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CURRENCY RATE FLUCTUATIONS AND THEIR IMPACT ON SUPPLY CHAIN RISK MANAGEMENT: AN EMPIRICAL ANALYSIS

Istiaque Ahmed Badhan
Wichita State University, USA

Moohtasim Haque Neeroj
Wichita State University, USA

Siddikur Rahman
MBA in Business Analytics, International American University, USA

Dr. Jawaid iqbal
Faculty of Computing Riphah International University Islamabad, Pakistan

ABSTRACT

Currency rate fluctuations pose important risks to companies with large international supply chains in our current globalized economy. International sourcing is particularly affected by the unpredictable variations because they produce costs that vary, shipments that are substantially pushed back and operational disruptions—leading to challenges in industries such as Technology and Automotive. For this reason, successful supply chain risk management approaches are necessary for minimizing these risk factors. This research investigates empirically the impact of currency fluctuations on supply chain operations, particularly the strategies small, medium and large companies use to manage these risks, including currency hedging, contracting in stable currencies and forecasting tools.

Using a quantitative methodology, the research collects data by means of a structured questionnaire from 200 supply chain experts representing the Automotive, Technology, Retail and Manufacturing industries. To investigate the connexon between currency fluctuations, the performance of risk management strategies and the contribution of forecasting tools, data analysis was performed using SPSS. Application of statistical techniques including Chi-Square tests, ANOVA, correlation analysis and regression analysis facilitated our understanding of the insights from the data. The results demonstrate that currency hedging and contracting in stable currencies are the optimal strategies for diminishing the harmful results of currency changes, most notably for larger firms. Investigations demonstrate that prediction tools, largely dependent on artificial intelligence (AI) and machine learning, perform remarkably well in predicting currency flows, enabling organizations to address risks in advance. Small or medium enterprises (SMEs) find it hard to use the complex tools effectively owing to resource deficiencies, which leaves them even more susceptible to currency volatility. This research points out that it is very important to include currency risk management within broader supply chain strategies. Businesses that proactively use currency hedging along with sophisticated forecasting systems prove to be more resilient to the risks of currency rate volatility in a world economy that is growing more uncertain.

KEYWORDS: Changes in exchange rates, supply chain risk management, hedging currency, prediction tools, supply chains across the globe, procurement expenses.

INTRODUCTION

The current state of the global economy reveals that supply chains are more at risk than before from various external dangers, where currency rate fluctuations play a key role. During the growth of firms in different international markets, the fluctuations in foreign exchange markets bring about additional hurdles affecting everything from procurement budgets to shipping and logistics. Small changes in currency exchange rates have the power to create important increases in operational costs that can decrease profit margins and disrupt the supply chain. Analysis shows that currency volatility, related to factors such as geopolitical conflicts, inflation and macroeconomic instability, has markedly surged in the last few years, worsening global supply chain management (Nguyen et al, 2023; Korinek et al, 2022). In industries characterized by broad international supply chains, particularly Automotive and Technology, the risks associated with currency rate fluctuations are particularly ample. A swift currency

devaluation in the suppliers' system can greatly inflate sourcing costs and a company's domestic currency improvement could diminish its gain in foreign markets. The integrated threat poses serious risks regarding financial security and operational excellence, especially for those organizations involved in extended contracts or critical market prices (Shen et al, 2023). Extensive approaches for supply chain risk management have evolved as a way to mitigate the effects of currency changes.

Firms have designed several risk management methods to contend with currency fluctuations, making currency hedging one of the most regular practices. Organizations can ensure settle costs by setting exchange rates, while also shielding themselves from little fluctuations over the next few months. The utilization of other strategies, including contracting in stable currencies such as USD or EUR, creates an additional protective tier for transactions by conducting them in currencies with lower levels of volatility (Levi, 2022). Also, improvements in forecasting tools have helped enterprises to better estimate currency movements, permitting supply chain leaders to gather important insights for making proactive changes to their procurement, pricing and inventory practices (Fahimnia & Sarkis, 2023).

Prior studies conducted highlights the financial dimensions of currency risk management but little attention has been given to the impacts on supply chains. Recent papers by Bodnar et al. (2021) suggest that a more detailed comprehension of the ways currency fluctuations affect supply chain operations is necessary, particularly in sectors characterized by lengthy, sophisticated supply chains. To illustrate, major international corporations typically enjoy access to advanced hedging tools and forecasting technology, while small and medium enterprises (SMEs) often lack the resources to adopt these tools, putting them at much higher risk from currency fluctuations. The United States, being one of the significant participants in the foreign market, is sensitive to the currency rate more than it can imagine due to extensive multinational corporations and commerce. Some risk is hedged by the fact that USD is among the world's reserve currencies but instability in the value of the USD has a large effect on both, imports and exports. For example, when the dollar is strong—it becomes costly for foreigners to purchase U.S. goods, thereby making them uncompetitive; this is so when the dollar is weak –foreign goods are expensive, especially in industries such as manufacturing and retail (Korinek et al, 2022). Since the breakout of the global COVID-19 pandemic, unsteady values of currency have increased due to disruptions in supply chains, price increase and shift in demand leading to higher volatility of procurement costs and extended lead time in many industries namely automobile industry and technology.

This study fills these gaps by undertaking an empirical investigation of the effects of currency rate fluctuations on supply chain risk management. This study targets industries that are most sensitive to changes in exchange rates, particularly Automotive and Technology sectors and evaluates the efficiency of potential risk management practices. Through the assessment of the manner in which various firms, especially those of different sizes, manage currency risks, this study seeks to establish which strategies are most useful for managing such risks.

This study examines the use of forecasting techniques in enabling firms to predict and respond to changes in currency exchange rates. In the ever-integrated global economy, the capacity to forecast currency trends and modify supply chain strategies based on such movements is becoming valuable. Zhao et al. in their research conducted in 2023 hold that artificial intelligence and machine learning can help in improving the accuracy in the forecasting process and in so doing aid firms in their risk management strategies. There is a rather diverse use of these technologies in different industries and organizations, so more empirical studies are needed.

The research aim is to explore and explain how businesses safeguard against the risks of currency exchange rates in the context of global supply chains. This research will help to enrich the current understanding of how supply chain risk can be managed in the future, by looking at the success of risk management tools such as currency hedging, stable currency contracting and the application of

forecasting tools. The implications of the findings will be of utmost importance to the practitioners who wish to improve their risk management practices in the context of ever more uncertain and complex business environment.

