LEVERAGING AGILE SUPPLY CHAINS FOR IMPROVED FINANCIAL PERFORMANCE IN HEALTHCARE SECTOR COMPANIES IN MALAYSIA

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(Received 23rd April 2025; revised 13th July 2025; accepted 22nd July 2025)

Abstract. This research aims to identify factors affecting supply chain agility (SCA) through the lens of financial ratios and evaluate their effect on a company's financial performance. This research involves companies which were listed in the healthcare sector on Bursa Saham Malaysia (BURSA) with at least thirteen years of historical financial reports. The findings reveal that from the four key SCA attributes included in this research, Supply Chain Resilience (SCR) and Planning and Demand Forecast Accuracy (PDFA) are the two attributes that have a significant impact on financial performance, while Supply Chain Flexibility (SCF) and Supplier Collaboration do not have a significant impact. The findings of this research also demonstrate that Supply Chain Agility attributes are numerous, and if the attributes are included to complement one another, they will have a stronger and more significant impact on improving financial performance. However, if companies implement supply chain strategies that only focus on one SCA attribute at a time, the impact may not be as significant as compared to more comprehensive strategies, which complement one another. The healthcare sector can utilize the findings from this research to improve its financial performance. The result does not encourage the sector to be too flexible, as this will increase complexities and hurt its operating costs, instead, it provides a framework for the healthcare sector to develop strategies to be more supply chain resilient and improve its planning and demand forecasting accuracy and balance focus on the supplier's collaboration.
Keywords: *supply chain, agility, flexibility, resilience, collaboration, forecast accuracy*

Introduction

Over the past decades, many companies have faced the "globalisation" phenomenon where the world is getting smaller, and people, the social economy and businesses are more connected and integrated (Schaeffer, 2003). The freer trade with increasing trade agreements between countries, removal of trade barriers (Li et al., 2022) and the ease for consumers to access global markets through modern technology entail a lot of pressure for companies to be more competitive and survive. It has brought a new operating structure into the business called "Global Supply Chain" (Balan et al., 2006) and has transformed supply chain management with increased interconnectivity of global markets and complexities to navigate. Supply Chain Management is not just about moving one product between two points, from point A to point B. The goal of supply chain management is to add value for the stakeholders involved in the whole chain, benefiting the end customers and consumers (Tien et al., 2019). Managing the global supply chain offers the capability to create and reach the markets before competitors and achieve a competitive advantage by providing increased customer satisfaction through delivering the right product at the right time at a greater value for money because of reduced overall cost (Tien et al., 2019). The improvement in technology, digital platforms, and connectivity intensifies the competitive environment

for companies to improve their supply chain end-to-end management and processes (Marinagi et al., 2014).

For companies to remain resilient in the playing field, they require supply chain management, which is more sophisticated, moving away from traditional management to agile management, which is flexible, responsive, innovative and resourceful to ensure efficiency and effectiveness (Carvalho et al., 2012). Supply Chain Agility (SCA) is a critical component of modern supply chain management. It is a dynamic sensing capability for companies as it allows them to identify opportunities and threats in the marketplace and provide an agile supply chain response (Eckstein et al., 2015). It emerges as a vital capability that enables companies to quickly navigate market fluctuations, disruptions and changing consumer demands (Sharma et al., 2017). The real test for many organisations on their sustainability, resilience and SCA is through the recent global COVID-19 pandemic, a significant crisis that disrupted many companies (Wang and Wang, 2023). Many supply chain professionals are challenged and triggered to reassess and revisit their company's strategic supply chain plans (Ivanov, 2020), while the organisation fosters flexibility, innovation, and speedy response mechanisms of SCA, which helps businesses thrive in the competitive globalisation landscape.

Research scope and objectives

There is limited research done in the healthcare sector in Malaysia on how leveraging an agile supply chain can enhance financial performance by applying financial ratios to represent SCA attributes. A search was done through Google Scholars, Connected papers, Scopus, SpringerLink, JSTOR and Science Direct between the year 2018-2024, though there is much research about SCA and its impact on financial performance from various methods of research and perspective, there is no research that is done that is looking specifically on SCA and financial performance using the financial ratio as a proxy in the healthcare sector in Malaysia. Therefore, this research uses four SCA attributes as independent variables, namely flexibility, resilience, supplier collaboration, and Planning and Demand Forecasting accuracy, while the dependent variable is financial performance. The financial ratio of Inventory Turnover (InvTO) will be used as to proxy for Supply Chain Flexibility (Zhu and Liu, 2024), Return on Asset (ROA) as a proxy for Supply Chain Resilience (Birhanu et al., 2017), Account Payable turnover (APTO) as a proxy for Supplier Collaboration (Tchamy et al., 2018) and Gross Margin Ratio (GP) for Planning and Demand Forecasting Accuracy (Forehand et al., 2021), which impact the financial performance. Net Profit Before Tax (NPBT) will be a proxy used for financial performance (Johnson and Templar, 2011).

