b_7RM\_Sales + b_8PUR\_Sales + b_9PFW\_Sales + b_{10}FA\_Util + b_{11}Sales\_FA + b_{12}SALES\_GR + b_{13}GDP\_GR$……(3)

6.3.4 Significance of Design of Experiments (DoE) for the current study

Design of experiments (DoE) is a method that allows scientists and engineers to examine the relationship between multiple input variables (factors) and critical output variables (responses) systematically and efficiently. It is a structured approach to data collection and discovery. DoE aims to determine the effects of the primary factors and their interactions with the response variable. In the current research, the author used the response surface methodology (RSM) to determine the joint response of the input variables and their corresponding levels on the return on assets per class. The procedure is popularly adopted for solving various industrial problems (Raymond. H. Myers et al., 2009).

6.4 Results summary and discussion

6.4.1 Finalization of significant variables

This study may involve individual (group) effects, time effects, or both in the analyzed panel data. Fixed effect and random effect models help analyze such results. Panel data models provide techniques for dealing with heterogeneity and examining fixed and random effects in the data (Hun Myoung Park, 2011). A fixed effect model analyses whether intercepts differ within a group or period, while a random effect model explores variations in component differences among individuals or periods. The random effects model postulates that individual non-time-changing and unobservable components are uncorrelated with independent variables.

Conversely, the fixed effects model assumes these two factors correlate with independent variables. The prevailing scholarly literature (Rüttenauer & Ludwig, 2023) commonly advocates utilizing fixed effects rather than random ones. Consequently, the author employed a fixed effects model, accounting for both firm and year-fixed effects. The author used the fixed effects model to produce a preliminary set of regression findings

based on panel data using EViews (EViews, 2022) relevant to each class. Further, the author addressed the potential for the endogeneity in the data. The details of the endogeneity exercise are summarized in section 5.5.2. To account for the observed endogeneity, the author incorporated more instrumental variables. The complete list of these variables may be seen in Appendix A1. The author used appropriate strategies to overcome the endogeneity issue, the details of which are incorporated in section 5.5.3. The final panel regression results are summarized in Table 6.3. Panel data models typically exhibit lower adjusted R-square values than time series models. A limited number of independent variables can account for the variation in the dependent variable in a standard regression model for a particular organization. According to William Gould (2003), when we compare the same dependent variable with other firms, the same combination of independent variables will account for a significantly smaller amount of variability.

Table 6. 3 Panel data analysis summary (2012-2021)

Variables	Class 1	Class 2	Class 3	Class 4	Class 5
Constant		0.00* (7.87)	0.00* (10.98)	0.00* (20.97)	0.00* (23.25)
DTE		0.00* (-0.21)		0.01* (-0.44)	0.04* (-0.66)
STB		0.00* (-0.01)			0.1** (-0.00)
QR	0.02* (1.03)		0.1** (1.17)	0.00* (6.31)	
GWC		0.02* (-0.04)		0.00* (-0.07)	0.00* (-0.07)
DD	0.03* (-0.05)	0.1** (-0.02)	0.01* (-0.07)		
FA_Util	0.00* (1.39)	0.00* (0.53)	0.00* (2.73)		0.00* (1.10)
FGT				0.06** (0.00)	
RM_Sales		0.00* (-1.93)	0.00* (-12.10)	0.00* (-19.76)	0.00* (-21.74)
PUR_Sales	0.00* (-31.82)		0.00* (-8.73)		
PFW_Sales			0.00* (-79.40)	0.00* (-106.70)	0.00* (-69.88)
SALES_GR			0.01* (-2.78)	0.00* (3.52)	
GDP_GR					
Adjusted R Square	0.43	0.58	0.70	0.67	0.60
Prob (F-Statistic)	0.000	0.000	0.000	0.000	0.000

Coefficient value in parenthesis; * 95% Significance level; ** 90% Significance level; Coefficients rounded to two decimals

6.4.2 Consideration of levels for the significant factors

The author treated the finalized significant variables as factors in line with the DoE terminology and considered three levels per factor to build the DoE experiments. A controlled level of the independent variable is called a factor. Based on the raw data, the author finalized ranges for the three levels of the factors. Table 6.4 summarizes the levels of each significant factor considered for the DoE run.

Table 6.4 Levels of significant factors for the design of experiments

Factor	Unit of measure	Level 1	Level 2	Level 3
DTE	Ratio	<0.5	0.5-1.0	>1
STB	Number	<75	75-150	>150
QR	Ratio	<0.33	0.33-0.66	>0.66
GWC	Days	<75	75-150	>150
DD	Days	<40	40-80	>80
FA_Util	Ratio	<1	1-2	>2
FGT	Number	<50	50-100	>100
RM_Sales	Percent	<0.4	0.4-0.8	>0.8
PFW_Sales	Percent	<0.01	0.01-0.02	>0.02

6.4.3 Experimental design

Due to multiple independent variables in the experimental design, there is more to consider than the "main effect" of each independent variable on the return on assets. The effect of one independent variable on the dependent variable (return on assets) may vary with the number of the other independent variables, suggesting that the effect of one independent variable may be contingent on the magnitude of the other independent variable (University of Washington, 2014). The author built experimental designs using response surface methodology (RSM), a custom design feature in JMP (2021). RSM models are constructed using the finalized significant input variables (factors) and factor levels for the five distinct firm classes. The experimental design component of the solution aids in predicting the relationship or interaction between the measurable response (return on assets) and the

evaluated factors. The prediction occurs at numerous factor levels. The optimization component of the method aids in determining the factor values that produce the optimal response value (Schamburg & Brown, 2004). The author limited the investigation to crossing two independent variables to examine the interaction effects in the experimental design.

6.4.4 Model fit summary and significance

The fit quality of the model is evaluated using the coefficient of determination (R^2), and the model's adequacy is confirmed using the F-test in the analysis of variance (ANOVA). The model significance summary is enclosed in Table 6.5. Based on the summary observed, the independent predictor variables can sufficiently explain the variation in response variable (ROA).

Table 6.5 Model significance summary

Class	R^2 Value	P Value	F Calculated (ANOVA)	F Critical	Conclusion
Class-1	0.97	0.0004	13.62	3.14	The model is significant.
Class-2	0.99	0.0001	47.50	2.99	The model is significant.
Class-3	0.98	0.0001	19.09	2.45	The model is significant.
Class-4	0.99	0.0001	49.93	2.75	The model is significant.
Class-5	0.99	0.0001	40.14	2.75	The model is significant.

Class 1

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	18	166.50234	9.25013	13.6207
Error	8	5.43299	0.67912	Prob > F
C. Total	26	171.93533		0.0004*

Class 2

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	72	1952.6992	27.1208	47.5073
Error	8	4.5670	0.5709	Prob > F
C. Total	80	1957.2662		<.0001*

Class 3

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	32	641.49529	20.0467	19.0393
Error	12	12.63497	1.0529	Prob > F
C. Total	44	654.13027		<.0001*

Class 4

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	98	3455.3490	35.2587	49.9396
Error	9	6.3542	0.7060	Prob > F
C. Total	107	3461.7032		<.0001*

Class 5

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	98	3933.8406	40.1412	31.0326
Error	9	11.6417	1.2935	Prob > F
C. Total	107	3945.4823		<.0001*

Figure 6. 3 Class-wise analysis of variance (ANOVA)

The author provided a summary of a class-specific analysis of variance in Figure 6.3. The Analysis of Variance (ANOVA) table helps infer the aspects of the model fit. The sum of squares is near the total sum, indicating that the model can adequately account for a substantial proportion of the variation. A further conclusion from the summaries is that the F ratio is considerably higher than the critical F values, and the p-values for all classes are less than 0.05. Based on these crucial observations, the author considers these findings highly significant and trustworthy.

Figures 6.4 to 6.8 present a concise overview of the impact of the factors (independent variables) on the return on assets, organized by class. The p-value, which is less than or equal to 0.05, aids in determining the importance of the variable on the return on assets. The LogWorth bar positioned at the top of each chart represents the variable with the most significant influence on the return on assets. The LogWorth values in the effect summary table are the logarithmic conversions of the p-value for each model effect. This transformation modifies the p-values to establish an appropriate scale for graphing.

Class 1 inferences: Class 1 firms exhibit the most substantial main effects for Gross Fixed Asset Utilization Ratio (FA_Util) and Quick Ratio (QR) and the most substantial interaction effects for Debtor Days (DD) and Quick Ratio (QR). Figure 6.4 demonstrates the significant other impact. *Enhanced asset efficiencies and effective working capital management practices should aid Class 1 companies in increasing their ROA.*

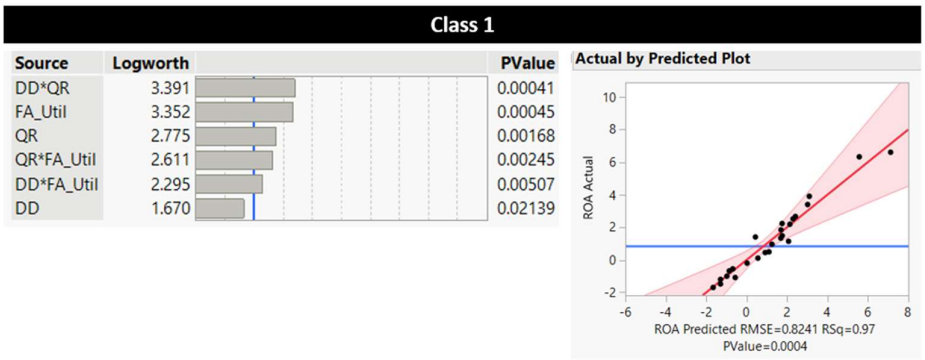

Figure 6. 4 Effect summary for Class-1 firms

Class 2 inferences: Debtor Days (DD) and Gross Working capital cycle days (GWC) have the most significant main effects. Additionally, Gross Working capital cycle days (GWC) and short-term borrowings (STB), Gross Working capital cycle days (GWC), and Gross Fixed Asset Utilization Ratio (FA_Util) have the most significant interaction effects for Class 2 firms. The remaining considerable results are illustrated in Figure 6.5. *Class 2 companies must implement favorable capital structure decisions and effective operations*

management practices in conjunction with better liquidity management practices to increase their ROA.

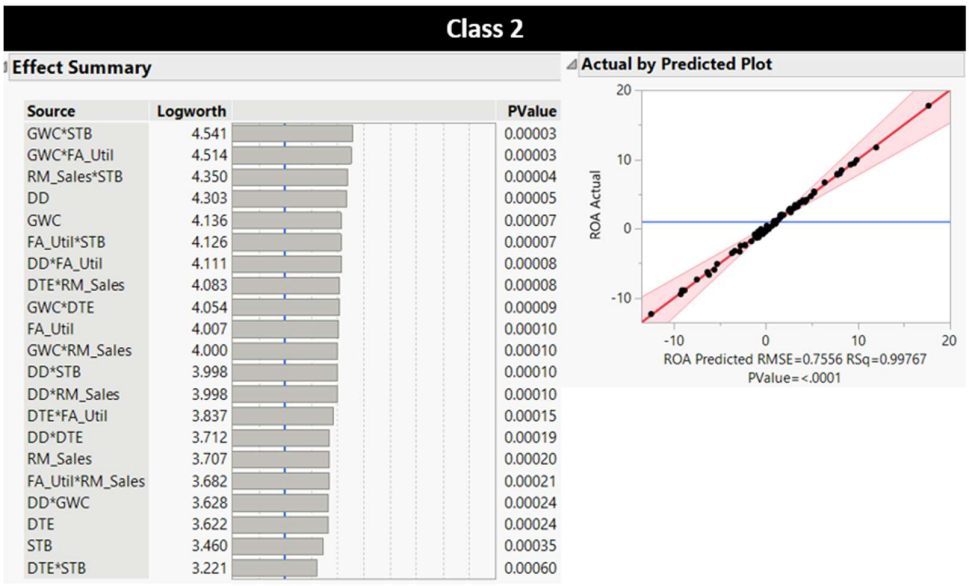

Figure 6. 5 Effect summary for Class-2 firms

Class 3 inferences: Class 3 firms exhibit the most substantial main effects for Quick Ratio (QR) and the most significant interaction effects between Debtor Days (DD) and Quick Ratio (QR). Figure 6.6 demonstrates the significant other impact. *Improved operational efficiencies, liquidity management practices, and augmented asset utilization are crucial to attaining enhanced ROA for Class 3 firms.*

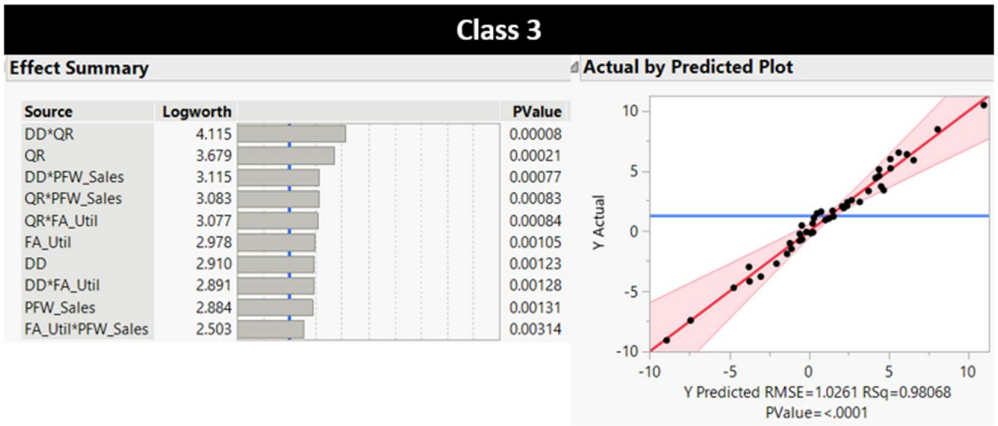

Figure 6. 6 Effect summary for Class-3 firms

Class 4 inferences: Class 4 firms exhibit the most robust debt-to-equity ratio (DTE) main effect and debt-to-equity ratio (DTE) interaction effects with finished goods turnover ratio (FGT), short-term borrowings (STB), and power, fuel, and water as a percentage of sales (PFW_Sales). The remaining significant effects are illustrated in Figure 6.7. *Optimal capital structure combinations with improved operational efficiencies are crucial to attaining enhanced ROA for Class 4 firms.*

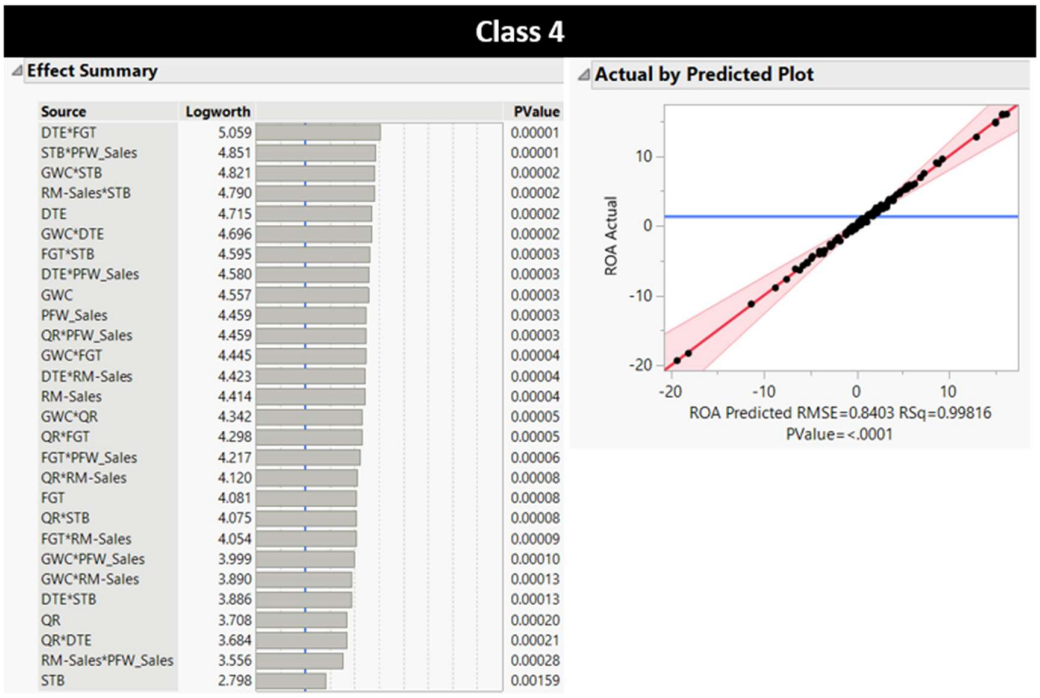

Figure 6. 7 Effect summary for Class-4 firms

Class 5 inferences: Class 5 firms exhibit the most substantial interaction effects between debt-to-equity ratio (DTE) and Raw materials as a percentage of sales (RM_Sales), Gross Working capital cycle days (GWC), and Gross Fixed Asset Utilization Ratio (FA_Util). The remaining significant effects are illustrated in Figure 6.8. *While the ROA for Class 5 firms is superior to the rest of the firms as per the historical data, there is headroom in all four constructs identified for Class 5 firms to attain further improved ROA.*

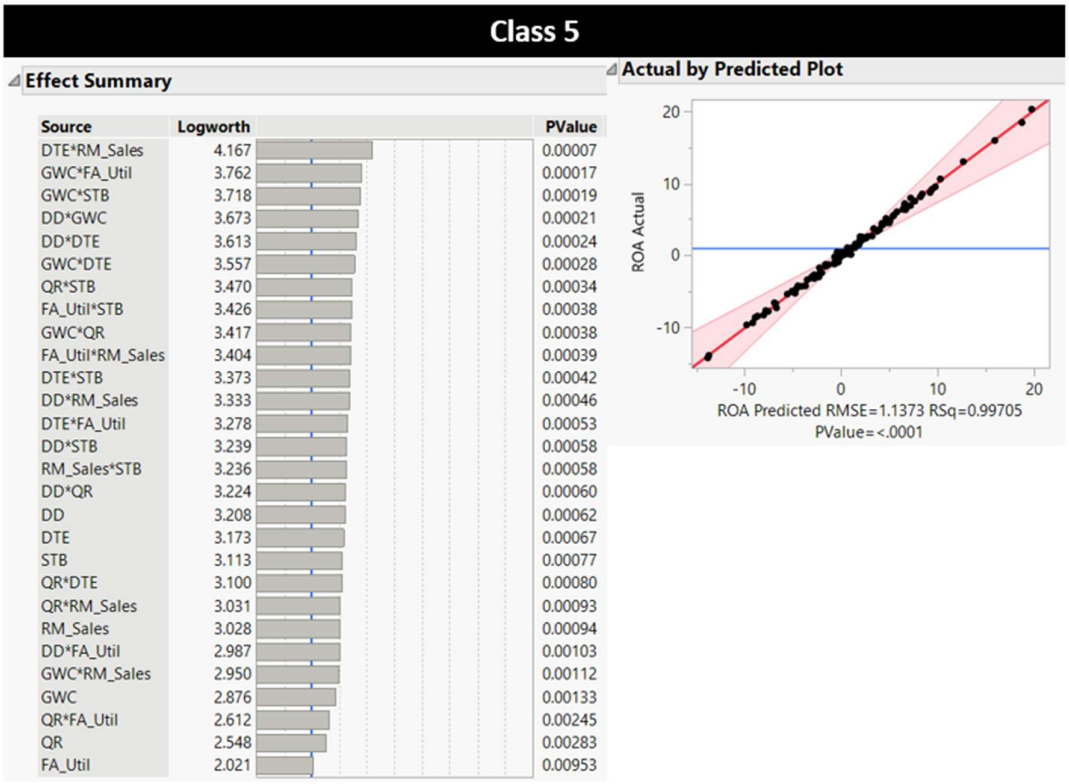

Figure 6. 8 Effect summary for Class-5 firms

As observed in the summary of class-specific summaries, the top effects for each class are reasonably distinct, indicating that the focus areas for each class of firms to accomplish return on assets are different.