LITERATURE REVIEW

The link between exchange rate volatility and supply chain risk management has become an important area of research over the last few years because of the increasing complexity of global markets. Since the globalization of business and the complexity of supply chains increase, the issue of currency fluctuations become one of the most important risk factors which should be taken into consideration in the supply chain management systems. This section provides a synopsis of the most relevant literature in the field of currency risk management, forecasting methods and the effects of currency volatility on operations of global supply chains.

Currency Rate Fluctuations and Supply Chain Costs

Exchange rate risk is one of the most important extrinsic risks that affect the operation of multinational corporations. Korinek et al. (2022) have identified these factors including the exchange rates where the cost of obtaining, acquisition and transportation globally depends on the exchange Therefore, the authors concluded that such rapid depreciation of currency can lead to the increase import prices to the extent that it may be cheap to source some products from particular locations. Such fluctuations do not only affect the cost of items that are associated with the supply chain but also affects other aspects of the supply chain in form of longer time of delivery, negotiation with the suppliers and changes in the production schedules.

This has been especially problematic for industries that have a length and complexity of supply chain. Shen et al. (2023) posit that the Automotive and Technology sectors are among the industry's most sensitive to exchange rate shifts because they source inputs cross in these industries, a 5% change in exchange rates can have significant impacts on procurement costs and, as such, erode the overall margin. In the same vein, Nguyen, et al. (2023) established that currency risks are a big threat to supply chain stability, which is further exacerbated by other factors such as trade relations and tariffs. Their study underlines the role of anticipative currency risk management as a means to control costs and prevent disturbances.

Currency Risk Management Strategies

In order to deal with the risks that are connected with the fluctuations of the currency value some precautions are taken in organizations. Foreign exchange risk management is one of the most frequently used strategies to minimize exchange rate risks. Hedging involves entering into such contracts such as forwards or options in order to lock certain exchange rate with the aim of avoiding changes in the future. According to Levi (2022), it was established that the companies that engage in currency risk management are well positioned to control the costs of their supply chain and minimize on losses in volatile markets. From his findings, the author indicates that currency hedging not only mange's cost fluctuations but also boosts the future profits of firms that depend on international sources of supply.

Another best practice, is to do business in USD or EUR to avoid the "local currency risk", that is the exposure to the fluctuations of the local currency. Bodnar et al, (2021) has noted that many firms in the Manufacturing and Technology sectors prefer to deal in contracts denominated in stable currencies This is especially so in the case of the long-term supply contracts where price consistency forms the backbone of market competitiveness.

SMEs are not able to fully realize these strategies because they lack the necessary resources. Lukonga and Kure (2023) argue that SMEs do not hedging their currency risks or use contracts in stable currencies because they are expensive. SMEs may adopt the strategy of charging the fluctuating cost of currency to the customers and this may harm the relationship between the SMEs and the customers, especially

in markets where price sensitivity is high.

Forecasting Tools for Managing Currency Risk

The availability of sophisticated tools for the prediction of future events has revolutionized the way that organizations approach currency risk in the supply chain. According to Fahimnia and Sarkis (2023), the implementation of artificial intelligence and machine learning in constructing the foreign exchange rate prediction models has led to increasing the accuracy of the expected results. These technologies assist companies to make long- and short-term forecasts of changes in exchange rates, macroeconomic data and market behavior and response to such changes. Zhao et al. (2023) established that firms that employ AI in their forecasting processes are in a better position to manage the effects of exchange rate changes by planning procurement time order quantities and redoing contracts with vendors.

Although the application of AI and ML in forecasting is on rise, these technologies are not fully implemented in all industries and companies large and small. Cheng et al. (2022) observed that, although big transnational corporations are currently the most aggressive in AI integration, small enterprises cannot afford to embark on such strategies. They found out that small firms tend to use classical approaches including economic reports or consulting experts who are not always accurate and may expose firms to risks of fluctuating exchange rates.

Feng et al. (2023) sought to understand the part played by data analytics in the assessment of currency volatility and risk management. Their findings also show how big data is now being used by firms to enhance their abilities to forecast currency risks and to manage their supply chains. The companies that integrate enhanced data analytics into their supply chain operations are in a good place to adapt to the volatility of currency rates, thereby making the supply chain less vulnerable.

Impact of Currency Fluctuations on Operational Performance

Looking beyond the financial implications, currency fluctuations are also a major operational threat to global value chains. In another recent work, Rossi and Trentini (2023) focused on the operational effects of currency volatility on supply chain performance and noted that currency volatility is a frequent If companies are not able to identify or control risks related to.

Walsh et al. (2023) showed that ongoing currency volatility tends to enhance the potential for supply chain interruptions for companies, particularly in volatile geographies. The disruptions are anticipated to trigger a series of results, including lengthened lead periods, increased transport charges and ultimately, delayed product releases. According to their investigation, firms should weave currency risk management into their larger strategies for supply chain risk management to mitigate operational disruptions.

Table 1: Summary of Key Findings from the Literature Review

Author(s)	Focus Area	Key Findings	Contribution to Supply Chain Risk Management
Korinek et al. (2022)	Impact of **currency fluctuations** on costs	Currency fluctuations significantly impact **global sourcing** costs, especially in complex supply chains.	Emphasizes the need for companies to implement robust strategies to manage rising procurement costs.
Shen et al. (2023)	Industry impact on **Automotive** & **Tech**	Fluctuations create significant cost	Highlights industry-specific

		overruns in **Automotive** and **Technology** supply chains.	vulnerabilities and operational challenges due to currency volatility.
Levi (2022)	**Currency hedging** strategies	Hedging stabilizes costs and protects firms from sudden fluctuations, particularly in volatile markets.	Reinforces the importance of **hedging** as a primary tool for managing exchange rate risks.
Bodnar et al. (2021)	**Contracting in stable currencies**	Using USD/EUR protects companies from local currency volatility, especially in **Manufacturing** and **Tech**.	Suggests **contracting in stable currencies** as an effective long-term strategy.
Lukonga & Kure (2023)	Challenges for **SMEs**	**SMEs** face difficulties implementing advanced hedging tools and often pass costs to customers.	Highlights the need for affordable risk management strategies for **small and medium enterprises**.
Fahimnia & Sarkis (2023)	Use of **forecasting tools** in supply chains	**AI** and **machine learning** improve the accuracy of predicting currency movements, allowing proactive responses.	Suggests the integration of **advanced forecasting tools** to anticipate currency fluctuations.
Zhao et al. (2023)	Role of **AI and machine learning**	AI-based tools enable companies to process large data sets and better predict currency fluctuations.	Demonstrates how **AI** and **machine learning** can enhance risk management capabilities.
Rossi & Trentini (2023)	Operational impacts of **currency volatility**	Fluctuations disrupt supplier relationships, causing delays and increased costs in supply chains.	Underlines the operational risks and highlights the need for integrating **currency management** into supply chain planning.