By using this financial ratio to proxy the SCA attributes, it will provide precise, quantifiable measures that can objectively assess SCA attributes that allow more accurate insights and reliable analysis to supply chain professionals and academicians around the topic of financial performance from the context of how exactly SCA impacts it instead of just through qualitative assessment. The idea is to perform the research together using SCA attributes and financial ratios, which helps improve the collaboration between the Supply Chain and Finance Managers (Zaman et al., 2023). The healthcare sector companies listed on BURSA included in this research have been listed for more than thirteen years, from when this research was carried out, i.e. it includes companies that started on BURSA at least in 2009 and are still actively traded. This is to ensure that sufficient and consistent data can be obtained. These companies

are listed at the Main Board, ACE market board or the LEAP Board, which can be further broken down into three sub-categories, i.e. Healthcare Equipment & Services, Pharmaceuticals and Healthcare Providers. This research aimed to investigate how SCA influences financial performance by using financial ratios as proxies for SCA attributes, with the following objectives: (1) To examine if the increase in flexibility in supply chain operation will improve the financial performance (profitability) of the company; (2) To analyse if there is a positive relationship between responsiveness and the financial performance (profitability) of the company; (3) To examine the significance of Supplier Collaboration's impact on financial performance (profitability); (4) To assess the positive impact of Planning and Demand Forecasting Accuracy on financial performance (profitability).

Literature review

This study examined the previous few years' research on supply chain management, its agility factors and importance in driving business and financial performance. Globally, Supply Chains continue to face challenges, and these challenges have evolved and come into different magnitudes that impact humankind in many forms. Challenges faced may be due to natural disasters like hurricanes, typhoons, tsunamis, and floods, which may be due to human-caused disasters, which bring geo-political instability and unprecedented and unforeseen circumstances like the recent COVID-19 pandemic (Patel and Sambasivan, 2021). When an organisation faces these challenges, there will be disruption in the supply chains. For organisations to survive and remain resilient, "agility" is pivotal to see how the organisation responds and overcomes the challenges to be able to continue to meet and serve their customers' demands (Sharma et al., 2017). A few key concepts that will help to better comprehend this research and formulate this research framework and methodology will be reviewed.

Evolution of supply chain management

The concept of "Supply Chain" (SC) has evolved over the past decades, starting with pre-industrialisation and expanding to include transportation management. The Global Supply Chain (GSC) emerged between 1900 and 1950, with organisations like UPS and DHL implementing automation and unit load (Ashcroft, 2021). The mid-20th century saw the rise of physical distribution, with DHL and FedEx joining freight management via trucking. IBM developed the first computerised inventory management and forecasting system in 1963. In 1975, JCPenney created the first real-time warehouse management system (WMS), reducing time spent searching for stock. Personal computing further revolutionised supply chain practices in the 1980s. In 1982, Keith Oliver introduced "supply chain management" to describe the process of planning, implementing, and controlling operations to satisfy customer requirements efficiently. The evolution of SCM from the early 21st century saw more inter- and intra-organisation integration through real-time data, sophisticated technology, and IT systems. The rise of manufacturing in Asia and AI with machine learning has transformed the supply chain ecosystem. The COVID-19 pandemic has highlighted the importance of supply chain functions, leading to a rethinking of long-term strategies (Ozdemir et al., 2022). SCA is considered a key attribute in contemporary supply chain management (Lee, 2004).

Supply Chain Agility (SCA)

Lee (2004) identified three qualities of Triple-A (AAA) supply chain organisations, agility, responsiveness, and flexibility. Agility is crucial for improving competitiveness and has been gaining attention from supply chain scholars. A recent literature review found that quickness, responsiveness, competency, and flexibility are the most important dimensions of agility. SCA is viewed as the 21st-century supply paradigm and a successful strategy for companies looking to rise to the top of national and international markets (Yusuf et al., 1999). However, the concept of SCA appears ill-defined and unstructured, with several significant themes surrounding its definition and facilitators. A comprehensive view of organisational agility was developed by Walter (2020), which derived four key agility categories: agility drivers, enablers, capability, and dimension. In the era of Industrial Revolution 4.0, adopting Industry 4.0 technologies, such as smart manufacturing, cloud computing, big data analytics, cyber-physical systems, and Internet of Things, significantly enhances agility capabilities. Key aspects of agility include supply chain, workforce, information systems, facilities, management, manufacturing, and technology agility (Mrugalska and Ahmed, 2021). IT integration and confidence in supply chain participants are key to achieving SCA and innovation, which can improve firms' competitive edge. Adopting IT and its effective implementation can enhance SCA. An adaptive leadership mindset is also essential for driving organisational agility by encouraging innovation, flexibility, and the ability to anticipate, respond swiftly, and empower teams to navigate dynamic challenges.

Definition and assessment of supply chain agility

Agile Supply Chain (SCA) is a crucial aspect of business performance, requiring organisations to balance agility and cost to build a resilient and responsive supply chain. Gligor's article identifies six key agility themes: quick response to supply and demand changes, smooth disruption management, surviving threats, embracing change, flexibility, integration, speed, and customer empowerment (Gligor, 2014). However, SCA measures are subjective and often rely on operational metrics rather than financial measures. The ultimate goals of SCA are maintaining competitiveness and increasing profitability. Structural characteristics, such as technology, organisational structure, policies, and process framework, often serve as the foundation for strategic orientation.