6.4.5 Analysis of residuals

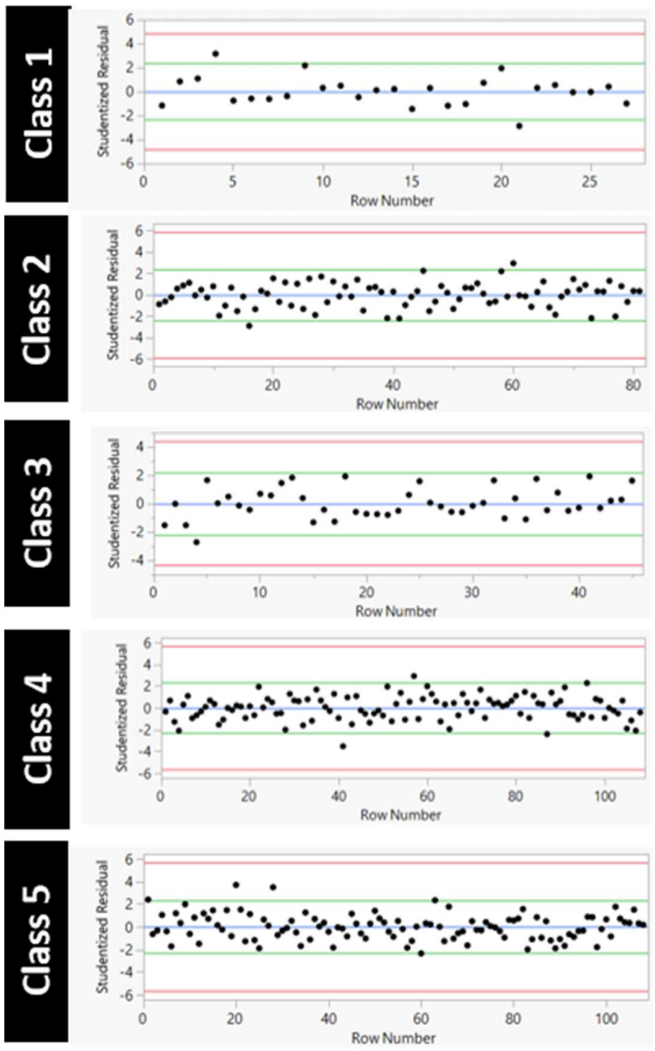

Figure 6. 9 Class-wise studentized residual summary

In regression analysis of a multivariate distribution, the variances of the residuals at different input variable values may differ even if the variances of the errors at these input variable values are identical. Understanding the behavior of residuals in regressions is crucial to identify outliers. A studentized residual is a quotient that divides a residual by an estimate of its standard deviation. Studentized residuals are more effective for detecting outliers and evaluating the assumption of equal variance. The studentized residual by row number plot performs a t-test for each residual. It is a variant of the Student's t-statistic in

which error estimation varies across points (Gray & Woodall, 1994). Studentized residuals exceeding the red limits may represent outliers. Figure 6.9 above provides a summary of the studentized residuals for each class. As observed from the graphs, there are no outliers.

6.4.6 Factor optimization

In the case of multiple-factor models, it is essential to comprehend the model's sensitivity to changes in the factor levels. The prediction profiler of JMP (2021) assists in identifying the factor values that can maximize a complex set of criteria. The outputs from the prediction profilers aid in comprehending the ideal combination of components and levels necessary to achieve the intended performance level of the response variable. The author selected the highest level of desirability for the response variable (return on assets) and created prediction profilers for each category. The profiler results offer valuable insights into the optimal operating levels of each critical variable to achieve the targeted return on assets.

Figure 6.10 summarizes the prediction profiler data for Class 1 firms.

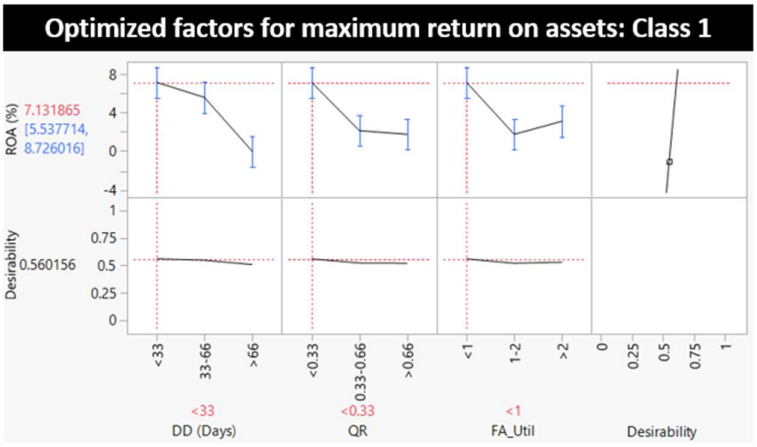

Figure 6. 10 Prediction profiler for Class 1 firms

According to the historical data, the 90th percentile return on assets is 6.2, and the 95th percentile return on assets is 10.4 for Class 1, whereas the median value is 1.16 from the data. There is a significant opportunity for the Class 1 firms to improve the return on assets to 7.13 based on the optimal settings recommended in the experiment.

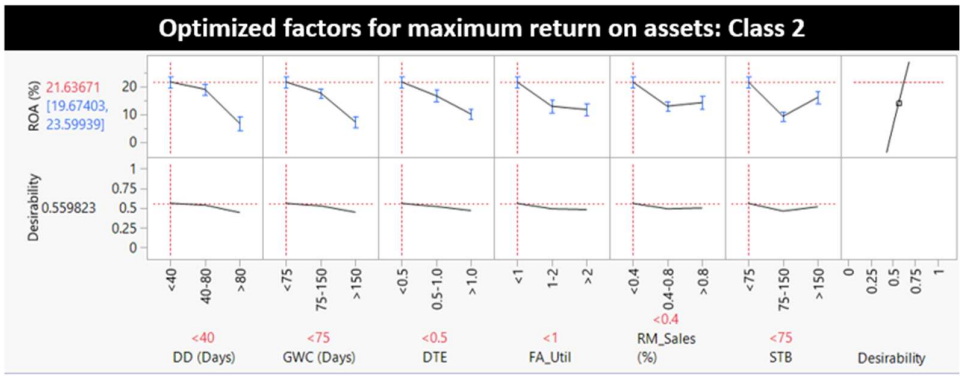

Figure 6. 11 Prediction profiler for Class 2 firms

Figure 6.11 summarizes the prediction profiler data for Class 2 firms.

According to the historical data, the 90th percentile return on assets is 13.9, and the 95th percentile return on assets is 18.7 for Class 2, respectively, whereas the median value is 3.81 from the data. There is a significant opportunity for the Class 2 firms to improve the return on assets to 21.63 based on the optimal settings recommended in the experiment.

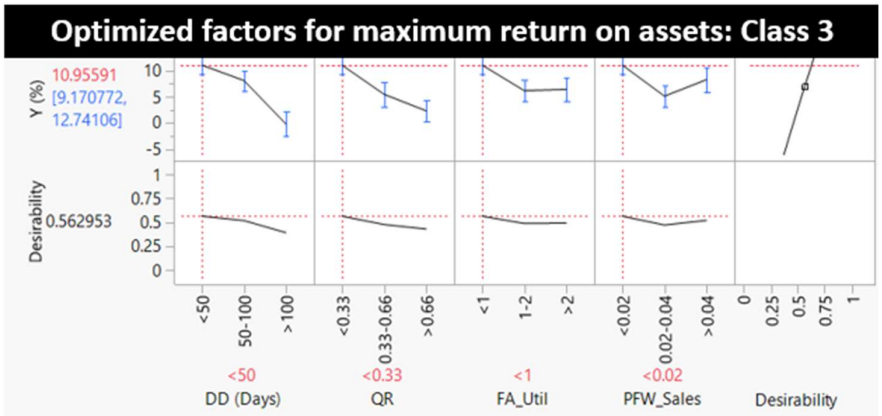

Figure 6. 12 Prediction profiler for Class 3 firms

Figure 6.12 summarizes the prediction profiler data for Class 3 firms.

According to the historical data, the 90th percentile return on assets is 12.7, and the 95th percentile return on assets is 17.9 for Class 3, respectively, whereas the median return is 3.64 from the data. There is a significant opportunity for the Class 3 firms to improve the return on assets to 10.95 based on the optimal settings recommended in the experiment.

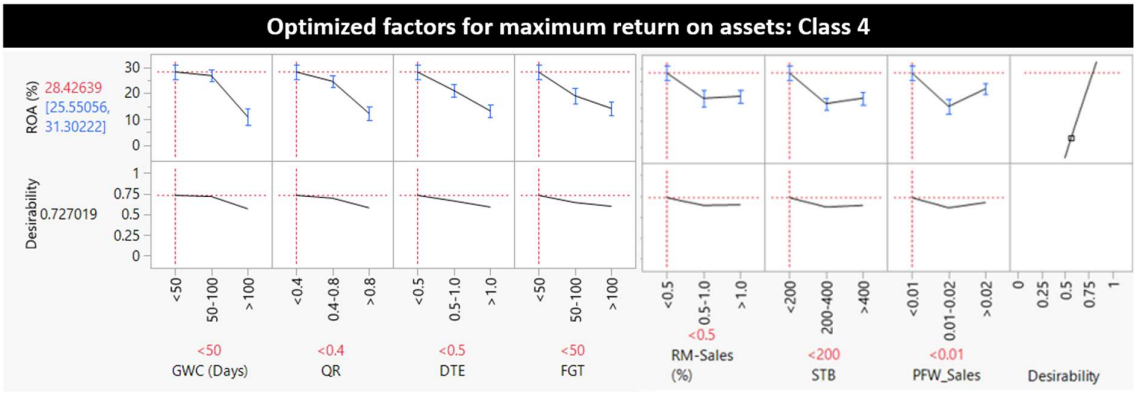

Figure 6. 13 Prediction profiler for Class 4 firms

Figure 6.13 summarizes the prediction profiler data for Class 4 firms.

According to the historical data, the 90th percentile return on assets is 11.9, and the 95th percentile return on assets is 15.6, respectively, for Class 4 firms. In contrast, the median return on assets is 3.25 from the data. There is a significant opportunity for the Class 4 firms to improve the return on assets to 28.42 based on the optimal settings recommended in the experiment.

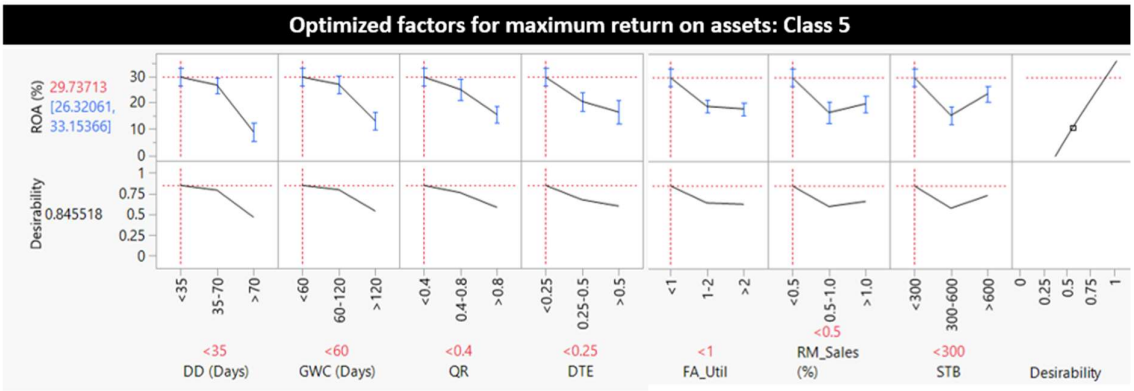

Figure 6. 14 Prediction profiler for Class 5 firms

Figure 6.14 summarizes the prediction profiler data for Class 5 firms.

According to the historical data, the 90th percentile return on assets is 13.35, and the 95th percentile return on assets is 17.0 for Class 5. In contrast, the median return on assets is 5.69 from the data. There is a significant opportunity for the Class 5 firms to improve the return on assets to 29.73 based on the optimal settings recommended in the experiment.

The author recognizes that the operational conditions of the companies may differ significantly, rendering it impractical to implement the suggested configurations directly. The number of influential variables that affect the return on assets (ROA) varies among different classes of firms. The regression analysis indicates that Class 3 firms have four statistically significant areas, Class 2 firms have six significant areas, and Class 4 and Class 5 firms have seven significant areas each. The attainment of a higher return on assets (ROA) relies on the extent of flexibility to impact performance per the key factors. Table 6.6 below demonstrates that Class 3 enterprises have the potential to attain a lower optimal Return on Assets (ROA) compared to the anticipated figure for Class 2 firms.

However, the author argues that the table provided can help practitioners effectively utilize appropriate solutions based on their specific circumstances to improve their return on assets. The choice guide for practitioners is available in Table 6.6.

Table 6. 6 Decision guide for practitioners

Firm class	Significant factors and their optimal levels (Recommended by the RSM Model)	Optimal ROA (%)
Class 1	DD (<33 days), QR (<0.33), FA_Util (<1)	7.13
Class 2	DD (<33 days), GWC (<75 days), DTE (<0.5), FA_Util (<1), RM_Sales (<0.4), STB (<75)	21.63
Class 3	DD (<50 days), QR (<0.33), FA_Util (<1), PFW_Sales (<0.02)	10.95
Class 4	GWC (<50 days), QR (<0.4), DTE (<0.5), FGT (<50), RM_Sales (<0.5), STB (<200), PFW_Sales (<0.01)	28.42
Class 5	DD (<35 days), GWC (<60 days), QR (<0.4), DTE(<0.25), FA_Util (<1), RM_Sales (<0.5), STB (<300)	29.74

6.5 Conclusions and implications

6.5.1 Conclusions

According to the financial data, there is a significant disparity in the profitability (ROA) between various classes of firms. The operating environment's structural implications significantly impact the firm's ability to increase profitability. The study acknowledges smaller enterprises' difficulties in achieving Return on Assets (ROA). The study presents ideas indicating the varying aspects contributing to higher Return on Assets (ROA) in different firms. The study aims to examine this phenomenon from a business's operations perspective. This analysis explores the operational and financial strategies companies must implement to improve their return on assets (ROA). The study presents tangible evidence that many organizations have distinct target variables and can attain a shared vision and performance at the value chain level without compromising each other. The primary objective of our study is to efficiently implement the stakeholder theory across the entire value chain while also contributing to developing a decision-making framework. The author strongly asserts that these frameworks enable each class type to focus on distinct operational domains.

Prior studies mostly concentrated on examining the interactions between two entities, whereas the value chain level investigations were limited. The scope of the studies was restricted to comprehending the influence of financial variables on the return on assets (Baños-Caballero et al., 2012; Fernández-López et al., 2020; García-Teruel & Martínez-Solano, 2007; Howorth & Westhead, 2003; Olufemi I. F. & Olubanjo T. A., 2009). Few studies have explored the supply chain dimension for improving ROA (Hofmann & Kotzab, 2010). Furthermore, most research in this field primarily focuses on Europe or China. According to the author's comprehension, no studies have examined the combined effect of financial and operational variables on enhancing the return on assets (ROA).

Crucially, a lack of research explores the Indian context in connection to this area of study. The research presents an innovative method to address the gap by analyzing the collective viewpoints of operations and finance among various Indian auto industry firms.

Suppliers with higher sales concentrations generally have lower leverage ratios, as they are concerned about many customers switching suppliers (Kadapakkam & Oliveira, 2021). A negative correlation exists between the firm's size, debt-to-equity ratio (DTE), and short-term borrowings (STB). Smaller companies with a high debt-to-equity ratio and significant short-term borrowing will refrain from investing in operational improvements because most of their income will be allocated towards fulfilling their recurring debt commitments. The lack of ability to achieve operational efficiencies negatively impacts the cost per unit and, eventually, the company's profitability. The author suggested maintaining lower Debt-to-equity ratio (DTE) levels to attain a greater return on assets. This observation aligns with the empirical studies conducted by (Erdogan et al., 2015; Kant, 2018; Nazir et al., 2021). The author recommended restricted use of short-term borrowings (STB) to avoid excessive debt payment obligations at higher interest rates. This recommendation also draws strength from the observations (Baum et al., 2007; Laura Raisa, 2015; Yazdanfar & Öhman, 2015; Yisau Abiodunt, 2013). Working capital is essential for the operation and survival of a business.

The company's working capital is stuck due to the limited capacity to convert raw materials into finished products efficiently. Moreover, the delay in collecting payment for delivered goods restricts the cash (working capital) accessible in the supply chain. The increasing intricacies of managing working capital have a direct impact on operations. Smaller businesses encounter difficulties securing recurring credit to borrow the necessary materials to fulfill the agreed-upon shipments to downstream partners. The author proposed implementing an effective method to manage Debtor days (DD) because of its

consistent influence on all classes. Our finding aligns with the conclusions stated by Hermawan et al. (2023). The author suggested varying degrees of working capital cycle days for distinct classes. This observation further validates the discoveries made by Aldubhani et al. (2022). The author suggested that a high ratio of fixed asset utilization (FA_Util) significantly impacts operational efficiency. This discovery is consistent with the findings Kant (2018) regarding the factors that influence the profitability of manufacturing companies in the United States.

The summary of hypothesis validation is included in Table 6.7.

Table 6. 7 Hypothesis validation summary

Hypothesis	Observation	Justification	Key literature support	Validity of hypothesis
H1	The hypothesis is valid for Class 2, 4 and 5	Regression summary	Erdogan et al., 2015; Kant, 2018; Nazir et al., 2021	Yes
H2	The hypothesis is valid for all classes	DoE results		Yes

6.5.2 Managerial implications

Power-based connections commonly define the automotive value chain. According to Corsten et al. (2006), in the value chain, the larger firms closer to the customer have more influence in determining the terms of trade. Overemphasizing the importance of individual firms and neglecting the broader value chain might lead to immediate cost savings but pose a risk to companies in the long term. According to More & Basu (2013), a significant difficulty Indian firms face in their supply chain is the lack of a shared vision across partners. Insufficient agreement on a common vision for the complete supply chain might lead to disastrous consequences.