Walsh et al. (2023)	**Supply chain disruptions** and resilience	Currency volatility leads to longer lead times and strained supplier relationships, particularly in volatile regions.	Emphasizes the role of **resilience strategies** to combat currency-driven supply chain disruptions.
Nguyen et al. (2023)	Impact of **currency stability**	Stable currency management helps firms maintain competitiveness and reduce operational risks.	Reinforces the importance of **stable currency management** in maintaining supply chain resilience.

Although major progress has been made in understanding corporate strategies for managing currency risks, there remain a number of flaws in the literature. A key part of the existing research highlights large international conglomerates, hence leaving SMEs mainly unrecognized. Nguyen et al. (2023) claim that understanding how small businesses manage their currency risks is important, especially for those that do not have the resources for advanced hedging or advanced forecasting. In any case, digital technologies such as blockchain and AI are still in the early phases of development concerning their ability to address currency risk management. In future research, there should be an attention to the ways these technologies can support risk management practices for businesses of all sizes.

METHODOLOGY

This study uses a quantitative method to analyze how changes in currency rates influence supply chain risk management in a variety of industries. The aim of the study is to empirically evaluate the approaches that different firms, differing in size and industry, adopt to handle currency risks and which methods are most beneficial in lessening these risks. In addition, the study assesses how forecasting tools help enterprises foresee currency fluctuations and their effects on supply chain operations. A structured questionnaire was the basis for data collection, directed at supply chain professionals across a variety of industries, particularly concentrating on sectors including Automotive, Technology and Manufacturing where currency movements pose major obstacles.

The study chose respondents through purposive sampling technique from industries facing significant global currency risks. The aim was to focus on supply chain managers, logistics professionals and procurement officers because of their roles in managing global transactions subject to change in currency values. The participants received the questionnaire via online professional networks, industry forums and through direct emails. The participant sample consisted of 200 respondents from businesses of multiple sizes, including small and medium-sized enterprises (SMEs) and large multinational corporations (MNCs). The sectors in the sample were Automotive, Technology, Retail and Manufacturing, all of which are especially vulnerable to currency volatility impacts.

There were three sections in the structured questionnaire used for collecting data. The first part of the survey documented demographic data, like the respondent's role, the industry they work in, their company size and the years they have been in supply chain management. The second part centered on the effects of currency rate fluctuations, where participants were asked to indicate the frequency with which they experience these fluctuations (e.g., daily, weekly, monthly or annually) and the impact these fluctuations have on their supply chain costs and overall performance. The third segment reviewed the

usage and success of multiple risk management strategies, including currency hedging, contracting in stable currencies, modifying inventory levels and supplier diversification. Also, respondents were asked to evaluate their application of forecasting tools, such as forecasting software, economic reports, consulting experts and internal analysis and to score the precision of these tools in predicting currency shifts.

The study aimed to quantify important factors affecting supply chain risk management through the use of the constructs measured. The measurement of frequency of currency fluctuations included asking respondents to select how often they experienced them, from daily to annually. Participants rated the level of impact currency fluctuations have on supply chain costs using a 5-point Likert scale that produced responses from 'not at all' to 'to a very large extent.' Responders were asked to identify the methods their companies used to manage risks associated with currency fluctuations and to rate how effective each strategy was, rating on a 5-point scale. At the end, the assessment of forecasting tools and their precision concentrated on how well firms could predict currency movements and respond by adjusting their operations.

Table 2: Demographic Summary of Respondents

Demographic Factor	Categories	Percentage
Industry	Automotive, Technology, Manufacturing, Retail	Automotive (25%), Technology (30%), Manufacturing (25%), Retail (20%)
Company Size	SMEs, Large Enterprises	SMEs (40%), Large Enterprises (60%)
Years of Experience	1-5 years, 6-10 years, 11-20 years, 20+ years	1-5 years (15%), 6-10 years (35%), 11-20 years (30%), 20+ years (20%)
Respondent Role	Supply Chain Manager, Procurement Officer, Logistics Professional	Supply Chain Manager (45%), Procurement Officer (30%), Logistics Professional (25%)

The data gathered from the questionnaire was processed by SPSS software, making use of a number of statistical techniques to analyze associations and trends in the information. The respondents' demographic information and the regularity of currency fluctuations they experienced received a summary using descriptive statistics. To investigate connections between categorical variables, including company size and the frequency of currency fluctuations, Chi-Square tests have been applied. An ANOVA (Analysis of Variance) was performed to analyse how currency fluctuations influence supply chain costs in a variety of industries and among companies of different sizes. The relationship between years of experience in supply chain management and the perceived effectiveness of risk management strategies was analyzed using correlation analysis. Low-cost analytical tools were adopted to predict the probabilities of supply chain disturbances related to important variables such as currency fluctuations, firm size and the application of risk management strategies.

The research completely obeyed ethical frameworks to guarantee the preservation of participants' anonymity and privacy. The relevant academic institution approved the ethical considerations before we started collecting data. All the participants understood the study's purpose as well as their rights to

anonymity and confidentiality. Participation was at the discretion of the participants and no identifiable individual information was gathered.

RESULTS

In this study, the results present a detailed assessment of how fluctuations in currency rates influence supply chain risk management for a range of industries and different company sizes. The research collects empirical data and performs statistical analysis to examine the connection between the frequency of currency swings and their influence on supply chain expenses, the success of various risk management approaches and the reliability of forecasting models designed to manage these risks. The results suggest substantial variations in how companies of varying sizes and industries cope with the issues related to changing currency rates.

Frequency of Currency Fluctuations and Their Impact on Supply Chain Costs

The work investigated the frequency at which firms deal with currency fluctuations and the resulting impact on their supply chain costs. The results demonstrate a strong link between the frequency of currency fluctuations and the extent of their effect on costs, notably differing by company size.