Financial performance through financial ratios

This research focuses on Supply Chain Analysis (SCA) and Financial Performance (FP), with SCA being the independent variable and FP being the dependent variable. Financial ratios are used to proxy SCA, providing insights into a company's operational efficiency, liquidity, and overall financial health. SCA impacts financial performance by affecting cash flow statements and income statements. Financial performance (FP) is the condition of achievement indicating how well a company uses its assets and capital to generate revenues and profits. Financial statements, including income and balance sheet statements, are used to analyse a company's financial condition and predict future financial positions. Key ratios to measure FP include liquidity ratio, profitability ratio, solvency ratio, and activity/efficiency ratio. Financial ratios are a common financial analysis tool for evaluating FP across different industries.

Key SCA attributes

Supply Chain Flexibility (SCF) is an independent variable that impacts a company's Financial Performance (FP) by allowing it to respond to environmental uncertainty. This research uses Inventory Turnover (InvTO) as a proxy for flexibility, analysing how efficiently and effectively inventories move across the company's supply chain (Simchi-Levi et al., 2018). A higher turnover rate indicates that a company and its supply chain are flexible and can quickly respond to changes in demand, protecting the company's operational and financial performance (Song and Song, 2009). Supply Chain Resilience (SCR) is an independent variable that impacts FP. A resilient supply chain company can maintain or improve its Return on Assets (ROA) even during disruptions (Calvo et al., 2020). Supplier Collaboration (SCC) is another independent variable that impacts FP by proxying through the Accounts Payable turnover ratio (APTO). A strong SCC can lead to better trading terms and a lower APTO ratio, improving the company's cash flow (Hui et al., 2018) and financial performance (Munene, 2018). A strong SCC can lead to information sharing on product innovation and process improvements, as well as relationships that can drive operational efficiencies and financial benefits. Planning and Demand Forecast Accuracy (PDFA) is another key enabler of SCA, which can minimise uncertainty, improve inventory and order management, and minimise the impact on sales and profit. A consistent GP helps project and predict future revenue, maintain inventory at an optimal level, and reduce stockouts and obsolesces, driving improvement in gross margin (Alfalla-Luque et al., 2023).

Critical review of theories

This research explores the use of Agile Supply Chain Management Theories (ASCM) and the Triple-A supply chain, which emphasises agility, adaptability, and alignment in healthcare supply chains (Christopher, 2000). ASCM emphasises the need for supply chains to be responsive to market changes, align with strategic goals, and maintain financial performance. The Triple-A supply chain focuses on managing uncertainty through agility, suggesting strategies to maintain buffer stocks and supplier relationships. Supply Chain Resilience Theory explores the capacity of the supply chain to resist and recover from disruptions, focusing on agility (Katsaliaki et al., 2022). Collaborative Supply Chain Management Theory focuses on enhancing business performance through collaboration and partnership within the supply chain (Osei and Asante-Darko, 2023). These theories can help healthcare companies improve their financial performance and competitive advantages in the market.

Conceptual framework and hypotheses

In this research, where the context focuses on the healthcare sector for companies listed on BURSA, four hypotheses will be included and aligned with the research objectives (*Figure 1*).

H1: There is a significant positive relationship between Supply Chain Flexibility and Financial Performance.
H2: There is a significant positive relationship between Supply Chain Resilience and Financial Performance.
H3: There is a significant positive relationship between Supplier Collaboration and Financial Performance.

H4: There is a significant positive relationship between Planning and Demand Forecast Accuracy and Financial Performance.

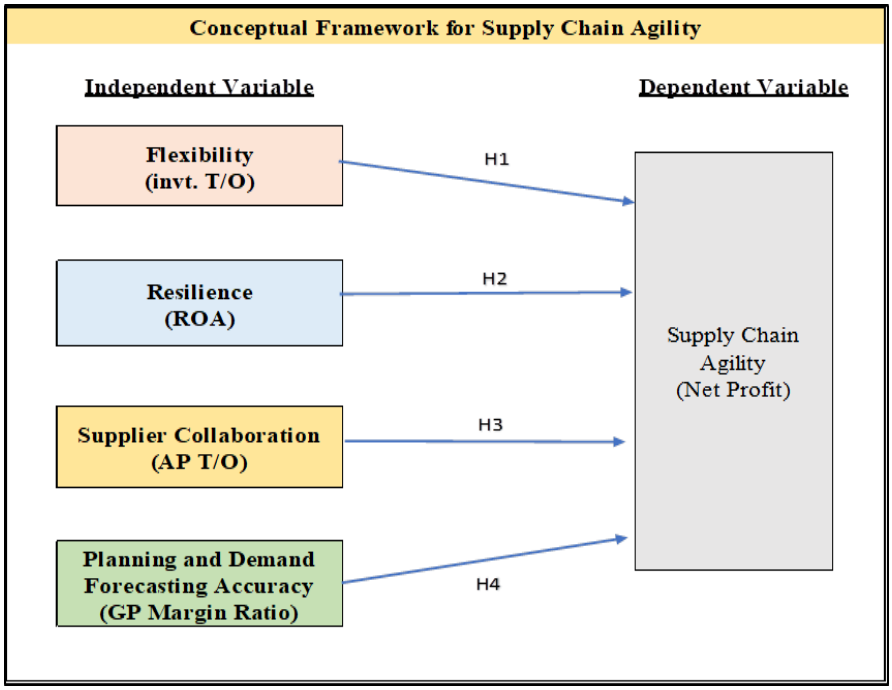

Figure 1. *Construct framework.*

By combining the four hypotheses, this research framework for SCA impacting financial performance will be represented by the Regression Model as Eq. (1):

$$FP = \beta 0 + \beta 1SCF + \beta 2SCR + \beta 3SCC + \beta 4PDFA + \epsilon \qquad \text{Eq. (1)}$$

Where; FP=Financial Performance; βo=intercept; β1=coefficient for Supply Chain Flexibility; β2=coefficient for Supply Chain Resilience; β3=coefficient for Supplier Collaboration; β4=coefficient for Planning and Demand Forecasting Accuracy; ϵ =error.