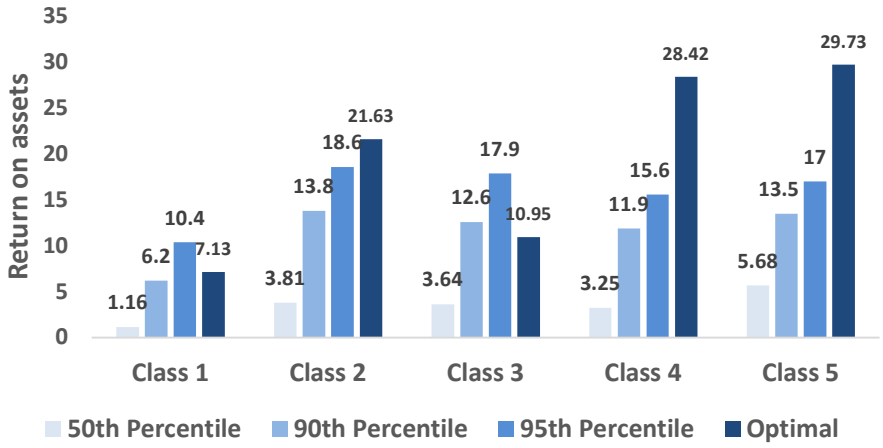

Figure 6. 15 Comparison of historical and optimal return on assets

Enhancing liquidity offers companies financial relief. According to Ambadapudi & Matai (2023), implementing a value chain-focused approach to supply chain management can lead to a rise in sales revenue ranging from 0.3% to 0.9%. The provision of financial relief will finally transfer the advantages to the lower value chain firms. The panel data results indicate that the factors that impact the return on assets vary across different classes of firms. Class 1 firms, which usually have limited access to sufficient capital, highly value the ability to continuously fund their operational requirements flexibly. Class 1 firms have a substantial increase in their return on assets (ROA) due to implementing liquidity measures. Nevertheless, the determinants that contribute to the enhanced Return on Assets (ROA) in firms classified as 3, 4, and 5 encompass all four constructs that have been considered. It is recommended that all classes of firms have a balanced performance management plan that emphasizes four main areas: capital structure, liquidity management, fixed capital efficiency, and operational efficiency.

There is a significant opportunity to enhance the return on assets for every class of firms compared to the existing median levels. It is crucial to comprehend which metrics are essential to the entities in the value chain to get the required performance levels. The analysis determined the maximum value that may be attained by effectively managing the

critical components depicted in Figure 6.15. This study effectively establishes a mutual correlation between financial performance and operations management, as emphasized by the author. The research findings allowed us to identify the precise set of variables important for every class of firms and suggest the most effective operating levels for them to reach the highest degree of performance (ROA). Companies can modify the identified factors depending on the specific circumstances of their business environment, as outlined in contingency theory. By doing so, they can attain enhanced returns on their assets. The various classes of the firm can alter the operating parameters and prosper simultaneously with the successful adoption of SCF. These studies aid managers of the businesses involved in optimizing their efforts to formulate effective plans for improving the critical variables. Businesses might utilize the suggested approach to ascertain the optimal level of input variables and their potential interaction effects to get the desired performance metric.

Chapter 7: Benefits of a Collaborative Liquidity Management Approach: A Simulation Study For The Indian Auto Value Chain

Preview: Section 7.1 describes the liquidity challenges of India's micro, small, and medium companies (MSME) in the wake of growth projections and associated research questions. Section 7.2 covers the appropriate literature supporting collaborative liquidity management and summarizes the hypotheses for the study. Section 7.3 outlines the conceptual framework, data sources, and their reliability and approach for the study. Section 7.4 describes the data inferences and overview of the financial distress for various firms across the past years. Section 7.5 covers the details of the panel data regression study, collaborative liquidity management, scenario-building summary, and simulation runs' results. Section 7.6 outlines the conclusions and implications of the study.

7.1. Introduction

According to Morgan Stanley (2022), India's GDP is anticipated to exceed that of Germany and Japan, positioning India as the third-largest economy globally, behind the United States and China, by 2030. India is poised for significant growth due to its robust domestic demand. An intensified desire for prosperity and economic progress results in a heightened utilization of natural resources across many businesses, thus leading to escalated emissions of pollution, predominantly carbon dioxide (Mitić et al., 2023). India's target of achieving net zero emissions by 2070 (Government of India, 2022a) necessitates a delicate equilibrium between economic growth and carbon neutrality (Macdonald & Spray, 2023). Power and Transportation industries contribute to 60% of carbon emissions in India (Garg et al., 2017). Therefore, the importance of the automobile sector and its extensive network of companies contributing to India's goal of achieving carbon neutrality becomes paramount. A prompt review of the current situation of Indian automobile firms

listed with the Ministry of Corporate Affairs (MCA), Government of India, unveils a daunting scenario. The registered number of enterprises has experienced a substantial decrease annually, with smaller firms being more vulnerable to financial difficulties, resulting in the observed exits (CMIE, 2021).

Power plays a significant role in the buyer-supplier relations in the value chain (Corsten et al., 2006). Larger corporations impose trade conditions that are advantageous to their interests. Debtors often withhold substantial amounts of money. The median value of accounts receivable, which refers to the amount of money owed to a business by its debtors, typically ranges from 14% to 33% of the total sales revenues in industrialized countries (Seifert & Seifert, 2011). In the fiscal year 2021, it was found that automobile companies with earnings of up to INR 250 crores ($30 million) had a median accounts receivable of 23% of their total revenue. MSME companies, classified as micro, small, or medium enterprises, have an average cash reserve of 6% of their income. The median percentage of total assets that may be attributed to current assets in these firms is 56%. When companies have low cash reserves, they invest in current assets, which causes them to look for short-term external financing and incur immediate commitments. This need may compel enterprises to acquire short-term loans at elevated interest rates, thus diminishing their profit margins. Kok Thim et al. (2011) employed two models to analyze the associations between financial distress and the features and vulnerabilities of firms. They observed a positive correlation between a company's size and the interest coverage ratio with financial distress. In contrast, a negative correlation was found between the increase in operating profits and financial distress.

Baumol (1959) emphasizes the advantages of larger firms over smaller ones in terms of investment and operational flexibility, which are essential for achieving profitability. Stekler (1964) discovered a negative correlation between the size of a company and the

variability of its profit rate. Similarly, Hall & Weiss (1967b) and Samuels & Smyth (1968) determined that profitability and business size are inversely linked.

The stakeholder theory (Donaldson & Preston, 1995) posits that cultivating value chain relationships is essential for enhancing corporate performance and meeting the needs of stakeholders. Organizations frequently put their benefits over shared objectives, demonstrating agency theory (Eisenhardt, 1989), which proposes that firms exhibit self-centered conduct in the presence of conflicting goals and risk attitudes. The current necessity is to have a situation that benefits all parties involved in the auto value chain, and the use of Supply Chain Finance is the goal (Hofmann & Belin, 2011). According to Seifert & Seifert (2011), SCF solutions resulted in a 13% reduction in working capital for consumers and a 14% reduction for suppliers. Nevertheless, a preliminary study conducted by Ambadapudi & Matai (2021) revealed that the utilization of Supply Chain Finance (SCF) by Indian automakers is constrained. There is a lack of research that specifically examines the advantages of collaborative liquidity management in enhancing the profitability of value chains.

The author tried to explore a few pertinent questions that remained largely unexplored in the Indian context:

- RQ-1: Why do the profitability levels vary across different firm sizes in the Indian auto industry, though they experience similar financial distress levels?
- RQ-2: How can a collaborative liquidity management approach limit financial distress by improving the profitability of the value chain?
- RQ-3: What is the measurable impact of implementing collaborative liquidity management on the performance of firms of different sizes?

The Contingency theory, proposed by Luthans & Stewart (1977b), emphasizes the need for a situational approach to enhancing corporate performance. Enhancing performance dimensions is contingent upon the organization's specific conditions, encompassing factors such as size. The author employed the situational method by classifying the enterprises into five categories according to their sales income. The author conducted a study using 3,070 firm-year records to examine how different liquidity indicators affect different firms' financial performance (return on assets). The study ensured a wide range of data to analyze. The author selected return on assets (ROA) as a universally applicable and all-encompassing performance measure, citing its advantages over alternative metrics (Ambulkar et al., 2023; Deloitte, 2013).

7.2. Literature review

Ensuring liquidity is crucial for effectively managing corporate operations and maintaining business performance. Historically, performance evaluation within a value chain has mostly centered around the activities and outcomes of individual firms. Big corporations exploit smaller companies by establishing trade conditions that are advantageous to them. As the value chain grows longer, the smallest entity in the chain experiences the most significant disadvantage due to unfair business practices that are currently prevalent. Prior studies focused on a limited number of factors contributing to a company's ability to maintain sufficient liquidity. There is a shortage of a thorough study examining the drivers and impact of liquidity management, specifically concentrating on the complete value chain.

7.2.1 Relationship between financial distress and profitability

Financial distress happens to a business when its earnings before interest and taxes, depreciation, and amortization (EBITDA) are insufficient to cover the interest expenses paid on its debt borrowings. According to Andrade et al. (1998), the distress costs were

calculated to be between 10% and 20% of the firm's value. Investments in financially troubled firms are typically limited due to their weak cash flows. The capital structure decisions of Indian manufacturing enterprises are highly influenced by factors such as size, asset structure, profitability, and short-term financial distress costs (Guha-Khasnobis & Bhaduri, 2002).

Under an optimistic scenario, financially distressed firms get investments from equity claimants who anticipate a positive change in the firm's financial situation (Bhagat et al., 2005). To evaluate the extent of financial distress in a particular company using the data from its financial statements, Altman (2005) developed statistical models commonly referred to as the Altman Z score. Sayari & Mugan (2017) demonstrate that industry features have varying effects on enterprises, emphasizing the necessity of creating customized financial distress models for specific industries.

The study by Mselmi et al. (2017) on French SMEs revealed that financially distressed businesses exhibited diminished profitability, liquidity, and financial leverage. Kliestik (2018) conducted a study where he analyzed the use of mathematical tools alongside traditional statistical methods to predict the financial well-being of firms. He also explored the advantages and disadvantages of these approaches. When a company's liquidity situation is illiquid, the expenses for fixed spending rise, and income declines, particularly during an economic downturn, the distress scenario can worsen (Kamaluddin et al., 2019). Amoa-Gyarteng (2021) establishes that liquidity, profitability, asset productivity, and solvency substantially impact the financial health of organizations, affecting their susceptibility to financial distress. In his 2021 study on insurance firms in Ethiopia, Isayas (2021) uncovers a negative correlation between economic distress and profitability, firm size, debt, and company age. Renalita & Tanjung (2023) conducted an empirical study on mining industry firms listed on the Indonesia Stock Exchange, utilizing data from 2017 to

2019. The analysis concluded that the value of these firms is not considerably affected by financial difficulties. Small firms significantly depend on short-term loans due to the significant expenses and complexities of obtaining long-term funding. Thus

Hypothesis-1(H1 a): The financial distress of the firm increases as the size of the firm decreases

Hypothesis-1(H1 b): The financial distress of the firm increases as the profitability of the firm decreases

7.2.2 Relationship between solvency and profitability

As the amount of debt increases, the fixed interest expense also increases, causing the break-even point to rise (Piper & Weinhold, 1982). Based on the pecking order theory proposed by S. C. Myers (1984), managers are advised to prioritize the allocation of funds for investment possibilities in the following order of preference: retained earnings, debt financing, and equity financing. Bank lending is the primary external source of finance for many MSMEs and entrepreneurs. They heavily depend on traditional debt from banks to fulfill their start-up, cash flow, and investment requirements (OECD Report, 2015). Smaller firms (MSMEs) fall into debt traps as they fail to generate sufficient retained earnings. The hidden expenses associated with higher debt levels restrict a company's capacity to develop strategic objectives. Companies functioning in an environment characterized by inflation are confronted with substantial changes in interest rates and heightened financial risks. Historical research consistently shows that small manufacturing enterprises that utilize loans experience negative leverage. According to their research on small manufacturing enterprises in Zimbabwe, Obert & Olawale (2010) revealed that using debt has a detrimental effect on profitability.

The primary causes of credit constraints are inadequate collateral assets and a lack of financial literacy among micro, small, and medium enterprises (MSMEs) (Singh &

Poornima, 2016). Due to limited credit availability, businesses cannot invest in potential opportunities because they have to use their funds to meet their working capital needs. Jan Habib et al. (2016) found a negative correlation between debt and profitability. This means that as debt increases, profitability decreases. This aligns with the Pecking order notion. In their study, Mugisha et al. (2020) present empirical findings that reinforce the assertions made in previous scholarly works on the detrimental effects of short-term debt on financial performance and solvency. The research was conducted on a sample of 453 small and medium-sized enterprises (SMEs) in Uganda. Moreover, the adverse consequences of cash credit constraints on corporate investment are intensified for MSMEs, resulting in substantial growth in working capital requirements and harmful impacts on profitability (Nicolas, 2022). Thus

Hypothesis-2(H2 a): The solvency of the firm increases as the size of the firm increases

Hypothesis-2(H2 b): The firm's solvency has a direct relationship with the profitability of the firm.

7.2.3 Relationship between cash management and profitability

Cash flow is essential for the survival and well-being of all companies, serving as the most crucial indicator of their financial condition. According to Pinkowitz & Williamson (2002), the market value of a dollar controlled by a firm is approximately $1.20, significantly exceeding one dollar. Income is calculated on a monthly, quarterly, and annual basis. Cash, on the other hand, is a constant issue (Jama et al., 2017). Most businesses allocate a substantial portion of their funds to working capital.

Consequently, it is logical to anticipate that how firms handle their working capital will significantly impact their profitability. The firm's management must understand the relationship between liquidity and profitability to maintain the most advantageous cash balances. Deloof (2003) suggested a strong inverse correlation between the cash

conversion cycle and business profitability based on an extensive dataset of publicly traded American corporations. To optimize their profits, companies must carefully balance their liquidity and profitability. Failure to do so may result in companies lacking sufficient liquid assets and being forced to borrow excessively from external sources or becoming illiquid. Contrary to well-known historical research findings, Sharma & Kumar (2011) found that reducing the cash conversion cycle harms profitability, as evidenced by their study on Indian businesses.

In his study, Tsai (2008) examines the potential risks to cash flow in business supply chains. The study suggests that firms can mitigate these risks by using strategies such as offering early payment discounts and utilizing Asset-Backed Securities. These measures aim to reduce the risk of cash inflow and shorten the Cash Conversion Cycle. In their study, Srinivasa Raghavan & Mishra (2011) analyze a supply chain of two levels, considering financial limitations. They propose that jointly making financing decisions can benefit lenders and merchants with limited cash resources. Guo & Liu (2020) suggest the utilization of Asset-Backed Securities (ABS) to mitigate cash flow risks in supply chains, particularly for small vendors. They underline the importance of diligent management of market demand, modularity, and interest rates.

Enterprises can attain profitability objectives while skillfully and productively preserving liquidity and managing short-term assets and commitments. Companies must diligently oversee their existing assets to fulfill immediate financial responsibilities. To enhance their liquidity position, firms should reduce the duration of debt collection from debtors since a positive correlation exists between cash management and firm liquidity (Danjuma et al., 2015). Virginia Nnenna et al. (2018) examined the correlation between cash and cash equivalents and the profitability of Nigerian manufacturing companies from 2003 to 2017. It was determined that firms with adequate cash flow management techniques and

robust liquidity ratios fared better than others. Additionally, it was shown that cash and cash equivalents significantly positively affected the return on assets of the examined enterprises. Aldubhani et al. (2022) employed a methodology of multiple regression analysis to investigate the correlation between working capital management and profitability. The study examined all ten manufacturing businesses listed on the Qatar Stock Exchange between 2015 and 2019. The author found that firms with shorter timeframes for collecting receivables and converting cash cycles will likely have higher profitability. Thus

Hypothesis-3(H3 a): The robustness of the cash position of the firm increases as the size of the firm increases

Hypothesis-3(H3 b): The ability of the firm to manage its cash has a direct relationship with its profitability.

7.2.4 Relationship between cash conversion cycle and profitability

The duration of the cash cycle is contingent upon the periods of inventory, receivables, and payables. The duration of the cash cycle expands as the durations for inventory and receivables lengthen. The decline occurs when the company can postpone the payment of its payables, extending the period in which the payables are due. Wang (2002), in her study, investigated the relationship between liquidity management and operating performance. She found a negative link between the cash conversion cycle and both return on assets (ROA) and return on equity (ROE). Research indicates that firms have the potential to enhance profitability by reducing the duration of their cash conversion cycle. Figure 7.1 provides the operating cycle overview.

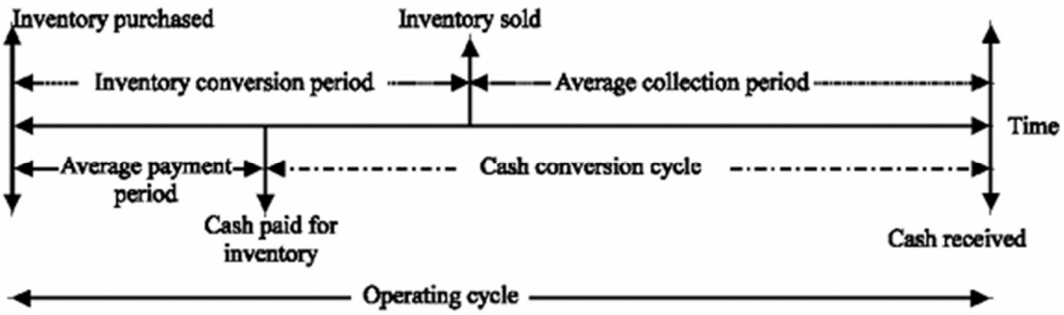

Figure 7. 1 Operating cycle overview Source: (Ross et al., 2003)

In his study, Mathuva (2010) examined the influence of several elements of working capital on Kenyan companies' profitability over 15 years. He found a substantial inverse correlation between the duration of cash collection from customers and the attained profitability. In a developing economy, Charitou (2010) conducted empirical research to examine the influence of working capital management on a firm's financial performance. The findings indicate that the cash conversion cycle and its main constituents, namely days in inventory, days sales outstanding, and creditors payment period, significantly correlate with the firm's profitability.

In his research, Yazdanfar & Öhman (2014) examined the influence of firm size on profitability. He found that larger corporations are more lucrative than smaller ones, and younger small and medium-sized enterprises (SMEs) with shorter Cash Conversion cycles are more likely to be advantageous. Trade credit can effectively resolve the problem of supplier moral hazard and the costly funding of working capital in a two-tier supply chain. Nevertheless, the method's effectiveness may be limited when financial barriers escalate the expenses associated with funding (Devalkar & Krishnan, 2019). Indian companies often employ trade credit, motivated mainly by inventory management and macroeconomic factors, with large-scale companies being the main buyers and sellers (N. Kumar et al., 2021b).

Adopting assertive working capital tactics can enhance business success. Chang (2018)

conducted a global empirical investigation on the association between the cash conversion cycle (CCC) and company success, using enterprises from multiple nations as samples. He confirmed the CCC's negative correlation with the company's profitability. In their study, Dalci et al. (2019) examined the potential moderating effect of business size on the link between the cash conversion cycle and profitability. The study focused on 285 non-financial firms in Germany over eight years. Their research demonstrates that a company's size impacts the correlation between the cash conversion cycle and profitability. When the size of a firm declines, the returns on assets (ROA) also decrease while the cash conversion cycle increases. Conversely, when the firm's size expands and the time it takes to convert funds into assets lengthens, the returns on assets also increase. From this standpoint, reducing the cash conversion cycle benefits profitability exclusively for small and medium-sized enterprises. Thus

Hypothesis-4 (H4 a): The cash conversion cycle increases as the size of the firm decreases

Hypothesis-4(H4 b): The length of the firm's cash conversion cycle has an inverse relationship with the firm's profitability.