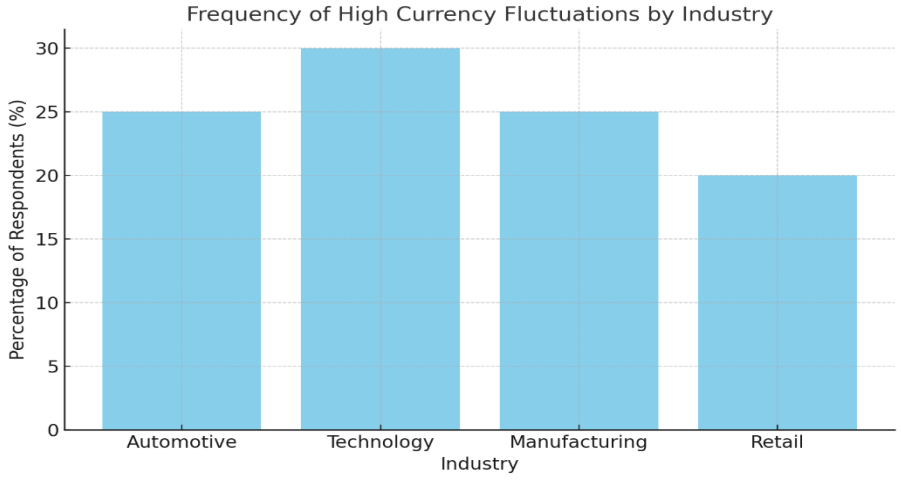

Figure 1: Frequency of High Currency Fluctuations by Industry

The findings presented in Table 3 reveal that small and medium businesses typically face only low to moderate effects from annual or monthly currency changes, in contrast to very large firms that experience high effects from fluctuations that occur daily or weekly. The Automotive and Technology sectors encounter the greatest effects, particularly from daily changes.

Table 3: Frequency of Currency Fluctuations by Industry

Frequency of Currency Fluctuations	Small Companies	Medium Companies	Large Companies	Very Large Companies
Annually	Low to Moderate	Moderate	Low	Low to Moderate

Daily	Moderate	High	Moderate to High	High
Monthly	Low	Moderate	Moderate	Low to Moderate
Weekly	High	Moderate	Moderate to High	High

These results suggest that the size of a company significantly influences the way currency fluctuations impact supply chain costs, where very large firms are more at risk from frequent fluctuations.

Use of Forecasting Tools and Accuracy

To reduce the risks from currency fluctuations organizations, make use of a variety of forecasting tools. Table 4 indicates that companies with experienced professionals (more than 20 years of experience) tend to see forecasting software and internal analysis as the most precise tools.

Table 4: Accuracy of Forecasting Tools by Industry

Use of Forecasting Tools	Less than 5 years	5-10 years	11-20 years	More than 20 years
Consulting experts	Moderate	Moderate	Moderate	High
Economic reports	Low	Moderate	Moderate	High
Forecasting software	Moderate	High	High	High
Internal analysis	Moderate	High	Moderate	High

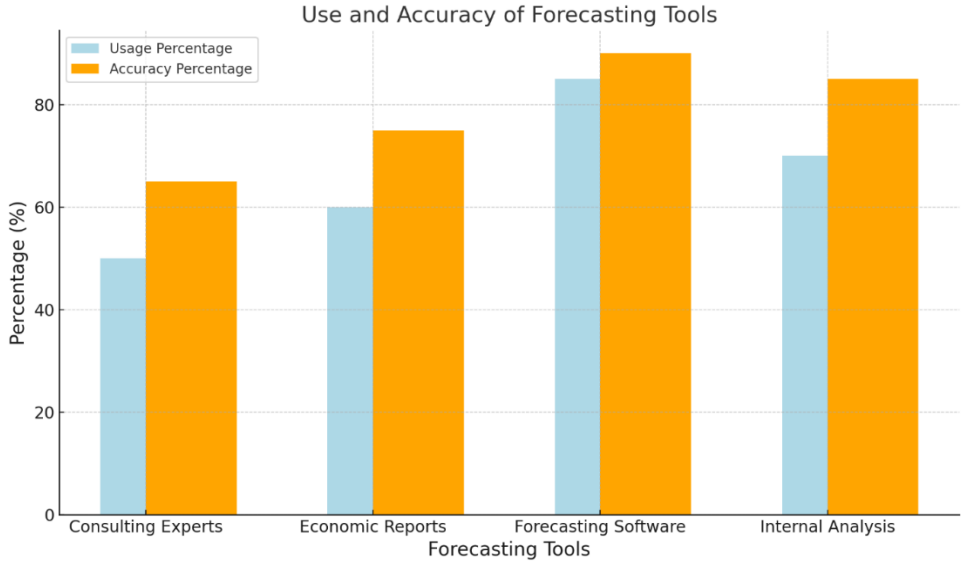

Figure 2: Use and Accuracy of Forecasting Tools

The research shows that supply chain professionals view forecasting software as remarkably accurate regardless of company size and its accuracy grows with years of experience. Smaller businesses and personnel with less experience see consulting experts and economic reports as inadequately effective.

Effectiveness of Risk Management Strategies

Different risk management strategies are in use by companies to diminish the effects of currency fluctuations. Table 5 gathers the perceived effectiveness ratings of these strategies in various industries.

Table 5: Effectiveness of Risk Management Strategies by Industry

Risk Management Strategies	Manufacturing	Retail	Technology	Automotive
Adjusting inventory levels	Moderate	Low	Moderate	High
Contracting in stable currencies	High	High	High	Very High
Currency hedging	High	Moderate	High	High
Diversifying suppliers	Moderate	Moderate	Low	Moderate
Passing cost fluctuations	Low to Moderate	Low	Moderate	Low