Materials and Methods

This research adopted a quantitative method based on empirical evidence of financial data and records extracted from the financial performance reports of the healthcare sector companies listed on BURSA. It is rooted in positivism, which emphasises the objectives, the quantification of data and the statistical scientific method for the hypotheses testing before conclusions are drawn (Park et al., 2019). Four hypotheses that link SCA attributes to financial performance have been identified, and these hypotheses will be statistically tested and analysed using the SPSS application. Quantitative methods of regression testing are used to test the strength and significance of the relationship, and ANOVA testing, which can provide valuable insight into how different levels of SCA impact the financial performance of the companies. *Table 1* shows the summary of the research design framework, which indicates the financial proxies used to represent the SCA attributes and financial performance. The regression results will be used to determine the significance of individual independent variables in the regression model. It will check whether each coefficient (β) is significantly different

from Null Hypothesis. If the (β) value is positive, it indicates a positive association between the independent variable and dependent variable, and if the (β) value is negative, it implies a negative association, where if there is an increase in the independent variable, it will tend to decrease the dependent variable. The significance level of the (β) value is tested using a p-value, and the common p-value used is 0.05. If the regression results in a p-value which is less than 0.05 ($p<0.05$), then the H-Null hypothesis will be rejected, and the Alternative hypothesis will be accepted. And vice versa, if the p-value is equal to or larger than 0.05, H-Null will be accepted, and the Alternative hypothesis will be rejected.

***Table 1**. Dependent and independent variables–description and financial ratio (proxy).*

Items	Description	Financial ratio (proxy)
DV	Financial performance	Net Profit (NP) before tax (NPBT)
IV	SCA-Flexibility	Inventory Turnover (InvTO)
IV	SCA-Resilience	Return on Assets (ROA)
IV	SCA-Supplier collaboration	Account Payable Turnover Days (APTO)
IV	SCA-Planning and Demand Forecast Accuracy	Gross Profit Margin (GP)

Results and Discussion

Demographic analysis

There are a total of twenty-nine (29) Medical Health Care companies listed on BURSA across the three Boards, namely the Main Board, ACE and LEAP Board, which are further categorised under three different sectors: the Health Care Equipment and Services, the Health Care Providers and the Health Care Pharmaceutical as presented in *Table 2*. Eighteen (18) companies are included in this research as listed in *Table 3*, with at least thirteen years of financial annual reports published and made available through the BURSA website. From the total of eighteen companies included in this research, 285 lines of data points were collected, with 50.53% of the data points from the Healthcare Equipment and Services, 28% from Pharmaceutical companies and 21.4% from the Health Care providers.

***Table 2**. Summary of source data.*

Bursa Board	No of Companies	Included in Research	HCE&S	HCPProv	HCPPharm
Main	19	16	8	3	5
ACE	6	2	1	1	0
LEAP	4	0	0	0	0
Total	29	18	9	4	5

***Table 3**. Summary of data (n).*

Sector	Observation (n)	Percent (%)	Cumulative (%)
Healthcare Equipment & Services (HCE&S)	144	50.53	50.53
Healthcare Providers (HCPProv)	61	21.40	71.93
Pharmaceuticals (HCPPharm)	80	28.07	100.00
Total	285	100.00	-

Descriptive statistics

Descriptive statistics for all dependent and independent variables are shown in *Table 4a* and *Table 4b*, which includes the minimum and maximum value, mean, standard deviation, variance, skewness and Kurtosis. The above table indicates that the data are considerably variable and non-normal in financial performance metrics, which could be driven by extreme values and a wide range of observations. The data shows Financial

Performance (FP) has a vast range from a loss of MYR 900,415 to a profit of MYR 10,033,813, with a mean of MYR 241,330. This implies a significant variability in profitability across the dataset. The high variance, along with skewness of 7.226 and kurtosis of 66.46, indicates that the distribution is highly skewed and heavy-tailed, due to a few extreme values (outliers). Inventory turnover (InvTO), which proxies Supply Chain Flexibility (SCF), ranges are wide from 0.00 days to 350.08 days with an average of 10.65 days. Its skewness of 9.29 and kurtosis of 96.7 reflect a highly skewed and peaked distribution. This suggests that while most companies have lower InvTO ratios, a few have exceptionally high turnover ratios, driving extreme value. Similar observations of high and moderate kurtosis are found for Return on Asset (ROA) which proxied Supply Chain Resilience (SCR), Account Payable Turnover (APTO) which proxied Supplier Collaboration (SCC) and Gross Profit Margin (GP) which proxied Planning and Demand Forecast Accuracy (PDFA), which are due to the nature and size of the companies within the healthcare sector. Due to small data points, transformation of the data and removal of outliers is not required, as the outlier data are valid phenomena and represent accurate data of the financial results of companies in this scope of research.