7.2.5 Impact of unprecedented events on liquidity

The COVID-19 pandemic led to unusual events that presented significant challenges in manufacturing businesses and supply chain networks (Stavropoulos et al., 2020). The implementation of lockdowns, restrictions, and economic slowdowns led to substantial disruptions to businesses, posing difficulties in cash flow management (World Economic Outlook, 2020). The long-term halt in economic activity in India has led to an increased awareness of risk and a sudden rise in the demand for individuals, companies, and financial institutions to keep liquid assets as a precautionary measure. The unprecedented unpredictability has exposed vulnerabilities in the financial system and endangered financial stability (Reserve Bank of India, 2020a). Demmou et al. (2021) investigated the

financial vulnerability of non-financial enterprises during the coronavirus (COVID-19) pandemic crisis. The researchers evaluated the impact of different policy measures in reducing the risks and severity of a liquidity crisis. The analysis suggests that, without legislative intervention, around 38% of firms will experience a deficit in available funds after ten months of applying confinement measures.

Karim et al. (2021) did a research study examining the impact of COVID-19 on the liquidity and financial stability of the banks listed in Bangladesh. The study uncovers a decrease in the liquidity and financial soundness of the listed banks following the outbreak of the epidemic. Most banks have insufficient liquidity ratios and cash reserves. In their study, Ahmad et al. (2022) thoroughly analyzed the correlation between working capital management and business performance in a sample of 577 companies from three emerging Asian nations. The study covered the period from 2004 to 2020. The results suggest that the effect of COVID-19 on the management of working capital and the performance of companies was more substantial compared to the 2008 crisis.

The corporate sector in the United States responded to the financial challenges presented by COVID-19 by issuing long-term debt to increase their cash reserves, with support from the United States government. It allocated funding from bank credit lines (Almeida, 2021). In the Indian context, the Reserve Bank swiftly and proactively implemented various conventional and unconventional measures to restore stability in the financial markets. The overall interest rate has declined per the monetary policy stance, and any liquidity constraints have been addressed before their potential escalation into solvency concerns within the financial industry.

7.3. Research design and methodology

The focal point of our study is the "organization" as the unit of analysis. Hence, the author gathered and examined factors at the organizational level. The author analyzed secondary data, specifically financial reporting data, obtained from the Centre for Monitoring the Indian Economy (CMIE, 2021). It is a leading supplier of corporate data. The CMIE has created an extensive database (ProwessIQ) that contains detailed information on the financial performance of companies registered with the Ministry of Corporate Affairs, Government of India. The author utilized the most recent ten-year data from the ProwessIQ database (FY 2012–FY 2021) to thoroughly analyze the current operational circumstances that led to the inclusion of 341 organizations. The author used the maximum revenue of INR 2,500 as a criterion based on the average sales data over the past ten years. To ensure that the dataset accurately reflects the entire range of the business climate, encompassing both high and low extremes, the author included enterprises with a diverse range of average sales data in our analysis. A total of 307 companies were utilized as a final sample to evaluate the operational environment disparities accurately. Micro, small, and medium enterprises (MSME) refer to smaller firms within the Indian car sector. Table 2.1 provides a concise overview of the categorization of firms as MSMEs based on a notification published by the Government of India on June 1, 2020 (Government of India, 2020).

The sample size in this chapter, consisting of 307 observations, is marginally more than the 280 observations examined in Chapters 5 and 6. The minor variation in the data set is mainly attributed to the delay in acquiring the data sets from ProwessIQ.

However, the data being considered (307 firms) includes only a small number of micro firms, as determined by the Government of India's criteria. To assess the disparities in the operating conditions, the author divided the firms into the categories specified in Table

7.1. This classification was done manually to cluster the firms into appropriate classes. Class 1 and Class 2 denote firms that fall into the Micro, Small, and Medium enterprises category.

Table 7. 1 Classification of firms for assessment

Average sales (Turnover)- INR Cr (1)	Class name (2)	Number of firms (3)	Size of the class (Total) (4)
0-50 - (Micro and Small firms)	Class 1	44	440
50-250 - (Medium firms)	Class 2	113	1,130
250-500 - (Large firms)	Class 3	56	560
500-1000 - (Extra-large firms)	Class 4	46	460
1000-2500 -(Largest firms)	Class 5	48	480

The dataset spans ten years and includes data for 44 firms belonging to Class 1. It consists of 440 records mentioned in Column 4 of Table 7.1. The samples in the evaluation meet the minimum requirements for sample size specified by Charan & Biswas (2013). Accurately identifying and defining variables is a crucial and foundational stage in empirical research. Variables in a research study are the characteristics or properties that can differ and be measured.

Table.7.2. provides a list of the variables identified for assessing the research questions. In addition, the author included sales growth (derived from financial reporting data) and GDP growth (World Bank Data, 2021a) as part of the data to control for any other variables that could affect the firm's performance. As these variables are standard in the auto industry for performance reporting, articulating our research findings using a common language is feasible. The author has comprehensively ruled out any threats to the internal validity of their study. The author believes this study's outcomes are externally valid because they are generalizable to a large degree.

Table 7. 2 Variables identified for assessing the research questions

Acronym	Variable	Variable inference	Data type
ROA	Return on Assets	Measures how management's efficiency is in generating profits from the assets	Continuous
CR	Current ratio	Indicates the ability of the organization to meet the current liabilities with the available current assets.	Continuous
C_COS	Cash to the average cost of sales per day	An indication of the number of days that the existing cash levels within the organization can cover the cost of sales.	Continuous
OCF	Operating cash flow	It indicates the cash generated by a company's normal business operations.	Continuous
DIR	Defensive interval ratio	Indicates how many days a company can operate without tapping into capital sources besides its current assets.	Continuous
TIE	Times interest earned ratio	This ratio calculates the times a company could pay its periodic interest expenses if it devoted all its earnings before interest and taxes (EBIT) to debt repayments.	Continuous
RM_TURNS	Raw material turns	Indication of the rate at which raw materials inventory is used and subsequently replenished.	Continuous
WIP_TURNS	Work in progress turns	Indication of the rate at which work-in-progress materials inventory is used and subsequently replenished.	Continuous
FG_TURNS	Finished goods turn	Indication of the rate at which finished goods inventory is used and subsequently replenished.	Continuous
DT	Debtor turnover	Indicates a company's efficiency in collecting receivables.	Continuous
CT	Creditor turnover	An indication of how efficiently a firm's assets are used and reflects the average speed with which payments to trade creditors are paid.	Continuous
SALES_GR	Sales growth	Measures the growth in the company's net sales in the current period in comparison to the previous period	Continuous
GDP_GR	GDP growth	Measures the growth in the country's output (GDP) in the current period in comparison to the previous period	Continuous

Figure 7.2 depicts the conceptual framework proposed. The author extracted crucial variables from financial reporting data to evaluate the research queries.

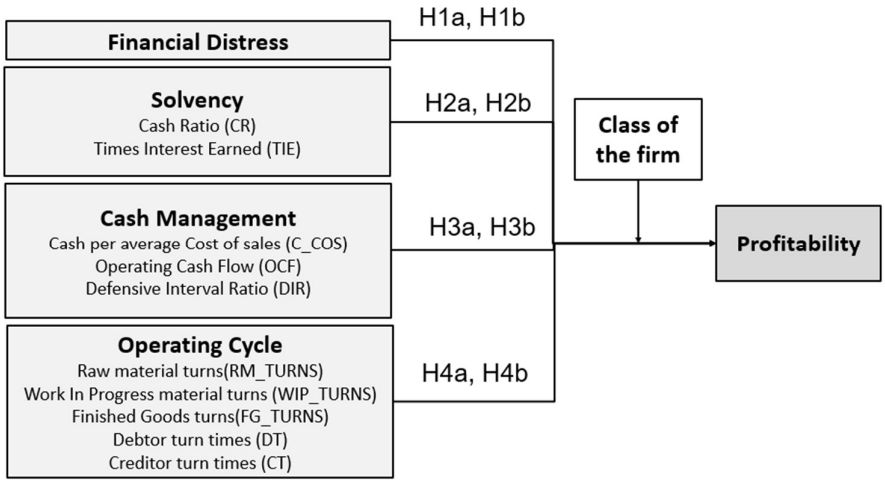

Figure 7. 2 Proposed conceptual model

7.3.1 Approach for the study

The main goals of the research are to understand the key variables that impact the firm's profitability per Class and to simulate the consequences of implementing a collaborative liquidity management approach on the firm's profitability performance. Figure 7.3 below summarizes the approach adopted for the current study.

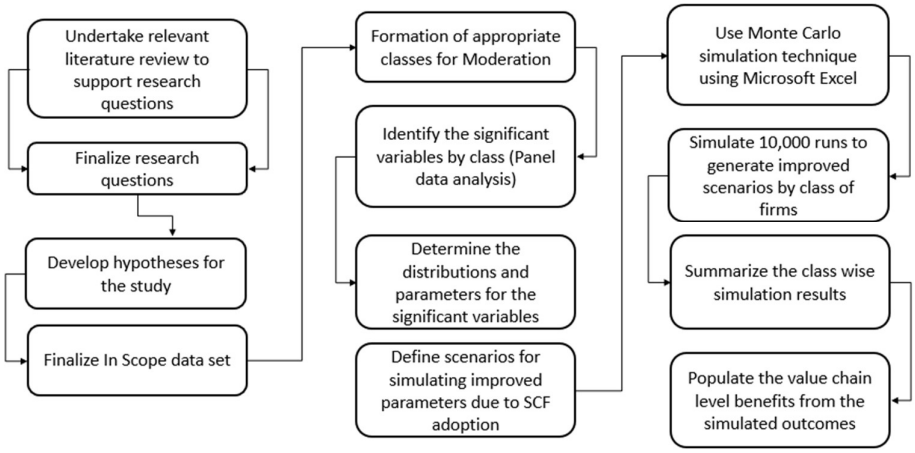

Figure 7. 3 Proposed research approach

7.3.2 Data completeness assessment

A 10-year data set for 307 companies yielded 3,070 records per variable. The author assessed data completeness before generating descriptive statistics and inferences. The only variable missing data was the times interest earned ratio (TIE). A 4% of data is missing for the variable. The author used appropriate data imputation methods (Reddy Sankepally et al., 2022) to fill in missing values.

7.3.3 Panel data technique

Panel data methods are very effective when the data contains observations of the same firm over time (Hans-Jürgen Andreß, 2017). These methods are generally used for effective policy design. The author analyzed the influence of identified variables across a sample of firms' profitability over ten years (return on assets).

This study has ten periods (t = 1, 2,..., 10) and 307 firms (i = 1, 2,..., 307). There will be 307 x 10 = 3,070 observation units using panel data.

The panel data methodology implies heterogeneity among the firms in the data set. When heterogeneity is not controlled in either time-series or cross-section data analyses, there is a substantial risk of obtaining biased results (Badi H. Baltagi, 2021).

A generic equation to analyze firms with panel data is as follows:

$Y_{it} = bX_{it} + h_i + l_t + e_{it}$ .....(1)

Y_{it} = Dependent variable (Return on Assets) of firm i in year t

X_{it} = Independent variable firm i in year t

b = Coefficient

h_i = Unobservable heterogeneity (assumed constant for firm i in year t)

l_t = Time-specific effect (assumed constant for any given t for a firm i)

e_{it} = Error term

Below is the regression equation (2) for the basal model. The author summarized the

results for five scenarios representing various firm sizes. The author removed the constant and error components from the generic equation for clarity.

$ROA = b_1CR + b_2C\_COS + b_3OCF + b_4DIR + b_5TIE + b_6RM\_TURNS + b_7WIP\_TURNS + b_8FG\_TURNS + b_9DT + b_{10}CT + b_{11}SALES\_GR + b_{12}GDP\_GR$…… (2)

7.3.4 Simulation technique

A business simulation is a computer-based exercise that mimics real-world company circumstances and procedures (Barnaby et al., 2021). Simulations can be created for a single participant or a group of participants who can compete or collaborate (Kulkarni & Sivaraman, 2013). Simulation is generally favored for analyzing intricate systems that pose challenges in mathematical modeling. Simulations can accurately represent complex interconnections and interdependencies that may be difficult to articulate using mathematical equations. It is necessary to examine a range of firms classified into distinct categories to understand the impact of numerous variables on a company's profitability. Simulation may be more appropriate if the system exhibits substantial fluctuation or uncertainty. The utilization of Monte Carlo simulation enables the representation of stochastic variables and the investigation of a spectrum of potential results, rendering it highly pertinent to the inquiry that the author planned to do. This allows the author to examine various situations and comprehend the influence of SCF adoption on profitability (ROA) before actual implementations.

7.4. Data summary and inferences

7.4.1 Pearson's correlation analysis

The author created correlation matrices for distinct dependent and independent variables classes to comprehend multi-collinearity. A threshold of +/- 0.75 considers the multi-collinearity effect among variables. The author did not find any instances of multi-collinearity in the data. Correlation matrices for Classes 1 through 5 are summarized in

Appendix A1.

7.4.2 Summarization of Class wise return on assets (ROA)

The author enclosed Class-wise ROA charts in Appendix A1.

- The median ROA for Class 1 firms is 1.15, and the ROA for 51% of the firms falls within the range of -0.33 to 5.07
- The median ROA for Class 2 firms is 3.74, and the ROA for 44% of the firms falls within the range of -0.34 to 5.66
- The median ROA for Class 3 firms is 3.40, and the ROA for 40% of the firms falls within the range of 0.99 to 7.79
- The median ROA for Class 4 firms is 3.22, and the ROA for 48% of the firms falls within the range of -2.60 to 5.20
- The median ROA for Class 5 firms is 5.08, and the ROA for 52% of the firms falls within the range of 2.46 to 9.26

7.4.3 Assessment of financial distress

The median Return on Assets (ROA) values for each Class did not provide evidence to support the hypothesis that profitability is positively correlated with firm size. The author was motivated to comprehend the organizations' fundamental financial stability, which directly signifies profitability (Ramnoher & Seetah, 2020). To examine the issue, the author evaluated the levels of financial distress among various classes of companies to comprehend their correlation with profitability. The author analyzed the most current five-year data (FY 2017-FY 2021) to provide a concise overview of distress levels using the Altman Z score (Altman, 2005).

EMS Score $=1.2\ (X_1) +1.4\ (X_2) +3.3\ (X_3) +0.6\ (X_4) +1.0\ (X_5)$ …….(3)

X_1= (Working Capital)/ (Total Assets)

X_2= (Retained Earnings)/ (Total Assets)

X_3= (Operating Income)/ (Total Assets)

X_4= (Book Value of Equity)/ (Total Liabilities)

X_5= (Total Sales)/ (Total Assets)

The below thresholds are applied to the Z score data to classify them into distress, grey, and safe zones.

- Z < 1.81 indicates poor financial performance, and the firm is considered bankrupt or sick.
- 1.81> Z< 2.99: indicates the grey area of bankrupt and non-bankrupt firms.
- Z > 2.99: indicates good financial performance, and the firm is considered a non-bankrupt or sick Class.

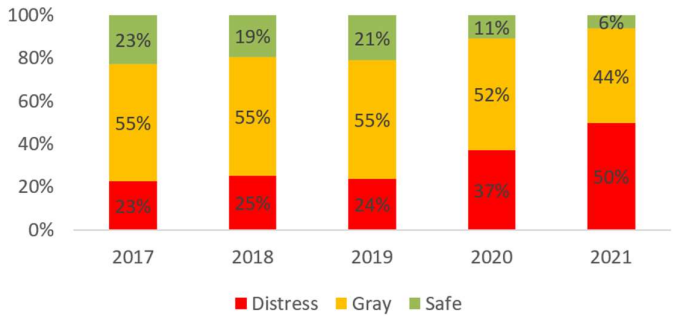

Figure 7. 4 Year-wise financial distress view of the firms

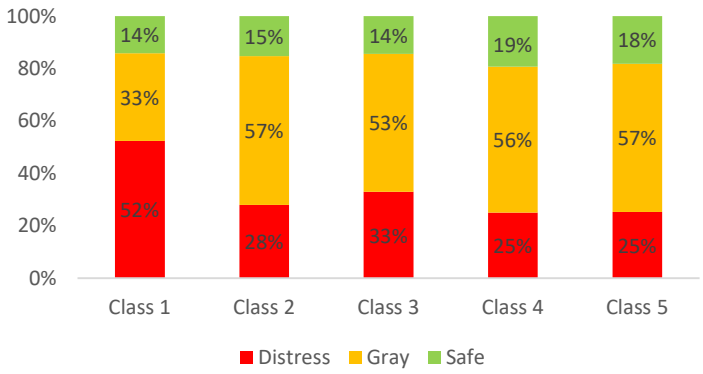

Figure 7. 5 Class-wise financial distress view of the firms

According to Figure 7.4, the author observed a progressive rise in firms entering the distress zone from FY 2017 to FY 2021. The author attributes this discovery to the liquidity squeeze experienced during COVID-19. Except for Class 1, which has a distress rate of 52%, the remaining classes exhibit similar levels of financial distress among enterprises. The data shown in Figure 7.5 contradicts Hypothesis-1 (H1a).

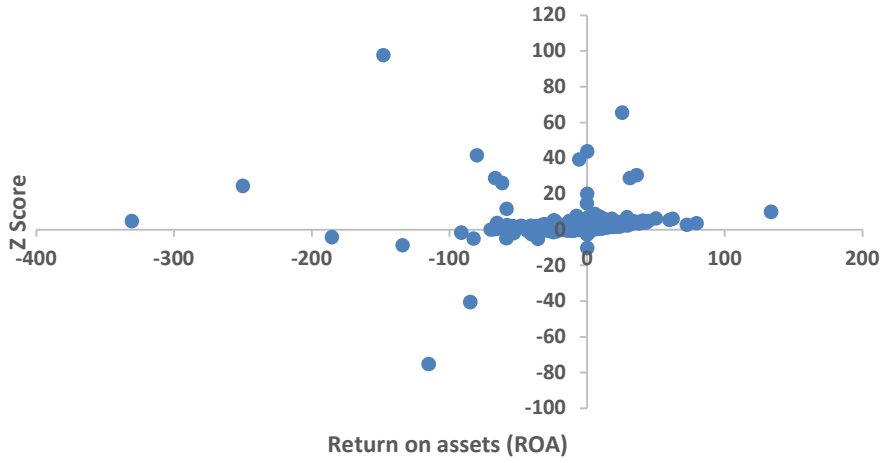

Figure 7. 6 Relationship between ROA and Z Score

The author mapped the relationship between ROA and Z score for all firms (safe, grey, and distress) in Figure 7.6. The author did not observe a linear relationship between ROA and Z score. This observation from the Figure 7.6 contradicts the Hypothesis-1(H1 b).

7.4.4 Summary of descriptive analysis

The author included the descriptive statistics for Classes 1 through 5 in Appendix A1. The listed summaries provide a general overview of the variances in the statistics, helping to understand the varying operating conditions of distinct company classes.

7.4.4.1 Current ratio and inventory positions

The current ratio is calculated by dividing current assets by current liabilities. Inventories account for a sizable component of current assets. The median current ratio (CR) varies from 1.19 for Class 1 firms to 1.07 for Class 5 firms. Class 1 and 2 firms have a greater

median current ratio (CR) value than the other classes. There is a danger in assuming a solid liquidity position based only on examining the current ratios for Class 1 and Class 2. The median Inventory turns for raw materials (RM_TURNS) increases from 6.34 for Class 1 firms to 11.10 for Class 5 firms. Inventory turns, when combined with the current ratio, provide a more complete picture. Inventory turns for raw materials (RM_TURNS), work-in-progress materials (WIP_TURNS), and finished goods (FG_TURNS) increased from Class 1 to Class 5, suggesting that higher-class firms can conduct their operations with fewer inventories than lower-class firms. Once inventories are subtracted, the current ratio presents a different picture, revealing a vulnerable liquidity position for lower-class firms (H2 a and H4 a).