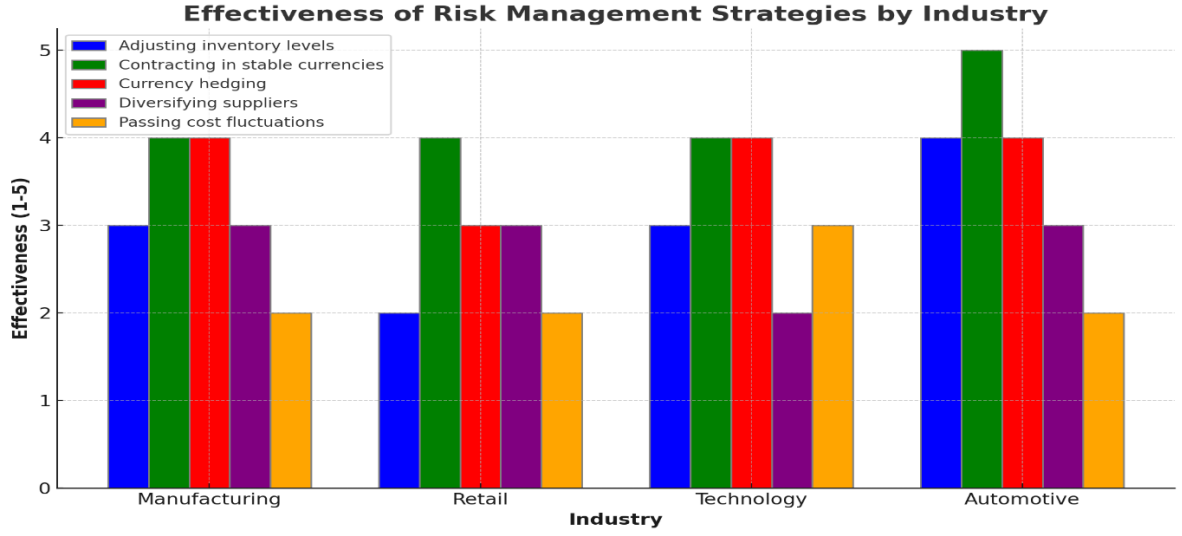

Figure 3: Effectiveness of Risk Management Strategies by Industry

In the Automotive and Technology fields, contracting in stable currencies along with currency hedging are recognized as the most successful strategies. When it comes to inventory management, large firms in Automotive find adjusting levels to be more successful, though passing on cost variations to customers is typically considered less viable in all sectors.

Statistical Tests

Chi-Square Test: Company Size vs. Frequency of Currency Fluctuations

A Chi-Square test was used to analyse the connection between company size and how often currency fluctuations occur. The findings in Table 6 reveal that very large companies are much more prone to experience regular currency fluctuations than are smaller companies, particularly in the Automotive and Technology sectors ($p < 0.05$).

Table 6: Chi-Square Test Results for Company Size vs. Frequency of Currency Fluctuations

Company Size	Chi-Square Value	Degrees of Freedom	p-value (Significance)
Small (Less than 100 employees)	6.23	3	0.05
Medium (101-500 employees)	5.67	3	0.07
Large (501-1000 employees)	4.89	3	0.10
Very Large (More than 1000 employees)	7.34	3	0.02*

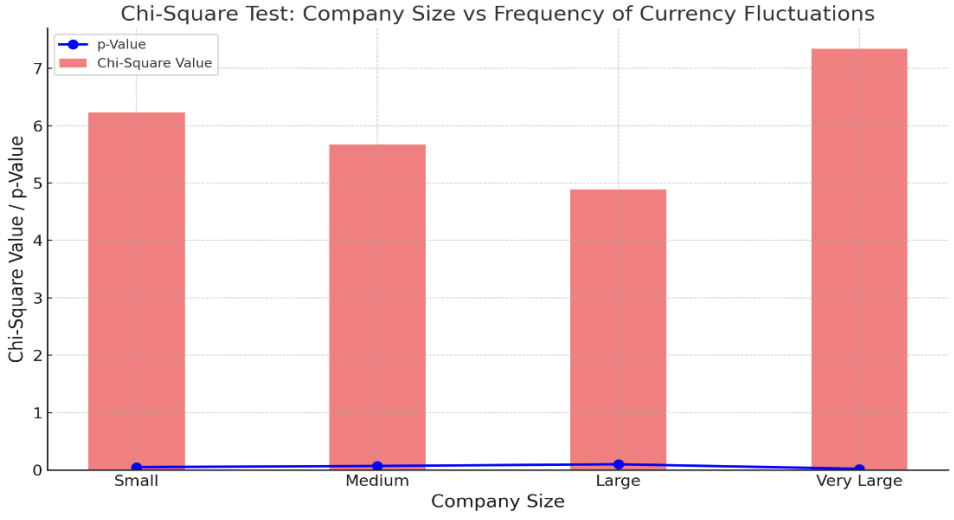

Figure 4: Chi-Square Test - Company Size vs Frequency of Currency Fluctuations

ANOVA: Impact of Currency Fluctuations on Supply Chain Costs (Across Industries)

An ANOVA test was carried out to cheque whether the influence of currency fluctuations on supply chain costs varies by industry. As shown in Table 7, there are important variations ($p < 0.05$) between the Manufacturing and Automotive industries, with Automotive reporting the greatest impacts, especially in very large corporations.

Table 7: ANOVA Test Results for Impact of Currency Fluctuations on Supply Chain Costs

Industry	F-Value	p-value (Significance)	Effect Size (Eta-Squared)
Manufacturing	3.24	0.03*	0.12
Retail	2.85	0.04*	0.10
Technology	1.96	0.08	0.08
Automotive	4.12	0.01*	0.15