***Table 4a**. Descriptive statistics (maximum and minimum).*

Variable prox	Variables	N	Minimum	Maximum	Mean	
			Statistic	Statistic	Statistic	Std. Error
Net profit before tax (NPBT)	Financial Performance	285	-900,415	10,033,813	241,330	51,075
Inventory Turnover (InvTO)	Supply Chain Flexibility (SCF)	285	0.00	354.08	10.65	1.82
Return on Asset (ROA)	Supply Chain Resilience (SCR)	285	-92.19%	83.16%	5.64%	0.93%
Acct. Payable Turnover (APTO)	Supplier Collaboration (SCC)	285	0.1	21.76	5.57	0.198
Gross Profit Margin (GP)	Planning-Demand Forecast Accuracy (PDFA)	285	-76.30%	87.01%	37.40%	1.32%
Valid N (Listwise)		285				

***Table 4b**. Descriptive statistics (Variance).*

Variable proxy	Variable	N	Variance	Skewness		Kurtosis	
		Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Net profit before tax (NPBT)	Financial Performance	285	743,500,000,000	7.226	0.144	66.46	0.288
Inventory Turnover (InvTO)	Supply Chain Flexibility (SCF)	285	946.7	9.29	0.144	96.7	0.288
Return on Asset (ROA)	Supply Chain Resilience (SCR)	285	247.67	-0.371	0.144	11.08	0.288
Acct. Payable Turnover (APTO)	Supplier Collaboration (SCC)	285	11.21	0.936	0.144	2.01	0.288
Gross Profit Margin (GP)	Planning-Demand Forecast Accuracy (PDFA)	285	498.36	-0.343	0.144	1.93	0.288
Valid N (Listwise)		285					

Correlation analysis

Table 5 shows the correlation between Financial Performance (FP) (dependent variable), which is proxied by NPBT, with the four independent variables. Based on correlation guidelines (Bobbitt, 2021), there is a weak correlation if the correlation

result is between 0.1 to 0.3 or -0.1 to -0.3. SCF, which is proxied by InvTO, has a negative and very weak correlation (-0.024) with FP and a confidence interval of -0.14 to 0.093. This relationship is not statistically significant; therefore, no meaningful relationship between FP and SCF. The SCC correlation coefficient is at 0.036, which indicates a very weak positive correlation with a confidence interval between -0.081 to 0.151, hence also indicating there is no meaningful relationship between FP and SCC. PDFA correlation coefficient is slightly stronger at 0.271, as compared to SCF and SCC, with a confidence interval between 0.160 to 0.375. This indicates a statistically significant positive relationship, showing that higher FP is somewhat associated with higher PDFA. SCR has the highest correlation with FP at 0.462, though it is still a moderate positive correlation, based on the standard correlation guideline. The confidence interval is between 0.365 to 0.549, which indicates a statistically significant moderate positive relationship, where higher FP is associated with higher SCR.

***Table 5**. Correlation analysis.*

Variable proxy	Independent variable	Correlation	Count	Statistics	
				Lower C.I.	Lower C.I.
Inventory Turnover (InvTO)	Supply Chain Flexibility (SCF)	-0.024	285	-0.14	0.93
Return on Asset (ROA)	Supply Chain Resilience (SCR)	0.462	285	0.365	0.549
Acct. Payable Turnover (APTO)	Supplier Collaboration (SCC)	0.036	285	-0.81	0.151
Gross Profit Margin (GP)	Planning-Demand Forecast Accuracy (PDFA)	0.271	285	0.16	0.375

Multicollinearity analysis

Table 6 is the correlation matrix from the multicollinearity test among all the variables. FP has a significant positive correlation with SCR (0.462, p<0.001) and PDFA (0.271, p<0.001), while there is no significant correlation with SCF (-0.024, p=0.688) and SCC (0.036, p=0.549). SCF has a significant negative correlation with SCR (-0.130, p=0.028) and PDFA (-0.145, p =0.014) and no significant correlation with SCC (-0.069, p=0.244). SCR has a significant positive correlation with PDFA (0.292, p<0.001) and no significant correlation with SCC (0.057, p=0.335). SCC significantly correlates negatively with PDFA (-0.424, p<0.001).