7.4.4.2 Operating cash flow ratio (OCF)

A company's operating cash flow (OCF) demonstrates its ability to generate cash via normal business activities. An appropriate cash balance indicates the firm's liquidity position and provides flexibility. The median operating cash flow (OCF) varies from 0.09 for Class 1 firms to 0.29 for Class 5 firms. From Class 1 to Class 5 firms, the author noticed a progressive increase in the median value of the OCF. This observation suggests that as a firm's size decreases, it faces a financial crunch and loses operational flexibility, which affects performance (H3 a).

7.4.4.3 Defensive interval ratio (DIR)

The Defensive interval ratio (DIR) is calculated by dividing current assets by daily expenditures. It measures how well a company transforms current assets to pay its day-to-day expenses. The higher the ratio, the greater the efficiency and the less stress on the company to seek extra financial resources. The median Defensive interval ratio (DIR) varies from 0.01 for Class 1 firms to 1.27 for Class 5 firms. The median DIR gradually grew from Class 1 to Class 5 firms, demonstrating that lower-class firms must seek

additional funding to meet daily expenses, indicating a fragile liquidity scenario (H3 a).

7.4.4.4 Times interest earned ratio (TIE)

The times interest earned ratio (TIE) is calculated by dividing earnings before interest and taxes by interest expenses. It measures a company's ability to meet its debt obligations regularly. This ratio analyzes how easily a company can pay its periodic interest expenses if it allocates all its earnings before interest and taxes (EBIT) to debt repayment. The higher the ratio, the more efficiently the company can satisfy its debt commitments. The median times interest earned ratio (TIE) varies from 2.17 for Class 1 firms to 5.28 for Class 5 firms. The median TIE increased gradually from Class 1 to Class 5 enterprises, implying that lower-class firms struggle to meet debt expenses, indicating a precarious liquidity condition (H2 a).

7.4.4.5 Debtor turns (DT)

The debtor turns indicate the speed at which the firm converts average debtors into cash in a given year. This is an efficiency indicator, and it assesses the company's capacity to collect cash. The higher the turns, the greater the frequency with which the organization can collect the cash. The median debtor turns (DT) varies from 5.35 for Class 1 firms to 7.75 for Class 5 firms. The median DT steadily increased from Class 1 to Class 5 enterprises, showing that lower-class firms take longer to transform sales into cash. A circumstance like this creates a liquidity problem (H4 a).

7.5 Panel data regression and simulation

7.5.1 Technique for panel data

In the panel data evaluated for this study, individual (group) effects, time effects, or both may exist. Such consequences can be analyzed using fixed effect and random effect models. Panel data models provide methods for dealing with heterogeneity and assessing fixed and random effects in data (Hun Myoung Park, 2011). A fixed effect model analyzes

whether intercepts differ throughout a group or over time, whereas a random effect model investigates variance component differences among individuals or over time. To perform the Panel regressions, the author followed the below procedure as outlined by Olufemi I. F. & Olubanjo T. A. (2009)

The author generated class-specific panel data regression and summarized the results in Table 7.3 below using the above-described methodology.

Table 7. 3 Panel data analysis summary (2012-2021)

Variables	Class 1	Class 2	Class 3	Class 4	Class 5
Constant					
CR	0.03* (0.35)		0.00* (1.14)	0.00* (3.54)	0.00* (3.55)
C_COS					
OCF	0.00* (3.28)	0.00* (3.47)	0.00* (3.59)	0.00* (7.22)	0.02* (2.31)
DIR	0.00* (57.14)	0.00* (3.28)	0.00* (5.88)	0.00* (0.52)	0.00* (0.23)
TIE					
RM_TURNS		0.00* (0.09)	0.08** (0.05)	0.00* (0.13)	0.00* (0.15)
WIP_TURNS					
FG_TURNS					
DT		0.00* (0.39)	0.00* (0.17)	0.07** (0.09)	
CT		0.00* (0.22)			
SALES_GR					
GDP_GR					
Adjusted R Square	0.26	0.63	0.65	0.37	0.48

Coefficient value in parenthesis; * 95% Significance level; ** 90% Significance level

7.5.2 Scenario building and simulation summary

The final mix of variables and the coefficient of the significant variables vary for each Class, as demonstrated in Table 7.4, affecting profitability from a liquidity standpoint. Since the final collection of essential variables goes for each class, the activities required

to enhance liquidity would also differ. The author strongly recommends using a Supply Chain Finance (SCF) solution in an environment where a cooperative liquidity management strategy can benefit the entire value chain. The author devised five scenarios based on the given hypothesis to simulate the potential benefits.

7.5.3 Scenario methodology description

Using the (JMP, 2021) distribution platform insights, the author determined suitable closest data distributions for the significant variables identified from panel data analysis. Table 7.4 below summarizes the variable distributions grouped by class.

Table 7. 4 Class-wise variable distribution summary

Variable	Class-1	Class-2	Class-3	Class-4	Class-5
CR	Exponential		Normal	Exponential	Lognormal
OCF	Normal	Normal	Normal	Normal	Normal
DIR	Normal	Normal	Normal	Normal	Normal
RM_TURNS		Exponential	Exponential	Normal	Exponential
DT		Exponential	Exponential	Exponential	
CT		Exponential			

The author built five distinct scenarios by altering the distribution parameters to understand the impact of the improved variables on the Class's financial performance (ROA). The author enclosed the scenarios in Table 7.5 below.

Table 7. 5 Simulation scenario definition summary

Parameter	Scenario-1	Scenario-2	Scenario-3	Scenario-4	Scenario-5
Average	Improve by 5%	Improve by 10%	Improve by 15%	Improve by 20%	Improve by 25%
Std. Deviation	Reduce by 5%	Reduce by 10%	Reduce by 15%	Reduce by 20%	Reduce by 25%

7.5.4 Simulation scenario summary

The author conducted ten thousand simulation runs for each variable utilizing a suitable distribution-based random number generator technique in MS Excel. The simulation scenario summary is shown in Figure 7.7.

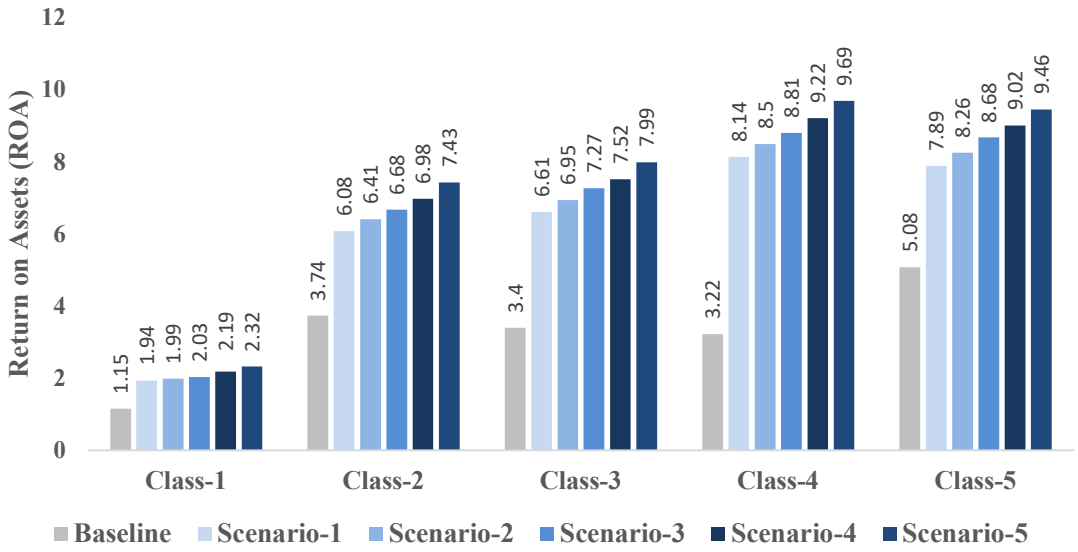

Figure 7. 7 Class-wise simulation scenario summary

The ability to convert current assets into cash and effectively manage day-to-day expenses yields substantial advantages, ultimately enhancing profitability as measured by return on assets (ROA). The simulated outcomes demonstrate a significant enhancement in the return on assets (ROA) across every class of companies in all scenarios. For all classes of firms, the author observed a significant boost (up to 100% from the existing median level) in the estimated return on assets (ROA) in the simulated scenario.

7.6 Conclusions and implications

7.6.1 Conclusions

According to data from the government of India, there are many exits in the auto industry, and very few new firms are registered with the government. Financial distress leads to departures from the industry, and firms across different classes (in terms of revenue) face a liquidity crunch that results in financial distress. Based on the findings, the author confirmed that the financial distress of registered Indian auto firms is unrelated to the firm's size. Most of the research in this domain is concentrated either in Europe or China. As per the author's understanding, no studies comprehensively explored the impact of liquidity variables on the ROA in the Indian context. The author examined various liquidity dimensions that can impact the ROA. The study empirically demonstrates that each Class of firm has distinct liquidity requirements and can collaboratively achieve a shared vision and value chain-level performance instead of gaining it at each other's expense. The study's findings suggest a roughly 100% improvement in the median Return on Assets (ROA) for each class of firms. Implementing necessary structural changes by the Government of India to provide a fair-play business climate can benefit the industry and make it more globally competitive. Supply chain financing (SCF) may be the right vehicle for changing the business and credit landscape. According to the literature, implementing SCF will benefit various stakeholders (Seifert & Seifert, 2011).

The ability to provide a faster influx of cash to fulfill the organization's day-to-day needs is vital. Firms of all types must adopt this strategy to avoid excessive short-term borrowings. This strategy assists organizations in achieving the necessary flexibility while avoiding excessive interest payments, ultimately improving profitability (ROA). The author recommended improved solvency levels to achieve a higher return on assets (H2 b). This observation aligns with the empirical studies conducted by Kontuš & Mihanović,

(2019) and Mohanty & Mehrotra, (2018). The author also recommended optimal cash management practices for improved ROA (H3 b). This recommendation also draws strength from the observations (Oluoch, 2016; Pinkowitz & Williamson, 2002; Yousef & Smirat, 2016). Working capital is essential for the operation and survival of a business. The inability to rapidly convert raw materials into finished goods ties up a company's working capital. In addition, the longer it takes to receive payment for sold products, the more cash (working capital) is restricted in the supply chain. As the challenges of managing working capital increase, operations are impacted. It is difficult for businesses, especially smaller ones, to borrow (repeatedly on credit) the materials necessary for delivering the agreed-upon shipments to the downstream players. The author recommended a strategic approach to managing debtor turns (DT), as this variable consistently influences all classes (H4 b). The author's observation is also consistent with the findings of (Hermawan et al., 2023). The summary of hypothesis validation is included in Table 7.6.

Table 7. 6 Hypothesis validation summary

Hypothesis	Observation	Justification	Key literature support	Validity of hypothesis
H1 a	The financial distress of Class 1 firms is highest. However, the financial distress level for the other classes is comparable.	Data observation		No
H1 b	The author did not observe a linear relationship between ROA and Z score.	Data observations		No
H2 a	Lower-class firms revealed a vulnerable liquidity position based on cash ratio compared to higher-class firms. Lower-class firms are left with lesser earnings before interest and taxes to meet the	Data Observations		Yes

	interest expenses compared to higher-class firms.			
H2 b	CR (Cash ratio) variable is found to be significant in the regression study, and the recommended coefficient of cash ratio shows an increasing trend from Class 1 to Class 5	Regression summary	(Kontuš & Mihanović, 2019; Mohanty & Mehrotra, 2018)	Yes
H3 a	The author noticed a progressive increase in the median value of the operating cash flow position from lower- to higher-class firms.	Data Observations		Yes
H3 b	OCF and DIR variables are significant in the regression study, and the recommended coefficient of OCF (need for more cash flow from operations) shows a positive value for all classes of firms. Additionally, the recommended coefficient of DIR (availability of additional funds to manage working capital) shows a steadily decreasing trend from lower classes to higher classes.	Regression summary	(Oluoch, 2016; Pinkowitz & Williamson, 2002; Yousef & Smirat, 2016)	Yes
H4 a	The median debtor turns steadily increased from Class 1 to Class 5 enterprises, showing that lower-class firms take longer to transform sales into cash.	Data Observations		Yes
H4 b	RM_Turns and DT variables are found significant in the regression study, and the recommended coefficient of RM_Turns (need for quicker enhanced throughput of raw material) and the recommended coefficient of DT (ability to realize the cash for sale quickly) shows a steadily decreasing trend from lower classes to higher classes.	Regression summary	(Hermawan et al., 2023)	Yes

7.6.2 Implications

Exclusively prioritizing the firm's interests without considering the broader value chain could result in quick cost savings and provide a potential long-term hazard for organizations. In their study, More & Basu (2013) discovered a notable obstacle in Indian companies: the lack of a shared vision across partners in the supply chain. The absence of a commonly agreed-upon vision inside the supply chain could lead to disastrous consequences. Hence, it is crucial to recognize that the performance of each organization inside the value chain holds great importance. In general, both big and small businesses have expressed significant worry regarding their cash. Optimizing liquidity management improves profitability and safeguards organizations against financial hardships. The author has recognized a significant opportunity to enhance the return on assets for each group of companies by utilizing the median values within each group.

The study demonstrated the benefits that all participants in the value chain receive when they operate in a collaborative liquidity management environment. The study deviates from the notion of dominant power dynamics and instead suggests fostering a collaborative environment, which aligns closely with stakeholder theory. The research findings highlighted the distinct focus attributes associated with each company's category. Firms can improve their return on assets by focusing on the identified elements pertinent to their business environment. This technique is per the core tenets of contingency theory. The implementation of efficient government laws and the presence of solid financial institutions contribute to the improvement of financial practices in the industry (Berger & Udell, 2006). Enhanced financial processes enhance profitability for enterprises in the value chain and aid in developing more resilient balance sheets. Companies with more robust financial situations are better equipped to handle unexpected events, both internal and external, and their ability to bounce back can help all participants in the value chain

reach the stated benefits in terms of profitability. These studies aid managers in streamlining their efforts to identify effective ways to improve liquidity. According to Ambadapudi & Matai (2023), adopting a supply chain finance strategy that emphasizes the value chain can lead to a sales revenue growth of 0.3% to 0.9%. Enhanced liquidity provides financial relief to companies. Granting financial assistance will ultimately help parties decrease their value chain expenditures, resulting in advantages for the customer. Our study is relevant to professionals, particularly as the worldwide automotive sector gears up for the shift towards electric cars (EVs).

Chapter 8: Conclusions, Contributions, Recommendations, Limitations and Future Directions

Preview: Section 8.1 summarizes the conclusions of our research. Section 8.2 outlines the contributions from the research. Section 8.3 summarizes the recommendations made by the author from the research and summarizes the theoretical and practical implications of the study. Section 8.4 includes the current study's limitations and recommends future directions to validate further and extend the research.

8.1 Conclusions

India's significant domestic consumption levels make it capable of playing a more prominent part in the global economic development narrative. At this juncture, the Indian automobile sector aims to achieve two goals: growth and adherence to carbon emission regulations. Nevertheless, based on the data provided by the Government of India, many exits are occurring in the automotive industry. In contrast, only a few new companies are officially registered. Besides, MSMEs are expected to play a significant role in India's economic growth, and there is a noticeable difference in the contribution of MSMEs to the GDP of the United States, China, and India. Financial distress prompts exit from the business, and companies of various revenue classes encounter a shortage of available funds, leading to financial difficulties. It is crucial to strengthen the entire domestic ecosystem to benefit from this opportunity for India.

Based on the financial statistics, there is a significant variance in the profitability (ROA) among different classes of companies in the Indian automotive business. The consequences of the operational environment substantially impact a firm's ability to enhance profitability. In light of this, the author sought to understand the disparities in the operational circumstances of different classes of firms, which could hinder the growth of the domestic automobile sector. Given the variability in operating conditions, a universal strategy may not help firms attain exceptional financial performance. The

study commences by observing the challenges that smaller companies (MSMEs) encounter in achieving return on assets (ROA). Additionally, the author proposed hypotheses suggesting that the factors that facilitate enhanced ROA differ among firms. The study analyzes this phenomenon from a company's operations and financial perspectives.

The research examines firms' operational and financial strategies to enhance their Return on Assets (ROA). Consistent with the contingency theory, every firm class requires tailored endeavors to strengthen its financial performance. The author conducted a study examining the influence of several independent variables on a company's profitability (ROA) by analyzing data from 280 enterprises over ten years. The key conclusions from the study are listed below.

- The author identified relevant variables per each class of firms that can improve the financial performance of each class of enterprises.
- The study ascertains that interactions among different variables are crucial in achieving profitability.
- The author identified various levels at which the significant variables must operate to improve profitability.
- The study provides evidence that various classes of firms have unique resource needs and can attain a shared vision and enhance performance at the value chain level without compromising each other's interests.

As a part of this study, the author addressed the three research objectives stated in the Literature review chapter in section 2.10.

1. Examined the influence of significant variables on the enterprise profitability for various classes of Indian auto firms and generated a decision framework for the practicing managers
2. Created a methodology to analyze the significant variables' factor effects and their levels for profitability improvement for various classes of Indian auto firms in an

SCF environment

3. The author quantified the financial and operational impact of sharing supply chain surplus within the network with greater adoption of SCF for the Indian auto industry.

Table 8.1 below summarizes the conclusions by mapping the objectives, corresponding gaps, and the adopted research methodology.

Research Gaps	Research Objective	Methodology	Findings
Very few studies were conducted on Indian geography. Level of awareness and adoption of SCF solutions by the Indian enterprises	To understand the **influence of significant variables on the enterprise profitability** for various classes of Indian auto firms	Panel data regression technique	• Different classes of firms have unique target variables • Firms can achieve a shared vision and value chain-level performance rather than doing so at each other's cost.
Interdependent effects of influencing variables on firm performance in an SCF environment	To systematically analyze the **significant variables' effects and their corresponding levels** on profitability improvement for various classes of Indian auto firms in an SCF environment.	Design of Experiments (DoE) technique	• Significant opportunity to enhance the return on assets for every class of firms compared to the existing median levels. • Estimated a profitability improvement in the range of 3 times to 7 times for various classes of firms.
Comprehensive benefit evaluation of the complete supply chain network due to SCF adoption Effects of the liquidity management and their connection to the firm's overall value creation. SCF adoption levels on supply chain risks and performance volatility	To assess the **financial and operational impact** of sharing supply chain surplus within the network with greater adoption of SCF for the Indian auto industry.	Monte Carlo Simulation technique	• Tangible benefits of greater adoption of supply chain finance in realizing supply chain members' shared vision • The median return on assets (ROA) had a close to 100 percent increase for all classes.

Table 8. 1 Summary of current research

Implementing essential structural reforms by the Government of India to establish a business environment that promotes fair competition can positively impact the industry, enhancing its worldwide competitiveness. Supply chain financing (SCF) can effectively transform the business and credit environment. Implementing Supply Chain Finance (SCF) has been shown in the literature to provide advantages for several stakeholders (Seifert & Seifert, 2011). The study focuses on effectively implementing stakeholder theory throughout the value chain and adds to the development of a decision-making framework. The author firmly believes these frameworks allow each class type to concentrate on specific operational areas.

8.2 Contributions

Through this study, the author makes four critical contributions.