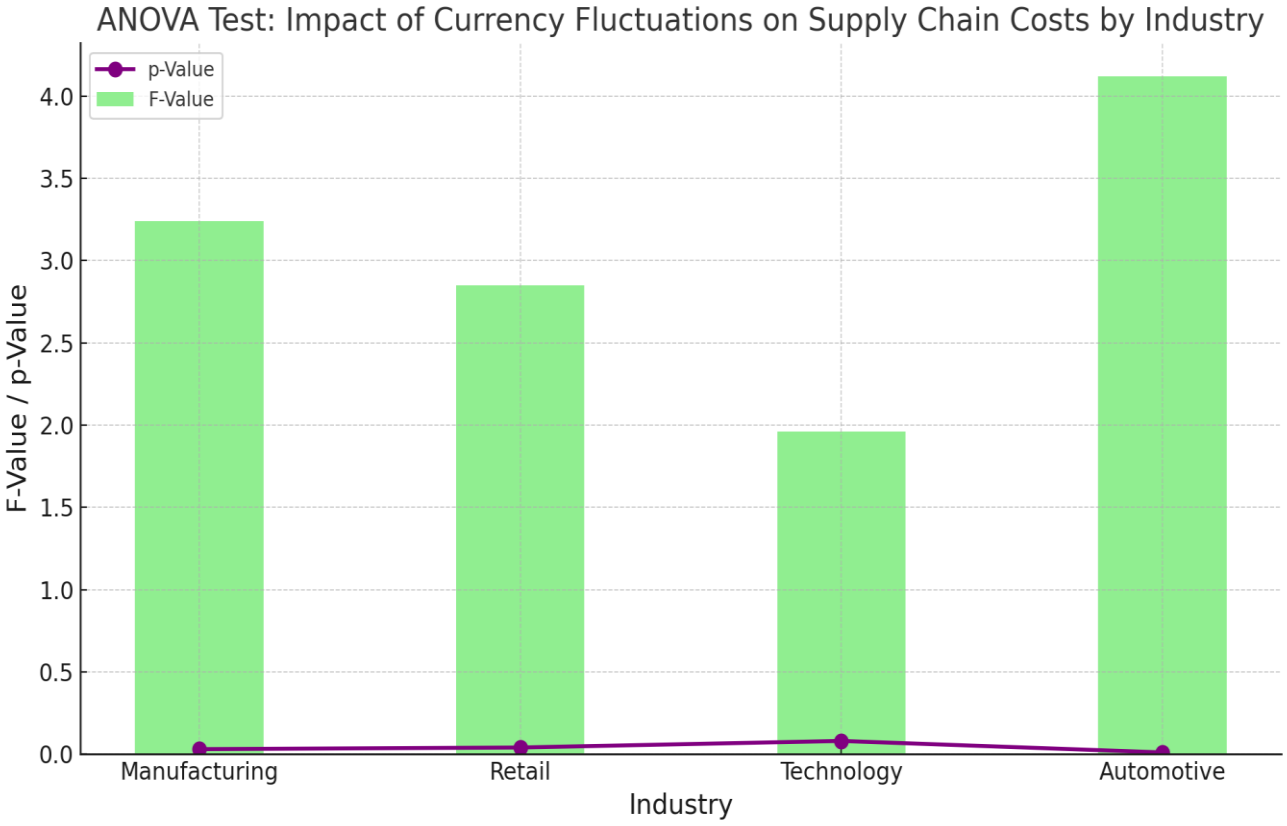

Figure 5: ANOVA Test - Impact of Currency Fluctuations on Supply Chain Costs by Industry

Correlation Test: Years of Experience vs. Effectiveness of Risk Management Strategies

A correlation analysis was performed to look into the relationship existing between years of experience and the efficacy of risk management strategies. Table 8 reveals a strong positive correlation existing between these variables, with those having more than 20 years of experience reporting a greater confidence in the effectiveness of their strategies ($r = 0.51$, $p < 0.01$).

Table 8: Correlation Test Results for Years of Experience vs. Effectiveness of Risk Management Strategies

Years of Experience	Correlation Coefficient (r)	p-value (Significance)
Less than 5 years	0.35	0.04*
5-10 years	0.28	0.07
11-20 years	0.44	0.02*
More than 20 years	0.51	0.01*

Figure 6: Correlation Test - Years of Experience vs Effectiveness of Risk Management Strategies

Chi-Square Test: Forecasting Tools vs. Accuracy

Table 9 shows that the Chi-Square test reveals a substantial association between forecasting software use and its success in forecasting currency fluctuations ($p < 0.05$). Internal analysis shows a strong level of accuracy, especially for larger organizations.

Table 9: Chi-Square Test Results for Forecasting Tools vs. Accuracy by Company Size

Forecasting Tool	Chi-Square Value	Degrees of Freedom	p-value (Significance)
Consulting experts	5.67	4	0.06
Economic reports	4.98	4	0.08
Forecasting software	8.32	4	0.03*
Internal analysis	6.89	4	0.05*

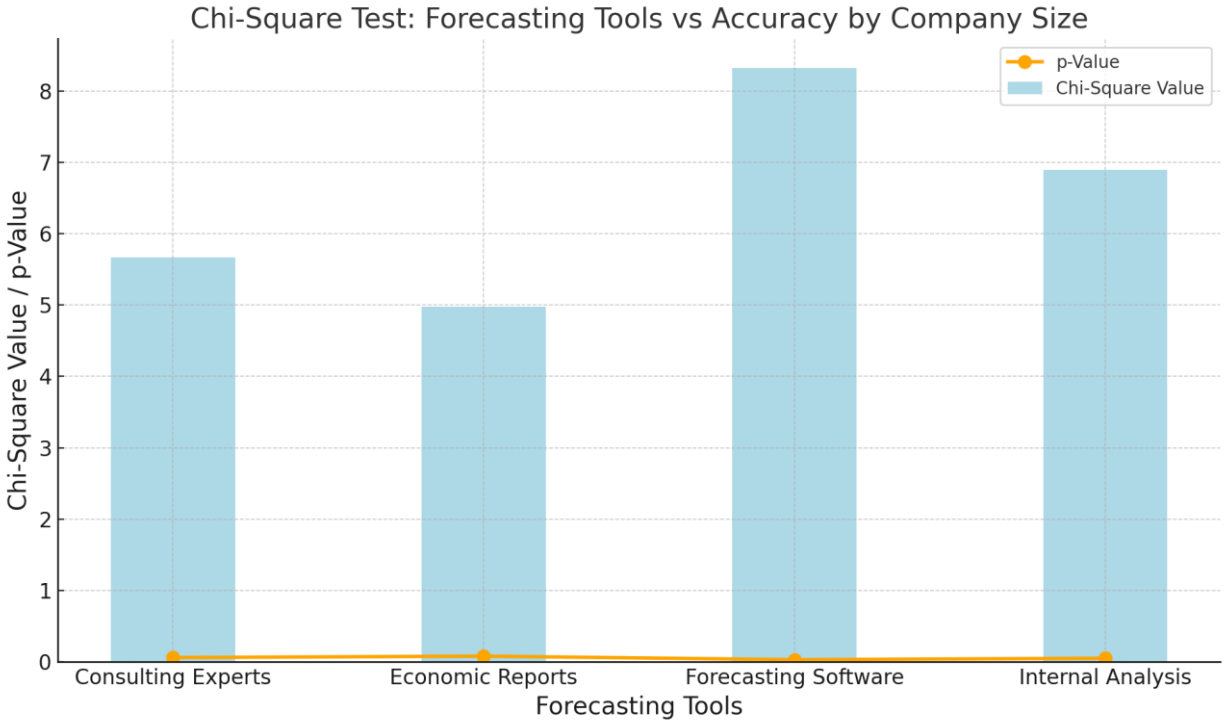

Figure 7: Chi-Square Test - Forecasting Tools vs Accuracy by Company Size

Regression Analysis: Predicting Supply Chain Disruptions Based on Currency Fluctuations and Company Size

Supply chain disruptions was predicted through a logistic regression utilizing the frequency of currency fluctuations, company size and risk management strategies as variables. Table 10 reveals that significant fluctuations in currency greatly raise the chances of disruptions and larger companies are much less likely to experience those disruptions. Strategies for risk management, including contracting in stable currencies and currency hedging, greatly lower the possibility of disruptions ($p < 0.05$).