***Table 6**. Multicollinearity.*

Category		FP	SCF	SCR	SCC	PDFA
Financial Performance (FP)	Pea. Corre.	1	-0.024	.462**	0.036	.271**
Net Profit Before Tax (NPBT)	Sig. (2-tailed)		0.688	<0.001	0.549	<0.001
	N	285	285	285	285	285
Supply Chain Flexibility (SCF)	Pea. Corre.	-0.024	1	-0.13*	-0.069	-0.145*
Inventory Turniver (InvTO)	Sig. (2-tailed)	0.688		0.028	0.244	0.014
	N	285	285	285	285	285
Supply Chain Resilience (SCR)	Pea. Corre.	.462**	-0.13*	1	0.057	0.292**
Return On Asset (ROA)	Sig. (2-tailed)	<0.001	0.028		0.335	<0.001
	N	285	285	285	285	285
Suplier Collaboration (SCC)	Pea. Corre.	0.036	-0.069	0.057	1	-.424**
Acct. Payable Turnover (APTO)	Sig. (2-tailed)	0.549	0.244	0.335		<0.001
	N	285	285	285	285	285
Planning-Demand Forecast Accuracy (PDFA)	Pea. Corre.	.271**	-0.145*	0.292**	-.424**	1
Gross Profit Margin (GP)	Sig. (2-tailed)	<0.001	0.014	<0.001	<0.001	
	N	285	285	285	285	285

*Note: **Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed).*

Regression test

Table 7 is the Regression test for the research model. The R represents the multiple correlation coefficient, i.e. the magnitude and orientation of the linear relationship between the DV and IV. For this model, R=0.495 indicates a moderate positive correlation between DV and all the IVs combined. R-squared (0.245) and Adjusted R-squared (0.234) indicate that 24.5% or 23.4% of the dependent variable (NPBT) variances can be explained by the independent variables. F-change at 22.679 indicates that an additional Independent Variable to the model will improve the overall fit of the model by 22.679%. Sig F change at p<0.001 shows that the model is statistically significant and that the independent variables collectively have a significant effect on the dependent variable. Based on *Table 8*, which captures the regression test results of the DV with individual IV, where the research model is as stated in Eq. (1).

Table 7. *Regression test results.*

Model	R	R-Square	Adjusted R-Square	Std.Error of the Estimate	R-Square Change	F Change	df1	df2	Sig. F change
1	.495 [(a)]	0.245	0.234	754698.2	0.245	22.68	4	280	<0.001

Note: (a) Predictors: (Constant), Planning-Demand Forecast Accuracy, Supply Chain Flexibility, Supply Chain Resilience, and Supplier Collaboration.

Table 8. *Regression test results with coefficient matrix.*

Model	Unstandardized coefficient		Standardized coefficient	t	Sig.	95% confidence interval for B	
	B	Std. Error	Beta			Lower bound	Upper bound
(Constant)	-351,639.67	155530.75		-2.261	0.025	-657797.7	-45481.67
Supply Chain Flexibility (SCF) *Inventory Turnover (InvTO)	1,839.90	1489.9	0.066	1.235	0.218	-1092.93	4772.732
Supply Chain Resilience (SCR) *Return on Asset (ROA)	22,133.80	3049.52	0.404	7.258	<0.001	16130.89	28136.7
Supplier Collaboration(SCC) *Acct. Payable Turnover (APTO)	26,963.61	15237.77	0.105	1.77	0.078	-3031.53	56958.74
Planning-Demand Forecast Accuracy (PDFA) *Gross Profit Margin (GP)	798.07	2396.18	0.207	3.33	<0.001	3263.28	12969.88

From the test result, when all independent variables are zero (0), FP=-351639.67 (negative or loss). Regression test results in Table 8 indicate that the p-value of SCR and PDFA is lower <0.001, hence, will reject the H0 hypothesis and accept the H2 and H4 hypotheses. The p-value for SCF and SCC is bigger than 0.05, therefore accepting the H0 hypothesis and rejecting H1 and H3 hypotheses. Based on the regression test results, the financial performance of the healthcare sector companies listed on BURSA is impacted by the SCA attributes, which are modelled in this research. Referring to *Table 1*, the DV and IV financial proxy matrix, supply chain flexibility (SCF), supply

chain resilience (SCR), supplier collaboration (SCC), and planning and demand forecasting accuracy (PDFA) collectively have a significant impact, (as presented in *Table 7*), on the financial performance (FP). However, based on the individual Pearson correlation test, the results of the multicollinearity in *Table 6* indicate that SCF is negatively correlated with FP and with the regression test, where p=0.218, bigger than 0.05, hence H0 is accepted and H1 is rejected. Therefore, SCF has no impact on FP. SCR has a positive correlation to FP, p<0.001, therefore, H0 is rejected and H2 accepted, which indicates that SCR does have a strong impact on FP. SCC has a positive correlation with FP; however, with p=0.078, H0 is accepted while H3 is rejected, indicating that SCC has no impact on FP in this research. PDFA has a positive correlation with FP, and with p<0.001, H0 is rejected and H4 accepted, indicating PDFA has a significant impact on FP. A summary of the individual hypotheses is presented in the following *Table 9*.

Table 9*. Summary of hypotheses with financial performance (Dependent variable).*

Financial Proxy	Independent variable (Supply Chain Agility Attributes)	Sig. (p-value)	Reject or Accept H0	Indication
Inventory Turnover (InvTO)	Supply Chain Flexibility (SCF)	0.218	Accept H0, Reject H1	No significant impact on FP
Return on Asset (ROA)	Supply Chain Resilience (SCR)	<0.001	Reject H0, Accept H2	Has significant impact on FP
Acct. Payable Turnover (APTO)	Supplier Collaboration (SCC)	0.078	Accept H0, Reject H3	No significant impact on FP
Gross Profit Margin (GP)	Planning & Demand Forecast Accuracy (PDFA)	<0.001	Reject H0, Accept H4	Has significant impact on FP