1. Identify significant decision areas to focus on based on the classification of the firms and their current operating environment and contribute to the research on contingency theory. This knowledge enables businesses to make better strategic decisions regarding their supply chains, resulting in superior financial performance. It is essential, as companies must make targeted efforts to improve performance.
2. Contribute to the research on stakeholder theory. There is little room for the prevalent power-based relationships because the focus areas of various classes of firms are distinct. Instead, such practices can take a backseat, and a shared value chain vision can be realized. The ambition of the shared vision emphasizes the need to depart from firm-centric approaches and encourages greater adoption of supply chain finance. Specifically, the research aligns with the past research of (S. Kumar et al., 2018) and extends the study by More & Basu (2013), who identified the absence of a shared vision among supply chain partners in Indian enterprises as a critical challenge.

3. Confirm the bidirectional relationship between financial performance and operations management. Efficient operations management enhances financial performance (García-Teruel & Martínez-Solano, 2007). Besides, financial flexibility enhances operational effectiveness (Martin & Hofmann, 2019). Appropriately, greater adoption of supply chain finance solutions within the value chain improves operational efficiencies.
4. A substantial body of work in this area corresponds to European SMEs, and recent research contributions indicate that China is acquiring significant momentum in exploring the challenges of Small and Medium Enterprises. More literature needs to address the difficulties of smaller enterprises, particularly in India. The preponderance of previous research consisted of case-based analyses and surveys. Very few studies have examined exhaustive empirical calculations based on financial data. Also, minimal efforts were made to analyze the efficacy of supply chains beyond the traditional way of limiting to the firm in question (Busi & Bititci, 2006). The author addresses this gap in our current study

8.3 Recommendations and implications

The current study critiques the prevailing approach to power imbalances in the Indian auto value chain. It highlights the practice of how larger and more influential enterprises take advantage of smaller and less powerful firms by imposing favorable conditions (Liebl et al., 2016). There must be an environment where all the value chain participants prosper simultaneously, resulting in a sustainable operating environment. There is a significant opportunity to enhance the return on assets for every class of firms compared to the existing median levels.

The key recommendations from the study are listed below

- Practitioners are recommended to leverage the decision framework proposed in the study (Table 6.6) to focus on specific factors that align with their operational requirements to achieve the most significant advantage from the work. The summary of the class-wise recommendation is included below.
    - **Class-1 Firms:** Based on the empirical investigation, the author recommends that Class-1 firms focus on liquidity management and asset utilization aspects of the business. Based on the output from the Design of Experiments analysis, the author recommended Debtor Days (DD) to be lower than 33 days, Fixed Asset Utilisation (FA_Util) to be closer to 100%, and Quick ratio (QR) to be 0.33 to maximize their Return on Assets (ROA). Maximizing capacity utilization helps keep unit costs lower, and the augmented adoption of supply chain finance helps improve liquidity management for firms.
    - **Class-2 Firms:** Based on the empirical investigation, the author recommends that Class-2 firms focus on capital structure, liquidity management, and asset utilization aspects of the business. Based on the output from the Design of Experiments analysis,, the author recommended Debtor Days (DD) to be lower than 33 days, Gross Working Capital Cycle days (GWC) to be less than 75 days, Debt to Equity ratio (DTE) to be less than 0.5, Raw material as a percentage of sales (RM_Sales) to be limited to 40% and, Fixed Asset Utilisation (FA_Util) to be closer to 100% and lower levels of short term borrowings (STB) at 75 to maximize their Return on Assets (ROA).

- **Class-3 Firms:** Based on the empirical investigation, the author recommends that Class-3 firms focus on liquidity management, asset utilization, and operational efficiency aspects of the business. Based on the output from the Design of Experiments analysis, the author recommended that Debtor Days (DD) be lower than 50 days, Quick Ratio (QR) be 0.33, and Fixed Asset Utilisation (FA_Util) be closer to 100.
- **Class-4 Firms:** Based on the empirical investigation, the author recommends that Class-4 firms focus on capital structure, liquidity management, and operational efficiency aspects of the business. Based on the output from the Design of Experiments analysis, the author recommended Gross Working Capital Cycle days (GWC) to be less than 50 days, Debt to Equity ratio (DTE) to be less than 0.5, Raw material as a percentage of sales (RM_Sales) to be limited to 50%, Quick ratio (QR) to be 0.4 and, Finished Goods Turnover (FGT) to be closer to 50 and lower levels of short term borrowings (STB) at 200 to maximize their Return on Assets (ROA).
- **Class-5 Firms:** Based on the empirical investigation, the author recommends that Class-5 firms focus on capital structure, liquidity management, and operational efficiency aspects of the business. Based on the output from the Design of Experiments analysis, the author recommended Debtor Days (DD) to be lower than 35 days, Gross Working Capital Cycle days (GWC) to be less than 60 days, Debt to Equity ratio (DTE) to be less than 0.25, Raw material as a percentage of sales (RM_Sales) to be limited to 50%, Quick ratio (QR) to be 0.4, Fixed Asset

Utilisation (FA_Util) to be closer to 100% and, lower levels of short term borrowings (STB) at 300 to maximize their Return on Assets (ROA).

  - Increased use of supply chain finance optimizes the financial aspects of the performance variables for various classes of firms.

- A lot of commonality exists for all classes of firms as far as liquidity needs are concerned. The study recommends that value chain players operate in a shared environment for mutual benefit, with a more extensive adoption of SCF.
  - The author recommends a collaborative practice to convert current assets into cash and effectively manage day-to-day expenses for all classes of firms by effective SCF adoption.
  - The author recommended five distinct incremental scenarios (Table 7.5) reflecting possible improvements in the focus variable per each class of firms (based on the simulation studies) that can be explored to improve the return on assets (ROA).
- The research presents a compelling argument in favour of implementing critical structural reforms by the Government of India that can facilitate increased adoption of SCF. This will create a business environment that fosters equitable competition, positively impacting the industry and improving its global competitiveness.
- The study promotes registering the broader MSME community (currently unregistered) with the Government of India to capitalize on the structural and policy improvements.

8.3.1 Theoretical implications

The study deviates from the notion of dominant power dynamics and instead suggests fostering a collaborative environment, which aligns closely with stakeholder theory. The research findings highlighted the distinct target variables associated with each company's class. Firms can improve their return on assets by focusing on the identified variables pertinent to their business environment. The study demonstrated the benefits that all participants in the value chain receive when they operate in a collaborative environment. Improved financial processes enhance profitability for enterprises throughout the value chain and contribute to developing more resilient balance sheets. Companies with more substantial financial positions can endure unexpected events from within or outside the organization and exhibit resilience (Tang, 2006b). By using appropriate supply chain finance (SCF) instruments, the participants in the value chain can get the specified benefits in terms of profitability.

8.3.2 Managerial implications

The automotive value chain is typically characterized by relationships founded on power. In the value chain, the downstream firms that are larger and closest to the customer tend to dictate the trading terms (Corsten et al., 2006). Overemphasizing the importance of individual firms and neglecting the broader value chain might lead to immediate cost savings but pose a risk to companies in the long term. It is imperative to look at the performance of the whole supply chain as the enablers for various classes of firms would be different. A decision framework is developed as an outcome of the study that practitioners from different classes might use to improve organizational performance. The significance and relevance of our research are evident for professionals, particularly as the worldwide automotive sector is gearing up for the shift towards electric vehicles (EVs).

The author acknowledges that the operational environment of the companies may vary significantly, and it may not be practical to implement the suggested configurations directly. Nevertheless, the author contends that the framework offers direction for practitioners to effectively utilize the suitable

mechanisms according to their particular circumstances to enhance their return on assets. Companies can modify the identified factors depending on the specific circumstances of their business environment, as outlined in contingency theory. By doing so, the firms can attain enhanced returns on their assets.

8.3.3 Policy implications

The policy implications of supply chain financing (SCF) transcend multiple dimensions of the economy, encompassing financial regulation, economic development, and supply chain resilience.

- **Class-1 and Class-2 firms**: SCF has the potential to bring more businesses, especially micro, small and medium businesses in emerging markets, into the formal financial system. SCF has the potential to significantly enhance financial accessibility for micro, small and medium businesses by capitalizing on the creditworthiness of larger firms. Policymakers might advocate for SCF as a mechanism to bolster these firms, which frequently serve as the fundamental support system of emerging economies.
- **Class-3 firms:** By optimizing working capital through SCF, Class-3 firms can enhance their competitiveness in the market. They can use the improved liquidity to invest in innovation, expand their product offerings, or enter new markets. SCF frameworks incentivize large companies to adopt more sustainable and socially responsible practices that creates a win-win value chain establishment.
- **Class-4 and Class -5 firms:** SCF policies offer a powerful tool to optimize cash flow and strengthen supplier relationships. Additionally, Supply Chain Finance (SCF) can promote supplier base diversification by facilitating access to funding for smaller or less established suppliers. These enhanced supply base results in minimized supply chain risks to the Class-4 and Class -5 firms.

- For all classes of firms, the policymakers must adopt effective regulations for SCF operations to mitigate systemic risks. This entails overseeing the credit risks transferred between entities in the supply chain and guaranteeing openness in SCF transactions.

8.4 Limitations and future research directions

Current research has limitations as the author considered only the registered Indian firms. There could be a lot of firms that are in the unregistered space. The analysis would have been more insightful if data from unregistered firms is included. Besides, the focus of current study is limited to the automotive industry.

Below are some of the critical future directions that can be explored:

1. **Comparative view**: Current study can be replicated in one or more regions where the automobile industry plays a crucial role in the economy. The choice of geography can vary from a developing to a developed country. Such studies will help in comparing the relevance of the target variables. A different geography with differences in operating conditions may result in an alternate set of variables. Such kinds of studies can help reinforce the methodology we suggested.
2. **Extension of scope of Industry**: The author limited the focus of their research to the Indian auto industry. The current work can be extended to other significant sectors within India crucial for economic development. Understanding the variable selection for different industries that can help achieve profitability will be interesting.
3. **Inclusion of additional constructs**: The author has finalized the constructs based on historical literature and an understanding of the business context. In future research, additional constructs can be included and evaluated for their significance in enhancing the profitability (ROA) of the firms.

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Appendix A1- Data Summaries

A1-1: Descriptive statistics of Class 1 data (Chapters 5 and 6)

	Observations	Mean	Median	Maximum	Minimum	Std.Dev
DD	380	80.80	64.46	618.47	7.47	70.12
QR	380	1.10	0.64	25.00	-	1.92
GWC	380	219.54	161.26	2,410.87	15.83	237.13
DTE	380	4.36	0.99	105.17	-	9.72
FGT	380	90.02	43.66	4,448.20	-1.26	303.90
STB	380	58.90	32.85	264.00	0.10	61.47
RM_Sales	380	0.66	0.58	11.72	0.06	0.92
PUR_Sales	380	0.02	-	1.81	-	0.10
PFW_Sales	380	0.06	0.03	0.80	0.01	0.10
FA_Util	380	2.63	1.81	21.81	0.21	2.85
Sales_FA	380	682.52	320.28	34,866.67	28.47	1,986.18
SALES_GR	380	0.21	0.05	18.74	-0.80	1.32
GDP_GR	380	0.05	0.07	0.09	-0.07	0.04

A1-2: Descriptive statistics of Class 2 data (Chapters 5 and 6)

Class-2	Observations	Mean	Median	Maximum	Minimum	Std. Dev
DD	1030	68.57	61.92	419.74	7.52	38.07
QR	1030	1.11	0.68	159.48	0.07	5.04
GWC	1030	168.67	139.89	3,701.41	18.45	149.21
DTE	1030	1.42	0.63	68.56	-	4.25
STB	1030	172.18	155.30	1,346.20	0.10	159.15
FGT	1030	179.49	41.51	8,075.80	0.48	642.08
RM_Sales	1030	0.58	0.56	6.90	0.00	0.32
PUR_Sales	1030	0.02	-	1.14	-	0.08
PFW_Sales	1030	0.11	0.03	18.76	0.00	0.90
FA_Util	1030	3.01	2.13	58.72	0.18	3.78
Sales_FA	1030	541.66	369.06	9,544.32	24.54	674.99
Sales_GR	1030	0.17	0.06	51.19	-0.98	1.71
GDP_GR	1030	0.05	0.07	0.09	-0.07	0.04

A1-3: Descriptive statistics of Class 3 data (Chapters 5 and 6)

	Observations	Mean	Median	Maximum	Minimum	Std.Dev
DD	540	57.91	55.83	140.94	7.33	23.34
QR	540	0.84	0.69	5.04	0.09	0.59
GWC	540	126.56	115.41	718.76	25.33	61.95
DTE	540	7.34	0.53	3,288.00	-	141.48
FGT	540	221.12	43.72	24,201.60	1.18	1,294.62
STB	540	363.80	225.75	2,896.50	0.10	407.68
RM_Sales	540	0.59	0.60	1.19	0.26	0.12
PUR_Sales	540	0.06	-	4.67	-	0.40
PFW_Sales	540	0.04	0.03	0.25	0.00	0.03
FA_Util	540	2.64	2.25	19.18	0.32	1.80
Sales_FA	540	437.57	377.19	2,432.35	19.44	261.83
SALES_GR	540	0.07	0.05	2.13	-0.66	0.24
GDP_GR	540	0.05	0.07	0.09	-0.07	0.04

A1-4: Descriptive statistics of Class 4 data (Chapters 5 and 6)

Class-4	Observations	Mean	Median	Maximum	Minimum	Std. Dev
DD	410	52.66	49.85	180.03	4.54	23.53
QR	410	0.71	0.57	3.61	0.09	0.48
GWC	410	108.53	102.21	280.19	23.11	44.28
DTE	410	1.13	0.72	28.91	-	1.92
STB	410	765.04	443.65	21,861.20	0.30	1,589.64
FGT	410	161.61	65.67	5,104.82	4.49	448.95
RM_Sales	410	0.64	0.65	0.95	-0.02	0.12
PUR_Sales	410	0.02	-	0.28	-	0.05
PFW_Sales	410	0.03	0.02	0.02	0.00	0.02
FA_Util	410	2.72	2.41	11.27	0.20	1.54
Sales_FA	410	457.34	396.14	4,140.95	30.52	322.68
Sales_GR	410	0.08	0.06	2.37	-0.54	0.26
GDP_GR	410	0.05	0.07	0.09	-0.07	0.04

A1-5: Descriptive statistics of Class 5 data (Chapters 5 and 6)

	Observations	Mean	Median	Maximum	Minimum	Std.Dev
DD	440	47.92	45.46	123.90	0.43	19.55
QR	440	0.95	0.75	5.28	0.08	0.70
GWC	440	105.27	96.15	334.09	11.28	47.24
DTE	440	0.59	0.33	10.29	-	1.00
FGT	440	186.55	48.93	13,065.68	3.76	827.60
STB	440	880.75	486.05	5,870.10	0.40	1,054.62
RM_Sales	440	0.63	0.65	0.91	0.08	0.12
PUR_Sales	440	0.02	0.00	0.45	-	0.06
PFW_Sales	440	0.03	0.02	0.19	0.00	0.03
FA_Util	440	3.29	2.79	37.28	0.73	2.80
Sales_FA	440	561.88	461.99	4,986.58	88.18	537.01
SALES_GR	440	0.08	0.07	3.22	-0.51	0.25
GDP_GR	440	0.05	0.07	0.09	-0.07	0.04

A1-6: Pearson correlation matrix for Class 1 data (Chapters 5 and 6)

	ROA	*DD*	*GWC*	*QR*	*DTE*	*FGT*	*FA_Util*	*Sales_FA*	*RM_Sales*	*PUR_Sales*	*STB*	*PFW_Sales*
ROA	1.00											
DD	-0.12	1.00										
GWC	-0.09	0.36	1.00									
QR	0.10	0.57	0.18	1.00								
DTE	-0.38	0.11	0.03	-0.12	1.00							
FGT	0.02	-0.07	-0.10	-0.03	-0.02	1.00						
FA_Util	0.29	-0.04	-0.03	-0.02	-0.15	0.01	1.00					
Sales_FA	0.07	0.05	0.00	0.17	-0.06	-0.02	0.38	1.00				
RM_Sales	-0.04	-0.09	0.63	-0.07	0.00	-0.01	0.14	0.04	1.00			
PUR_Sales	-0.33	-0.06	-0.06	0.04	0.10	-0.02	-0.03	-0.02	0.02	1.00		
STB	0.01	-0.00	0.00	-0.01	0.06	-0.04	0.17	0.19	-0.08	-0.05	1.00	
PFW_Sales	-0.13	-0.00	0.21	0.01	0.00	-0.03	-0.03	0.22	0.20	-0.05	0.09	1.00

A1-7: Pearson correlation matrix for Class 2 data (Chapters 5 and 6)

	ROA	*DD*	*GWC*	*QR*	*DTE*	*FGT*	*FA_Util*	*Sales_FA*	*RM_Sales*	*PUR_Sales*	*STB*	*PFW_Sales*
ROA	1.00											
DD	-0.09	1.00										
GWC	-0.14	0.47	1.00									
QR	0.07	0.01	-0.02	1.00								
DTE	-0.24	0.02	0.04	-0.03	1.00							
FGT	-0.04	-0.08	-0.08	-0.02	0.04	1.00						
FA_Util	0.17	-0.09	-0.11	0.02	-0.07	-0.02	1.00					
Sales_FA	0.20	-0.09	-0.12	0.03	-0.08	-0.04	**0.93**	1.00				
RM_Sales	-0.16	-0.11	-0.05	-0.02	0.02	0.00	0.09	0.08	1.00			
PUR_Sales	-0.02	-0.05	0.05	-0.00	0.04	-0.06	0.10	0.11	-0.11	1.00		
STB	-0.13	0.12	0.19	-0.03	0.11	-0.08	-0.15	-0.17	-0.06	-0.04	1.00	
PFW_Sales	0.11	-0.05	0.00	0.01	-0.01	0.01	-0.04	-0.04	0.04	-0.02	-0.04	1.00

A1-8: Pearson correlation matrix for Class 3 data (Chapters 5 and 6)

	ROA	DD	GWC	QR	DTE	FGT	FA_Util	Sales_FA	RM_Sales	PUR_Sales	STB	PFW_Sales
ROA	1.00											
DD	0.00	1.00										
GWC	-0.14	0.59	1.00									
QR	0.54	0.07	-0.11	1.00								
DTE	-0.05	-0.00	-0.01	-0.03	1.00							
FGT	-0.01	-0.08	-0.08	-0.02	0.00	1.00						
FA_Util	0.50	-0.01	-0.22	0.32	0.01	0.03	1.00					
Sales_FA	0.49	-0.06	-0.23	0.33	-0.05	0.01	**0.81**	1.00				
RM_Sales	-0.15	-0.08	-0.10	-0.04	0.07	0.04	0.21	0.16	1.00			
PUR_Sales	0.03	0.01	-0.10	-0.02	-0.01	-0.03	0.26	0.19	-0.02	1.00		
STB	-0.29	0.21	0.24	-0.34	-0.02	-0.06	-0.26	-0.33	-0.28	0.06	1.00	
PFW_Sales	-0.32	0.07	0.17	-0.16	-0.02	-0.01	-0.38	-0.37	-0.47	-0.04	0.27	1.00

A1-9: Pearson correlation matrix for Class 4 data (Chapters 5 and 6)