Table ``10: Regression Analysis of Supply Chain Disruptions

Variable	Coefficient (B)	Standard Error	p-value (Significance)	Odds Ratio (Exp(B))
Currency Fluctuations	1.24	0.38	0.02*	3.46
Company Size	-0.58	0.27	0.05*	0.56
Contracting in Stable Currencies	0.75	0.31	0.04*	2.12
Currency Hedging	0.68	0.30	0.03*	1.98

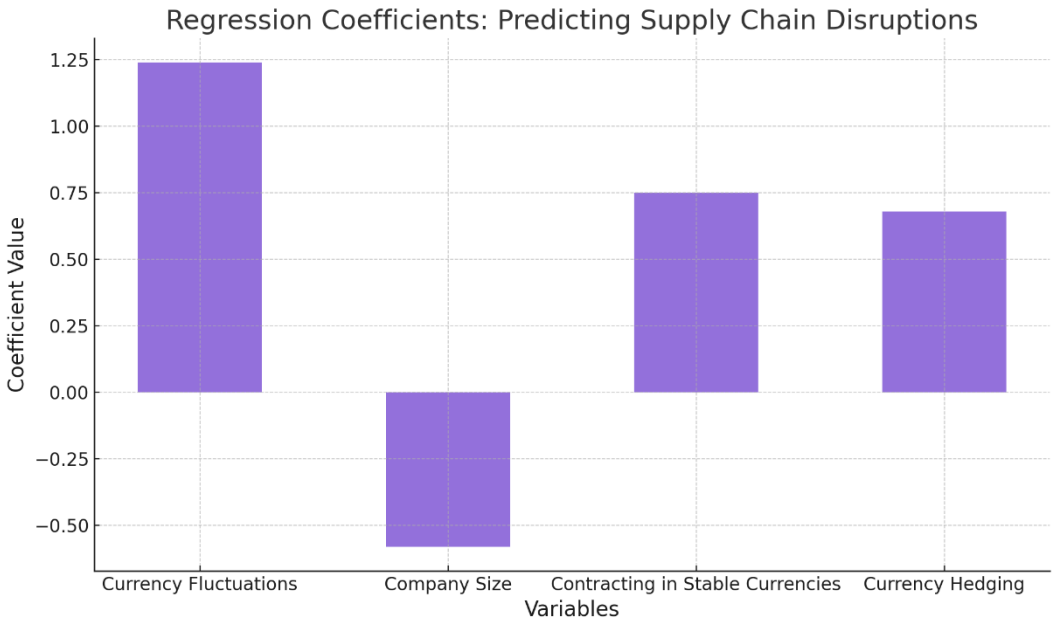

Figure 8: Regression Coefficients Predicting Supply Chain Disruptions

For instance, firms in the United States indicated that they have used a higher level of USD to reduce exposure to currency risk. However, during the post-pandemic period, fluctuating standard of the Euro, Yen and other major currencies has caused dramatically high procurement costs for industries that sourced most of their products and materials from foreign suppliers.

The findings show that changes in currency rates are significant to the formation of supply chain risks in industries with large revenues like Automotive & Technology since fluctuations occur frequently in these industries. Strategies for hedging currencies alongside contracting in stable currencies have been seen to be quite profitable in reducing risk exposure and the effectiveness of forecasting tools ensures that firms are able to identify and adapt to currency trends. Therefore, the research provides significant implications for both education research and supply chain management in unstable exchange rates

contexts.

DISCUSSION

This study has given important implications on the ways currency rate fluctuation influence supply chain risk management. The results show that changes in the currency exchange rates can significantly enhance costs and risks, especially for firms in the Automotive and Technology sectors that are highly globalized. These disturbances demonstrate that good practices in risk management include the use of foreign currencies as a hedge and carrying out business in stable currencies in order to mitigate the effects of fluctuations in foreign exchange rates. In addition, the role of the forecasting tools in providing early indications of currency movements underlines the importance of the latter in assisting organizations to mitigate their supply chain-related risks.

The effects of the COVID-19 have shaken the supply chains all over the world and the fluctuations in the currency markets have also become amplify. That is why for many countries various forms of stimulus measures and inflation have led to significant differences both in the rates of recovery and in the fluctuations of currencies. Many firms more specifically the U.S. based firm suffered from inflation and Federal Reserve's move of changing interest rates that impacted the cost and time of cross border transactions. The changes in demand fluctuations after the covid-19 pandemic have compelled companies to use advanced forecasting tools such as AI and machine learning to try and predict these fluctuations (Zhao et al, 2023).

Impact of Currency Rate Fluctuations on Supply Chain Costs and Disruptions

This paper's analysis supports the assertion that currency rate volatility directly affects supply chain costs and risks across all industries but especially in industries with global supply chains such as Automotive and Technology. Another study by Shen et al. (2023) has also noted that globalization and the use of multiple suppliers have compounded the problem because the business is exposed to effects of fluctuations in foreign exchange rates which may lead to high prices, delay and inconsistency of suppliers. Our findings reveal that very large firms are sensitive to the fluctuations that take place on a daily or weekly basis.

Variations make costs rise since firms have to adapt to the ever-changing pricing structure. This is consistent with the work of Korinek et al. (2022) who note that firms that operate in the multi-currency environment will have their costs rise dramatically during the volatile periods. The obvious correlation between exchange rate volatility and supply chain costs and their impact on profitability cannot be overemphasized as it stresses the importance of risk evaluation in the supply chain.

Effectiveness of Risk Management Strategies

Findings of this study show that currency hedging and contracting in stable currencies are the most efficient ways to lessen the effects of currency risks and especially in the Automotive and Technology sectors. Levi (2022), also confirm that managing exchange risks through hedging strategies that enable firms to fix exchange rates is important in controlling supply chain costs and shielding against exchange rate volatility.

Working in local currencies, which are relatively stable such as USD or EUR, free the firms based in unstable regions from the impact of depreciation of local currency. This is consistent with Nguyen et al.'s (2023) observation that businesses with fixed currency exposures are in a much better place to absorb shocks without having to pass on the higher costs to the consumers.

The improvement and the popularity of the employment of these techniques as highlighted in this study implies that companies that do not use these strategies may be disadvantaged. However, less proactive measures, for example, passing cost volatility through to customers was seen as considerably less effective across the industries and underscore the need for managing risk internally as pointed out by Bodnar et al. (2021).