This research hypothesised that the increase in SCF, SCR, SCC and PDFA will improve the financial performance. Key outcomes and findings show that with a combination of comprehensive strategies, which combined all four SCA attributes, there will be a positive impact on the financial performance of the healthcare companies listed on BURSA, and if companies could identify additional attributes, e.g. IT integration, financial performance may improve further by about 23%, indicated through the adjusted R-squared as seen in *Table 7*. Findings suggest that overemphasising isolated attributes can yield diminishing benefits to the company's financial performance. However, this research reveals a varied degree of influence and significance of the four factors independently. Supply Chain Flexibility (SCF), contrary to expectations, is found to have a negative correlation with financial performance, and the null hypothesis (H0) is accepted, indicating that SCF does not significantly impact the financial performance of the healthcare companies listed on BURSA. This outcome could indicate that too much flexibility might lead to inefficiencies or costs that outweigh its benefits. Excessive flexibility in the current dynamic environment may increase the operational complexities (Sánchez and Pérez, 2005), creating confusion in the process, which may lead to sub-optimal decisions. While there are many advantages of Supply Chain Flexibility (Bag and Rahman, 2021; Bai et al., 2019), it is important to note that SCF could potentially exert adverse effects on performance (Fantazy et al., 2009). In addition, being too flexible to meet customers' demands may increase operational costs if the manufacturer must accommodate frequent changeovers or distribution and logistics are too flexible to cater to customers' needs (Pellegrino et al., 2020). It underscores the need for healthcare companies to strike a balance, ensuring the company's flexibility strategies align with its strategic goals without compromising financial goals (Wang et al., 2024).

Conversely, SCR and PDFA emerged as the most significant positive contributors to financial performance. SCR allows the companies to respond swiftly to disruptions, returning to their original state or improving further, adapting to new environmental challenges where financial performance can be safeguarded (Huang et al., 2023). PDFA ensures there is visibility and alignment between customer demands to help in the planning of resources to be optimised. Human resources, production capacity, and inventory management are critical to ensure operations are optimised, minimising wastage and enhancing cost efficiency. PDFA can be the result of strong supply chain stakeholders' collaboration and data visibility. Companies' performance benefits from the visibility fostered through interactions, connectivity, and information sharing (Huang et al., 2023). These findings highlight the strategic importance of PDFA. Companies can consider investing in robust systems, machine learning (Feizabadi, 2020) and capabilities to enhance resilience and forecasting accuracy. On the other hand, SCC, while positively influencing financial performance, does not exhibit statistical significance in this research. This might suggest that the impact of SCC is more subtle due to a different portfolio of suppliers, where strong supplier management strategies are needed and differ between companies. SCC may also be potentially influenced by external factors like market conditions, companies' specific variables, and suppliers' financial capabilities. The different partnership-based focus areas may impact companies' financial performance differently (Shin et al., 2019). Like the lack of significant impact of SCF, the weak significance of SCC to the financial performance of healthcare sectors raises questions about its perceived importance, and companies may determine the practical implementation and strategies to be taken within their companies.

Conclusion

This research has provided valuable insights into the relationship between supply chain agility attributes and financial performance in the healthcare sector in Malaysia. It reveals that companies that overemphasise supply chain flexibility might introduce inefficiencies or increased costs, outweighing the benefits, which this finding varies to many previous supply chain management perspectives. This research agrees and highlights the significant benefits of supply chain resilience, planning, demand forecasting accuracy, and ensuring stability and reliability in operation. Companies within the healthcare sector can adopt a resilient and well-planned supply chain structure that aligns with the specific needs of the companies. Supplier collaboration, while beneficial, has a relatively softer impact on financial performance, therefore suggesting that collaboration with suppliers should be strategically managed to balance costs and benefits effectively. Understanding how flexibility, resilience, planning, demand and forecast accuracy, as well as supplier collaboration, work together can help companies to develop supply chain strategies that are more suited to their unique operational challenges. The findings of this study offer a foundation for strategic innovation and well-informed decision-making as the healthcare sector continues to evolve, opening the door to opportunities to improve financial performance and sustainable growth. However, it is important to recognise and acknowledge that this research has limits and gaps. Although these research findings are insightful, it is within the specific industry context. Therefore, the information and findings should not be applied directly to other industries or geographical regions. Future research should

review whether the results and findings can be applied to different sectors and their circumstances or environments. Effort and further research can be made to see if other factors and attributes could influence the relationship and complementary effect between supply chain strategies and financial performance.

Acknowledgement

This research study is self-funded.

Conflict of interest

The authors confirm that there is no conflict of interest involved with any parties in this research.