	ROA	DD	GWC	QR	DTE	FGT	FA_Util	Sales_FA	RM_Sales	PUR_Sales	STB	PFW_Sales
ROA	1.00											
DD	-0.15	1.00										
GWC	-0.21	0.69	1.00									
QR	0.46	0.09	0.10	1.00								
DTE	-0.31	0.14	0.13	-0.31	1.00							
FGT	-0.04	0.13	-0.04	-0.07	0.05	1.00						
FA_Util	0.26	-0.18	-0.28	0.13	-0.16	-0.08	1.00					
Sales_FA	0.20	-0.20	-0.31	0.16	-0.14	-0.02	**0.82**	1.00				
RM_Sales	-0.14	-0.27	-0.50	-0.13	0.05	0.15	0.26	0.30	1.00			
PUR_Sales	-0.03	-0.02	-0.01	0.03	-0.04	-0.09	0.27	0.24	-0.01	1.00		
STB	-0.17	0.34	0.35	-0.21	0.57	0.01	-0.21	-0.22	-0.11	-0.08	1.00	
PFW_Sales	-0.23	0.35	0.54	-0.07	0.07	-0.12	-0.38	-0.37	-0.53	0.01	0.17	1.00

A1-10: Pearson correlation matrix for Class 5 data (Chapters 5 and 6)

	ROA	DD	GWC	QR	DTE	FGT	FA_Util	Sales_FA	RM_Sales	PUR_Sales	STB	PFW_Sales
ROA	1.00											
DD	0.00	1.00										
GWC	-0.16	0.75	1.00									
QR	0.34	0.22	0.03	1.00								
DTE	-0.44	-0.08	0.05	-0.34	1.00							
FGT	0.06	-0.11	-0.14	-0.01	-0.03	1.00						
FA_Util	0.39	-0.14	-0.22	0.25	-0.15	0.01	1.00					
Sales_FA	0.44	-0.14	-0.23	0.24	-0.11	0.03	**0.82**	1.00				
RM_Sales	-0.07	-0.10	-0.39	0.01	0.04	0.05	0.21	0.20	1.00			
PUR_Sales	-0.05	-0.08	0.01	0.14	-0.05	0.01	0.04	0.01	-0.13	1.00		
STB	-0.29	0.29	0.36	-0.33	0.37	-0.04	-0.17	-0.21	0.02	-0.11	1.00	
PFW_Sales	-0.47	-0.02	0.15	-0.24	0.34	-0.09	-0.25	-0.27	-0.25	0.06	0.15	1.00

A1-11: Choice of Instrument Variables

Explanatory variable	Choice of instrument variables
Debtor days (DD)	Current assets (incl. short-term investments, loans & advances)
	Trade receivables & bills receivables to current assets
	Short-term trade receivables
Fixed Asset Utilization (FA_Util)	Net fixed assets utilization ratio(times)
Gross working capital cycle days (GWC)	Net working capital (cost of sales method)
	Raw material cycle (days)
	WIP cycle (days)
	Finished goods cycle (days)
	Net working capital cycle (days)
	Raw material turnover (times)
Quick ratio (QR)	Profit after tax (PAT) net of Plant & Equipment (P&E)
	Inventories as % of current assets
	Cash & bank balance as % of current assets
	Bank balance (short term)
	Current ratio (times)
	Cash to current liabilities (times)
	Cash to the average cost of sales per day
Short-term borrowings (STB)	Gross Plant Property & Equipment
	Current liabilities
	Short term inventories
	Long-term borrowings excl current portion

A1-12: Descriptive statistics of Class 1 data (Chapter 7)

Class-1	Observations	Mean	Median	Maximum	Minimum	Std.Dev
CR	440	1.90	1.19	54.38	-	3.40
C_COS	440	34.90	6.15	640.79	-	82.66
OCF	440	0.18	0.09	6.67	-7.33	0.84
DIR	440	0.01	0.01	0.94	-0.38	0.10
TIE	440	14.57	2.17	867.00	-215.25	69.57
RM_TURNS	440	11.63	6.34	277.33	-	21.77
WIP_TURNS	440	64.70	10.85	1,342.70	-0.45	183.51
FG_TURNS	440	85.76	11.57	4,448.20	-1.26	306.13
DT	440	7.51	5.35	48.88	-	7.26
CT	440	5.98	4.44	141.15	-	8.61
Sales_GR	440	1.78	0.05	718.30	-0.80	34.25
GDP_GR	440	0.05	0.07	0.09	-0.07	0.04

A1-13: Descriptive statistics of Class 2 data (Chapter 7)

Class-2	Observations	Mean	Median	Maximum	Minimum	Std.Dev
CR	1130	1.68	1.14	253.10	0.19	7.56
C_COS	1130	21.61	7.10	544.54	-3.84	44.86
OCF	1130	0.26	0.17	5.82	-1.71	0.52
DIR	1130	0.13	0.11	15.69	-4.72	0.67
TIE	1130	49.42	3.30	6,449.00	-1,849.00	368.51
RM_TURNS	1130	10.89	8.09	115.43	-	11.50
WIP_TURNS	1130	49.65	19.39	1,953.50	-	114.34
FG_TURNS	1130	172.92	24.87	8,075.80	-0.77	615.24
DT	1130	6.61	5.73	48.51	-	4.14
CT	1130	5.64	4.61	88.94	-	5.88
Sales_GR	1130	0.77	0.05	760.45	-1.00	22.63
GDP_GR	1130	0.05	0.07	0.09	-0.07	0.04

A1-14: Descriptive statistics of Class 3 data (Chapter 7)

Class-3	Observations	Mean	Median	Maximum	Minimum	Std.Dev
CR	560	1.31	1.15	6.15	0.29	0.71
C_COS	560	14.78	5.40	236.26	-	27.59
OCF	560	0.27	0.20	2.35	-1.26	0.34
DIR	560	0.33	0.21	4.83	-1.96	0.82
TIE	560	74.72	3.52	4,831.00	-5,168.00	524.40
RM_TURNS	560	10.59	9.07	84.60	-	7.07
WIP_TURNS	560	63.46	27.95	2,829.15	-	151.25
FG_TURNS	560	216.00	42.89	24,201.60	-	1,276.17
DT	560	7.95	6.37	49.82	-	6.32
CT	560	5.92	4.74	140.52	-	9.95
Sales_GR	560	0.32	0.06	143.79	-0.65	6.08
GDP_GR	560	0.05	0.07	0.09	-0.07	0.04

A1-15: Descriptive statistics of Class 4 data (Chapter 7)

Class-4	Observations	Mean	Median	Maximum	Minimum	Std.Dev
CR	460	1.18	1.01	5.17	0.09	0.68
C_COS	460	14.86	5.51	324.97	-	31.84
OCF	460	0.25	0.22	1.43	-1.68	0.33
DIR	460	0.02	0.29	7.14	-58.95	4.16
TIE	460	70.42	3.54	7,069.00	-2,078.25	505.85
RM_TURNS	460	13.08	10.53	68.97	-0.21	10.02
WIP_TURNS	460	523.69	58.69	1,33,201.60	-	6,459.47
FG_TURNS	460	138.51	49.99	4,997.30	-	402.34
DT	460	8.37	7.15	80.47	-	6.36
CT	460	5.24	4.87	19.00	-	2.47
Sales_GR	460	3.37	0.05	1,402.30	-0.59	65.51
GDP_GR	460	0.05	0.07	0.09	-0.07	0.04

A1-16: Descriptive statistics of Class 5 data (Chapter 7)

Class-5	Observations	Mean	Median	Maximum	Minimum	Std.Dev
CR	480	1.30	1.07	5.84	0.03	0.75
C_COS	480	14.00	5.35	147.96	-	22.08
OCF	480	0.31	0.29	1.48	-0.77	0.27
DIR	480	0.65	1.27	20.75	-282.44	13.62
TIE	480	136.20	5.28	17,934.00	-299.50	970.05
RM_TURNS	480	14.30	11.10	123.01	-	13.32
WIP_TURNS	480	109.19	55.99	1,245.95	-	180.49
FG_TURNS	480	210.76	51.11	13,065.68	-	988.85
DT	480	8.73	7.75	40.20	-	4.75
CT	480	5.82	5.20	25.11	-	3.03
Sales_GR	480	0.07	0.05	3.19	-0.61	0.26
GDP_GR	480	0.05	0.07	0.09	-0.07	0.04

A1-17: Pearson correlation matrix for Class 1 data (Chapter 7)

	ROA	*CR*	*C_COS*	*OCF*	*DIR*	*TIE*	*RM_TURNS*	*WIP_TURNS*	*FG_TURNS*	*DT*	*CT*
ROA	1.00										
CR	0.06	1.00									
C_COS	0.07	0.33	1.00								
OCF	0.20	-0.27	-0.04	1.00							
DIR	0.51	0.07	0.06	0.07	1.00						
TIE	0.17	0.13	0.34	-0.04	0.31	1.00					
RM_TURNS	0.04	-0.08	-0.01	0.01	0.06	-0.01	1.00				
WIP_TURNS	0.02	-0.08	-0.00	0.01	-0.01	0.05	0.14	1.00			
FG_TURNS	0.02	-0.04	-0.02	0.00	0.04	0.03	0.09	0.03	1.00		
DT	0.02	-0.16	-0.15	0.02	0.03	-0.03	0.08	-0.00	0.04	1.00	
CT	0.06	0.19	-0.05	-0.02	0.13	0.06	0.03	-0.07	0.02	0.23	1.00

A1-18: Pearson correlation matrix for Class 2 data (Chapter 7)

	ROA	*CR*	*C_COS*	*OCF*	*DIR*	*TIE*	*RM_TURNS*	*WIP_TURNS*	*FG_TURNS*	*DT*	*CT*
ROA	1.00										
CR	0.05	1.00									
C_COS	0.18	0.11	1.00								
OCF	0.45	0.05	0.31	1.00							
DIR	0.50	0.02	0.14	0.15	1.00						
TIE	0.25	0.06	0.40	0.37	0.20	1.00					
RM_TURNS	0.11	-0.02	-0.07	0.04	0.01	0.04	1.00				
WIP_TURNS	-0.04	0.11	0.05	0.01	-0.09	-0.01	0.04	1.00			
FG_TURNS	-0.04	-0.02	-0.09	-0.01	-0.03	-0.02	0.09	-0.01	1.00		
DT	0.05	-0.01	-0.07	0.07	-0.03	0.02	0.17	0.20	0.11	1.00	
CT	0.19	0.01	0.01	0.15	0.04	0.05	0.26	-0.01	0.06	0.25	1.00

A1-19: Pearson correlation matrix for Class 3 data (Chapter 7)

	ROA	CR	C_COS	OCF	DIR	TIE	RM_TURNS	WIP_TURNS	FG_TURNS	DT	CT
ROA	1.00										
CR	0.52	1.00									
C_COS	0.28	0.49	1.00								
OCF	0.55	0.31	0.22	1.00							
DIR	0.60	0.49	0.25	0.43	1.00						
TIE	0.19	0.17	0.08	0.08	0.14	1.00					
RM_TURNS	0.20	0.21	-0.05	0.16	0.13	0.05	1.00				
WIP_TURNS	0.10	0.08	0.22	0.08	0.09	0.05	0.02	1.00			
FG_TURNS	0.04	-0.01	-0.02	0.05	0.01	-0.00	0.07	-0.01	1.00		
DT	0.17	-0.11	0.11	0.21	0.06	-0.01	0.32	0.16	0.04	1.00	
CT	0.16	0.42	0.06	0.08	0.13	0.07	0.36	-0.04	-0.01	0.05	1.00

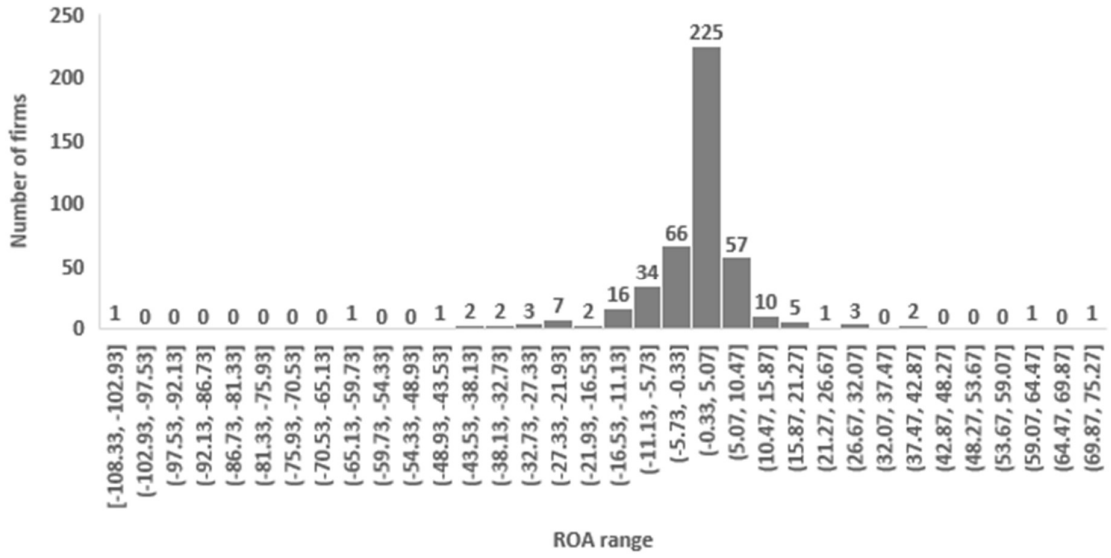
A1-20: Pearson correlation matrix for Class 4 data (Chapter 7)

	ROA	CR	C_COS	OCF	DIR	TIE	RM_TURNS	WIP_TURNS	FG_TURNS	DT	CT
ROA	1.00										
CR	0.35	1.00									
C_COS	0.16	0.41	1.00								
OCF	0.60	0.33	0.32	1.00							
DIR	0.53	0.13	0.07	0.43	1.00						
TIE	0.16	0.33	0.32	0.20	0.10	1.00					
RM_TURNS	0.15	-0.20	-0.14	0.03	0.10	-0.03	1.00				
WIP_TURNS	0.10	0.04	0.07	0.09	0.05	0.01	-0.01	1.00			
FG_TURNS	-0.03	-0.15	-0.05	-0.07	0.00	-0.02	0.12	-0.02	1.00		
DT	0.19	-0.01	0.11	0.18	0.03	0.07	0.20	0.02	-0.02	1.00	
CT	0.33	0.23	-0.07	0.19	0.10	0.04	0.26	-0.01	-0.09	0.45	1.00

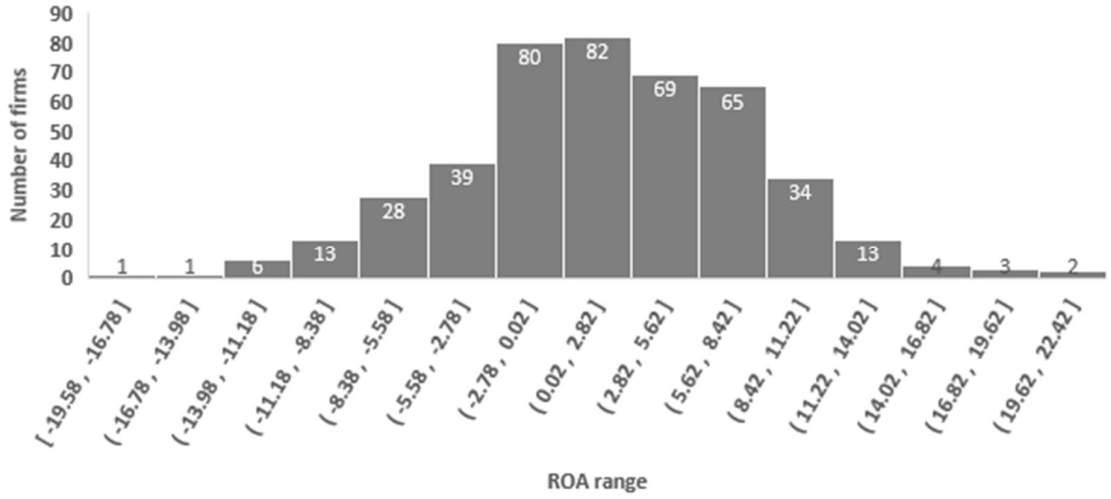
A1-21: Pearson correlation matrix for Class 5 data (Chapter 7)

	ROA	CR	C_COS	OCF	DIR	TIE	RM_TURNS	WIP_TURNS	FG_TURNS	DT	CT
ROA	1.00										
CR	0.40	1.00									
C_COS	0.11	0.45	1.00								
OCF	0.33	0.42	0.10	1.00							
DIR	0.53	0.16	0.06	0.12	1.00						
TIE	0.23	0.28	0.04	0.26	0.03	1.00					
RM_TURNS	0.24	-0.03	-0.01	0.05	0.05	-0.03	1.00				
WIP_TURNS	0.14	0.15	0.25	0.02	0.04	0.01	0.56	1.00			
FG_TURNS	0.06	-0.00	0.01	0.05	0.01	0.05	0.07	0.05	1.00		
DT	0.02	-0.22	-0.14	-0.00	0.03	-0.03	0.14	0.02	0.06	1.00	
CT	0.19	0.16	-0.02	0.16	0.07	0.16	0.14	0.03	-0.01	0.28	1.00

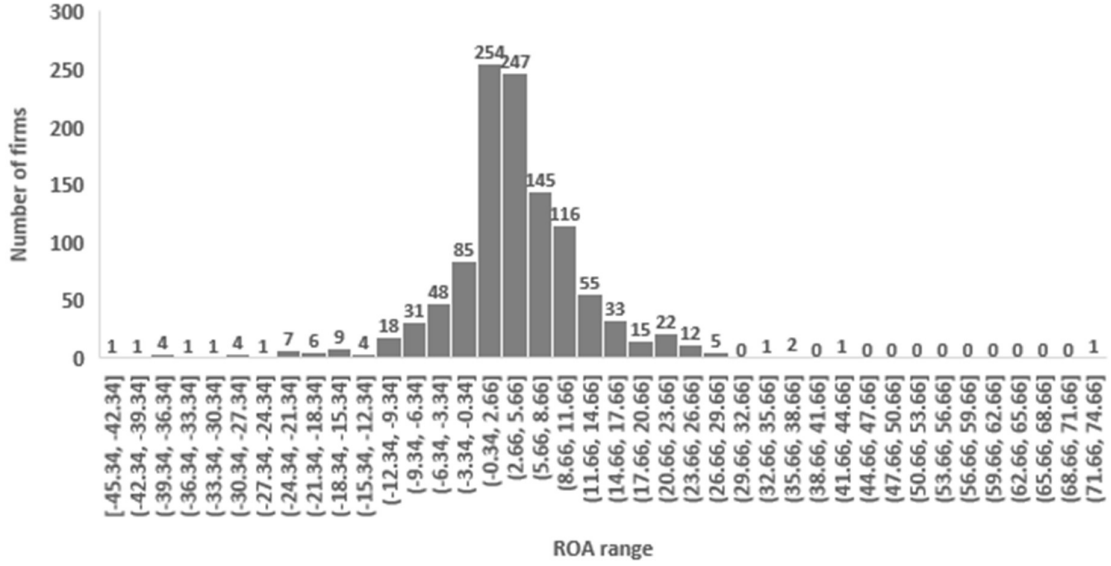
A1-22: ROA distribution for Class 1 (As-Is) (Chapter 7)