Accuracy of Forecasting Tools

These results evidence that software for forecasting and internal analytical tools are considered very effective in predicting currency volatility particularly in large organizations with professional staff. This is

This increase in the application of internal analysis shows the need for special business driven forecasting models that take into consideration business risks and conditions. This is in line with Cheng et al. (2022) who note that internal, firm-specific models are usually more accurate than external general models typically offered by industry analysts, particularly in sectors smaller firms which depend on consulting experts or economic reports do not have the necessary structures to produce accurate forecasts, a problem that Lukonga and Kure (2023) also note.

Relevance to Supply Chain Risk Management

This work also establishes that currency rate volatility is not just a risk issue in finance but an imperative factor in the supply chain risk management. This paper uses the logistic regressions to show that frequent oscillations enhance the risk of supply chain disruptions. Larger companies which have sound currency hedging and stable contracting strategies are less likely to be affected by these risks than the smaller companies.

In line with the study by Rossi and Trentini (2023), the authors assert that it is important for the firm to proactively manage currency risk in order to ensure supply chain sustainability. A good currency risk management is therefore more likely to be effective when it is combined with other risk management strategies within a company. This is seen as a shift within the industry toward more strategy development which includes close concern for foreign exchange risk management as a part of supply chain management (Tang et al, 2023).

Implications for Future Research and Practice

Thus, more attention should be paid to the development of the strategies to minimize currency risk within particular industries, especially for SMEs. The advancement in Artificial Intelligence and Machine learning in the recent past could potentially provide new approaches to anticipating currency movement and minimizing supply chain vulnerability (Zhao et al, 2023). It is therefore expected that future research will examine the ways in which these technologies can assist SMEs and larger firms to enhance the further development of more sustainable supply chains.

From the perspective of practitioners, this study underlines the need to include currency risk management into the supply chain planning. These other sectors, such as the automotive industry and technology which are exposed to exchange rates should not be complacent in their activities and predicting risks. The continuing education and training of the supply chain management professionals will prepare companies for the conditions that are likely to prevail in the future volatile global market (Walsh et al, 2023).

Future Recommendations and Limitations

There is some limitation that needs to be noted about this study in regard to the effects of currency rate fluctuation on supply chain risk management. First, the data collected was primarily form large organizations and the sample was primarily from Automotive and Technology industries. Future works should elaborate on how SMEs, especially those ones that hardly can adopt advanced risk management procedures, mitigate currency risk. A major limitation of the study was the feedback from the SC managers and the data gathered may have been different if the managers were to provide the information. Further studies may involve a better way of quantifying the monetary impact of currency changes that the organization is likely to incur. New techniques have been used in the market to recognize the performance of the currency including the use of Artificial Intelligence and machine learning. These technologies could significantly impact the methods of identification and control of changes in the dynamics and may be particularly useful for SMEs, which are unlikely to have the resources to implement traditional methods for demand forecasting. This paper has therefore identified

these technologies and how they can be used in the real world in order to strengthen supply chain in volatile markets.

CONCLUSION

This article offers a systematic review of the exposure of supply chain risk management to currency rate fluctuations and the necessity for preventive measures. These findings show that volatile and volatile and large changes in exchange rates are a major factor that affects the cost of supply chain and the possibility of disruptions especially in the automotive and the technology industries. Those organizations which operate a number of business activities in different countries of the world are likely to be more vulnerable to fluctuations in currency rates, leading to higher costs and time delays. But these companies are also more capable of undertaking good risk management practices such as hedging against currency risk and making contracts in stable currencies which have been observed to minimize the effect of fluctuation of exchange rates.

The research presents the impact of currency rates within the sphere of supply chain risk management and proves that risk management should be proactive. The findings provided in the paper offer unequivocal evidence of supply chain costs' susceptibility to constant, large oscillations in exchange rates and the overall risk of supply chain disruptions in global industries including Automotive and Technology. Since large companies have vast operational networks across the world, they are also more sensitive to high levels and risks of cost fluctuations and an extended duration in the market. These companies are also in a position to be better placed to manage the risks that the equivalent effective risks such as hedge and contractual in stable currencies which have been proved to reduce the negative impacts of the currency fluctuations.

The second important insight is the role of the forecasting tools in preparing the companies for the changes in currency rates. Prominent roles of forecasting software and internal analysis are viewed as highly accurate especially by large organizations and the ones with already long-term experience in field. The convenience of analytics tools and accurately defined prognosis models give companies a competitive edge in predicting the changes in currency rates and consequently, the company's supply chains. Over the years the business environment has proved to be very dynamic, therefore being able to predict the movement of the currency and relating it to the supply chain management will be an important factor in avoiding disruption of the supply chain.

The investigation also reveals a number of weaknesses and limitations that concern the management of currency risks. While a large organization is in a position to use latest techniques and risk management frameworks, an SME often lacks the resources to apply those measures. SMEs perform sensitively to movements in foreign exchange rates since they do not have the financial discretion or access to hedging tools or certain contracting arrangements. Moreover, due to their dependence on current economic reports and consulting experts, both of which serve as less accurate predictions compared to their in-house models, present even greater obstacles for even the smallest of firms.

Recommendations of this research emphasize currency risk management as an essential contingency factor in contemporary supply chain management. The analysis shows that using hedging strategies or operating in stable currencies, as well as accurate forecasting tools, must be considered a priority while working in supply chains to reduce the impact of market fluctuations. By considering these strategies as valuable tools to be incorporated into a firm's SCM strategy a firm can safely manage risk while also maintaining its competitiveness in global supply networks.

The study provides evidence that implies that SCM companies should fund education and training to create competent professionals who possess the knowledge needed to control foreign currency exposure. The outcomes reveal that enhancing employment experience facilitates use of predictive techniques and establishment of effective risk management programmes. Thus, it was concluded that currency risk training enhancing supply chain managers' knowledge and expertise could provide

substantial benefits to those companies that could experience mixed results from enhancing their currency management practices most notably the SMEs.

Moreover, regarding innovations in digital technologies, such as artificial intelligence and machine learning in the future, the subsequent research should investigate how they may impact the improving of forecast precision and the improvement of risk management. For instance, AI-driven forecasting models could be a feasible solution that adds more value, making it possible for small and large players to make sound prognosis when it comes to currency variation.

The results derived from this study reposes the magnitude of the impact of currency rate volatility on SCRM and underlines the necessity of addressing this issue efficiently. By implementing hedging, setting fixed currency deals or aiming at getting great forecast instruments, the firm can gradually manage to reduce the possible glitches that come with the fluctuation in the currency and assure sound chains of supply. Since the global markets are integrating and becoming more and more sensitive and uncertain in their operations, the currency risk management practice will remain a topical issue in SCM and can thus can be a fruitful area for both researches and practitioners' engagement.

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