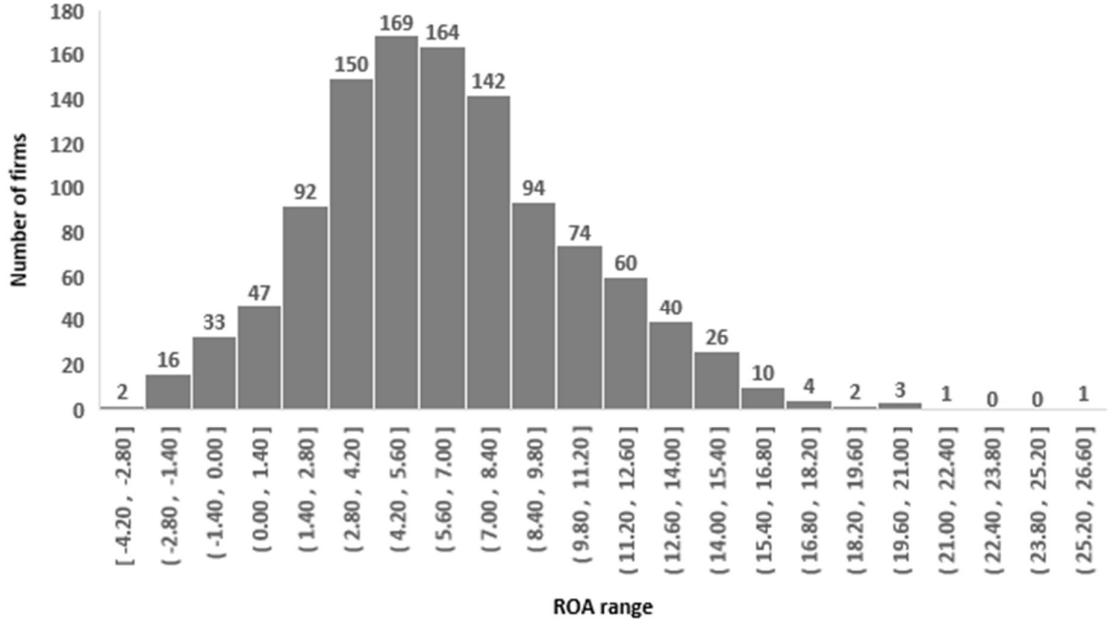
A1-23 : Simulated ROA distribution for Class 1 (To-Be-Scenario-1) (Chapter 7)



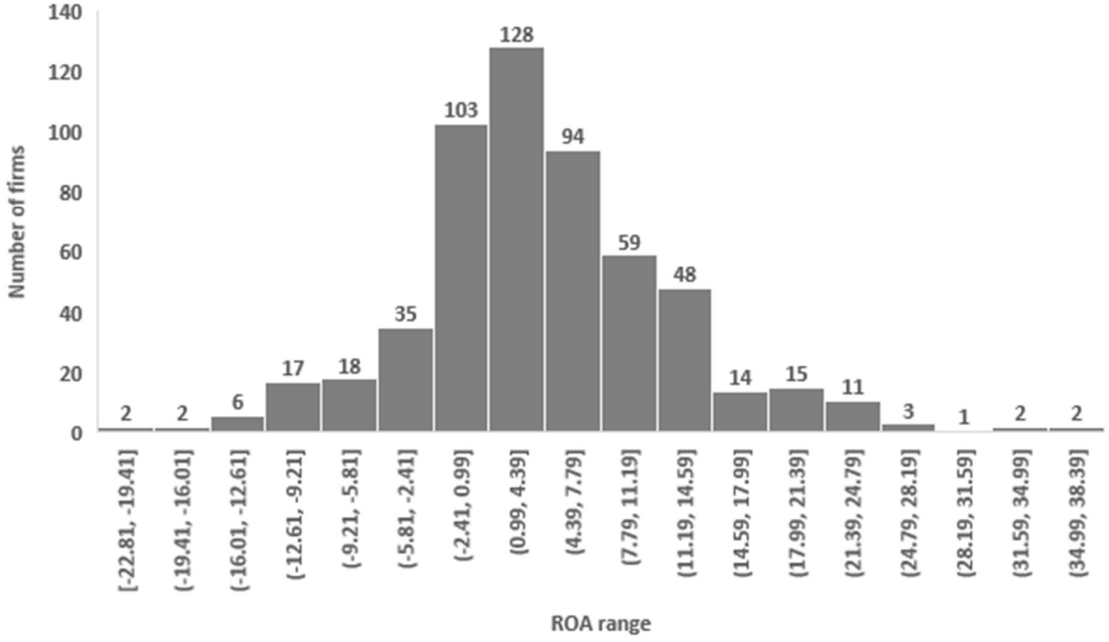
A1-24: ROA distribution for Class 2 (As-Is) (Chapter 7)



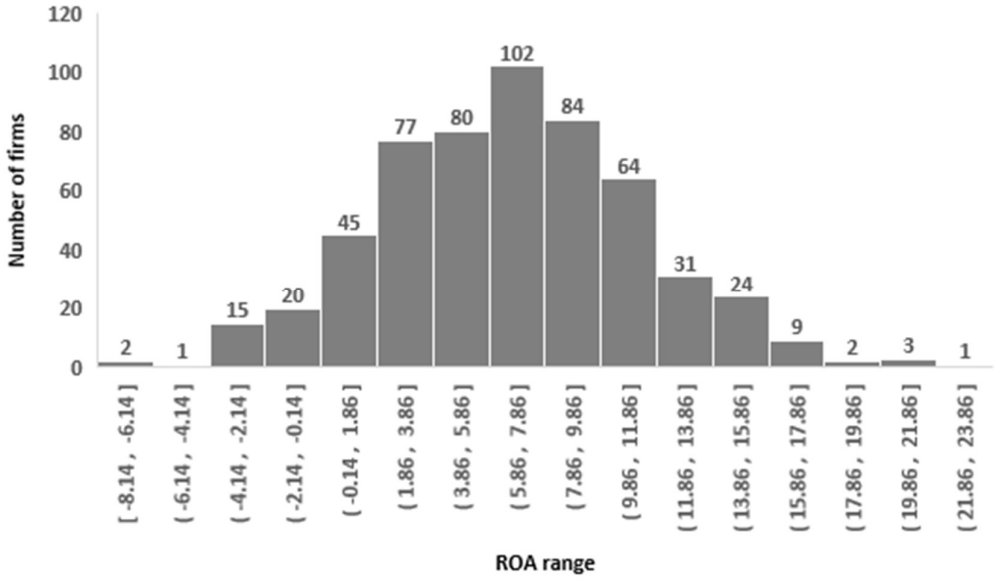
A1-25: Simulated ROA distribution for Class 2 (To-Be-Scenario-1) (Chapter 7)



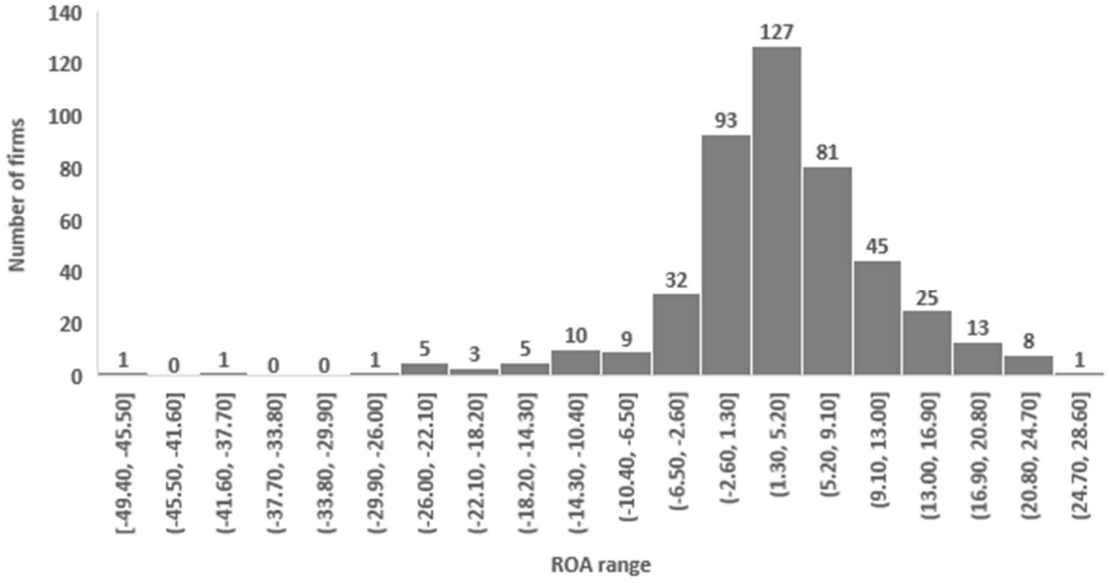
A1-26: ROA distribution for Class 3 (As-Is) (Chapter 7)



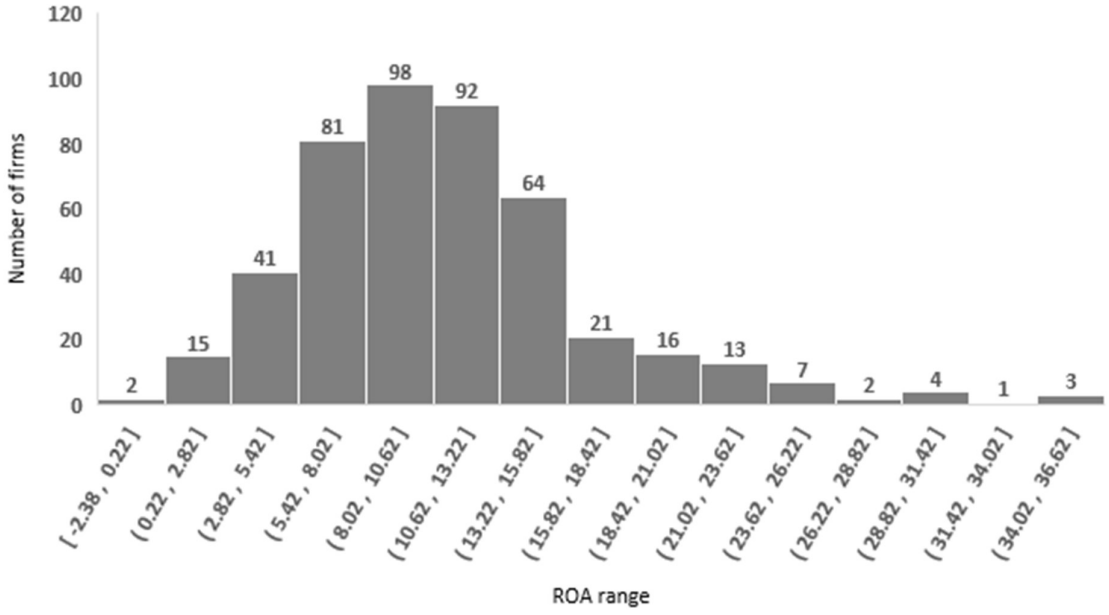
A1-27: Simulated ROA distribution for Class 3 (To-Be-Scenario-1) (Chapter 7)



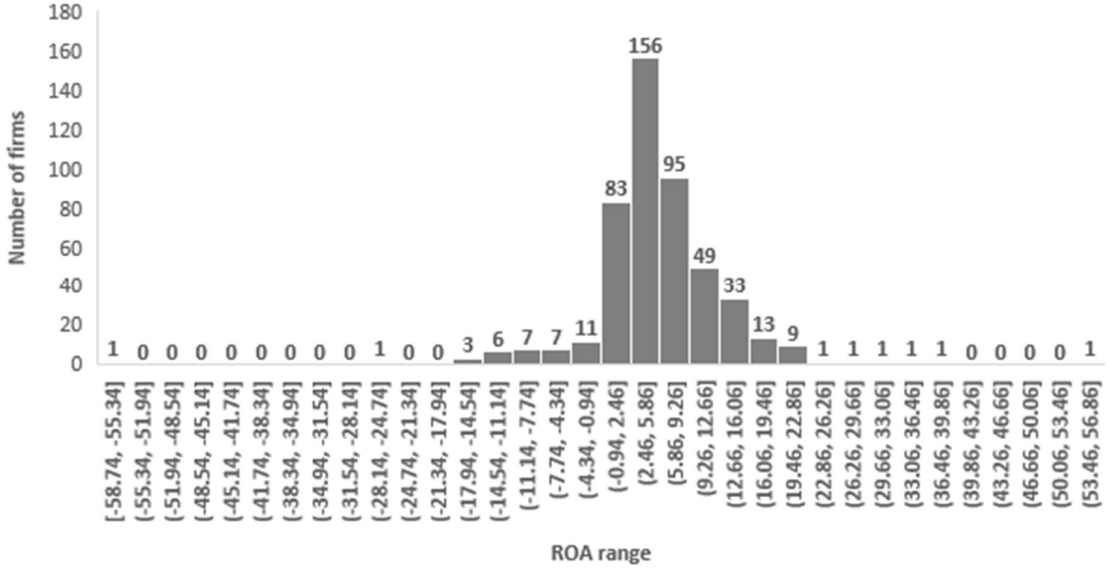
A1-28: ROA distribution for Class 4 (As-Is) (Chapter 7)



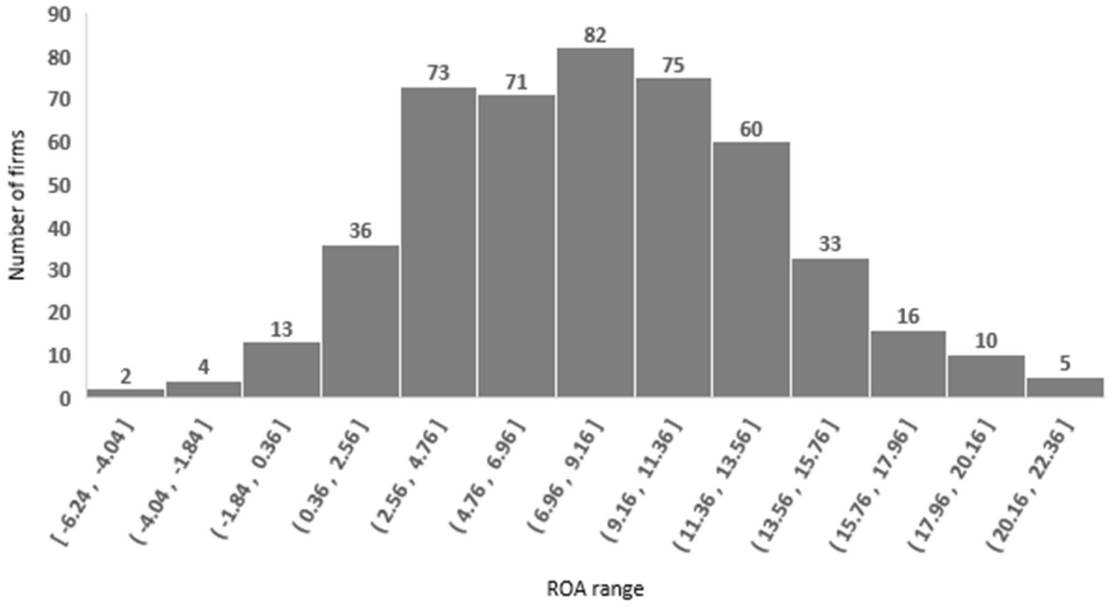
A1-29: Simulated ROA distribution for Class 4 (To-Be-Scenario-1) (Chapter 7)



A1-30: ROA distribution for Class 5 (As-Is) (Chapter 7)



A1-31: Simulated ROA distribution for Class 5 (To-Be-Scenario-1) (Chapter 7)



Appendix A2 – Publication details

1. Ambadapudi, H. and Matai, R. (2024), "Benefits of a collaborative liquidity management approach: a simulation study for the Indian auto value chain", **Journal of Modelling in Management**, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/JM2-12-2023-0283; (Scopus Indexed Q2, Impact Factor 2.5)
2. H. Ambadapudi and R. Matai, "State of Supply Chain Finance for Micro, Small and Medium Enterprise in India," ***2021 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)***, Singapore, Singapore, 2021, pp. 243-248, doi: 10.1109/IEEM50564.2021.9672981; (Scopus Indexed)
3. H. Ambadapudi and R. Matai, "Value Chain Benefits Estimation Due To Supply Chain Finance Adoption-A Simulation Study," ***2022 IEEE OPJU International Technology Conference on Emerging Technologies for Sustainable Development (OTCON)***, Raigarh, Chhattisgarh, India, 2023, pp. 1-6, doi: 10.1109/OTCON56053.2023.10113938 (Scopus Indexed) (**Best Paper Award**)
4. H. Ambadapudi and R. Matai, "Application of Computational Intelligence Techniques For Business Performance Improvement-A Case of Indian Auto Industry," ***2024 IEEE 9th International Conference for Convergence in Technology (I2CT),*** Pune, India, 2024, pp. 1-6, doi: 10.1109/I2CT61223.2024.10605177 (Scopus Indexed)
5. H. Ambadapudi and R. Matai, "Decision Strategies for Business Performance Management: An Empirical Study of the Indian Auto Industry," (Submitted) Managing Business Excellence
6. H. Ambadapudi and R. Matai, "The Role of Analytical Methods in Accounting for Informed Decision-Making: An Empirical Study of the Indian Automotive Industry," (Under Review) Meditari Accountancy Research Journal

International conference presentations

7. H. Ambadapudi and R. Matai, "Assessment Of Performance Enablers For Various Tiers Of Indian Auto Industry-A Design Of Experiments Approach," *International Conference On Innovation and Technology*, Bangalore, Karnataka, India, 2023
8. H. Ambadapudi and R. Matai, "Analytical assessment of operating business environment challenges for Indian Auto MSME-An empirical study," *9th International Conference on Business Analytics & Intelligence*, IIM Bangalore, 2022

Case study presentations

9. H. Ambadapudi and R. Matai, "Did Exide miss the bus in taking up the role of a torch bearer for India in the EV revolution?", **AIMA (All India Management Association)**, 2022 Case study competition, India, **2022** (**Certificate of Merit)**

Appendix A3 – Brief biography of the scholar

Hari is pursuing a doctorate at the Birla Institute of Technology and Science, Pilani. He has more than twenty years of professional experience as a business leader. He is responsible for selling supply chain and procurement technology solutions in APAC and EMEA in his current role as Senior Director on Coupa's Value Consulting team. Hari is primarily concerned with building and nurturing teams for consulting and decision science work in Supply Chain Management. Hari was previously affiliated with Tata Motors Ltd., GE Capital International Services, and IBM before joining Coupa. Hari is a Mechanical Engineer and completed his Industrial and Management Engineering postgraduate degree from IIT Kanpur (2003).

Appendix A4 – Brief biography of the Supervisor

Prof. Rajesh Matai has been a faculty member of business analytics, operations, and supply chain management in the Department of Management at BITS, Pilani, for the last 14 years. His research interests are Facility layout/Location problems, Combinatorial optimization problems, Supply Chain Management, and the MSME sector in India. Prof. Matai has published research papers in leading International and National Journals like the International Journal of Production Research, International Journal of Advanced Manufacturing Technology, Applied Mathematics and Computation, The Bottom Line, Measuring Business Excellence, Vilakshan, and reputed Conference proceedings like IEEM21, IEEM23. Prof. Matai is a senior member of IEEE. He is also a member of INFORMS, POMS, Analytics Society of India, Soft Computing Research Society, The Institute of Engineers (India), and AIMS International. Prof. Matai has guided four Ph.D. Students so far in his continued academic journey.