REFERENCES

[1] Alfalla-Luque, R., García, D.E.L., Marin-Garcia, J.A. (2023): Supply chain agility and performance: evidence from a meta-analysis. – International Journal of Operations & Production Management 43(10): 1587-1633.
[2] Ashcroft, S. (2021): The history of supply chain management. – Supply Chain Digital Web Portal 7p.
[3] Bag, S., Rahman, M.S. (2021): The role of capabilities in shaping sustainable supply chain flexibility and enhancing circular economy-target performance: an empirical study. – Supply Chain Management an International Journal 28(1): 162-178.
[4] Bai, C., Sarkis, J., Yin, F., Dou, Y. (2020): Sustainable supply chain flexibility and its relationship to circular economy-target performance. – International Journal of Production Research 58(19): 5893-5910.
[5] Balan, S., Vrat, P., Kumar, P. (2006) Assessing the challenges and opportunities of global supply chain management. – International Journal of Value Chain Management 1(2): 105-116.
[6] Birhanu, D., Krishnanand, L., Rao, A.N. (2017): Comparison of select financial parameters of Ethiopian consumer goods supply chains. – Benchmarking An International Journal 24(1): 102-117.
[7] Calvo, J., Del Olmo, J.L., Berlanga, V. (2020): Supply chain resilience and agility: a theoretical literature review. – International Journal of Supply Chain and Operations Resilience 4(1): 33p.
[8] Carvalho, H., Azevedo, S.G., Cruz-Machado, V. (2012): Agile and resilient approaches to supply chain management: influence on performance and competitiveness. – Logistics Research 4(1-2): 49-62.
[9] Christopher, M. (2000): The agile supply chain: competing in volatile markets. – Industrial Marketing Management 29(1): 37-44.
[10] Eckstein, D., Goellner, M., Blome, C., Henke, M. (2015): "The performance impact of supply chain agility and supply chain adaptability: The moderating effect of product complexity". – International Journal of Production Research 53(10): 3028-3046.
[11] Fantazy, K.A., Kumar, V., Kumar, U. (2009): An empirical study of the relationships among strategy, flexibility, and performance in the supply chain context. – Supply Chain Management an International Journal 14(3): 177-188.
[12] Feizabadi, J. (2020): Machine learning for demand forecasting and supply chain performance. – International Journal of Logistics Research and Applications 25(2): 119–-142.

[13] Forehand, K., Roman, J., Schaefer, T. (2021): Supply chain efficiency in the discount store industry post COVID-19: Applying the Supply Chain Efficiency Ratio. – Operations and Supply Chain Management An International Journal 8p.
[14] Gligor, D.M. (2014): The role of demand management in achieving supply chain agility. – Supply Chain Management an International Journal 19(5/6): 577-591.
[15] Huang, Y., Phan, V., Do, M. (2023): The impacts of supply chain capabilities, visibility, and resilience on supply chain performance and firm performance. – Administrative Sciences 13(10): 17p.
[16] Hui, K.W., Liang, C., Yeung, P.E. (2018): The effect of major customer concentration on firm profitability: competitive or collaborative? – Review of Accounting Studies 24(1): 189-229.
[17] Ivanov, D. (2020): Viable supply chain model: integrating agility, resilience and sustainability perspectives-lessons from and thinking beyond the COVID-19 pandemic. – Annals of Operations Research 319(1): 1411-1431.
[18] Johnson, M., Templar, S. (2011): The relationships between supply chain and firm performance. – International Journal of Physical Distribution & Logistics Management 41(2): 88-103.
[19] Katsaliaki, K., Galetsi, P., Kumar, S. (2022): Supply chain disruptions and resilience: A major review and future research agenda. – Annals of Operations Research 38p.
[20] Lee, H.L. (2004): The triple-A supply chain. – Harvard Business Review 82(10): 102-112.
[21] Li, Y., Wang, J., Oh, K. (2022): Effects of Globalisation on the Convergence of Poverty Levels among Asian Countries. – International Economic Journal 36(2): 193-205.
[22] Marinagi, C., Trivellas, P., Sakas, D.P. (2014): The impact of information technology on the development of supply chain competitive advantage. – Procedia-Social and Behavioural Sciences 147: 586-591.
[23] Mrugalska, B., Ahmed, J. (2021): Organisational Agility in Industry 4.0: A Systematic Literature Review. – Sustainability 13(15): 23p.
[24] Munene, F. (2018): Accounts Receivable management and financial performance of Embu Water and Sanitation Company Limited, Embu County, Kenya. – Kenyatta University 59p.
[25] Osei, V., Asante-Darko, D. (2022): Collaboration Within the Supply Chain. – In Springer eBooks 30p.
[26] Ozdemir, D., Sharma, M., Dhir, A., Daim, T. (2022): Supply chain resilience during the COVID-19 pandemic. – Technology in Society 68: 10p.
[27] Park, Y.S., Konge, L., Artino, A.R. (2019): The positivism paradigm of research. – Academic Medicine 95(5): 690-694.
[28] Patel, B.S., Sambasivan, M. (2021): A systematic review of the literature on supply chain agility. – Management Research Review 45(2): 236-260.
[29] Pellegrino, R., Costantino, N., Tauro, D. (2020): The value of flexibility in mitigating supply chain transportation risks. – International Journal of Production Research 59(20): 6252-6269.
[30] Sánchez, A.M., Pérez, M.P. (2005): Supply chain flexibility and firm performance. – International Journal of Operations & Production Management 25(7): 681-700.
[31] Schaeffer, R.K. (2003): Globalisation and technology. – Gale Academic OneFile Web Portal 4p.
[32] Sharma, N., Sahay, B.S., Shankar, R., Sarma, P.R.S. (2017): Supply chain agility: review, classification and synthesis. – International Journal of Logistics Research and Applications 20(6): 532-559.
[33] Simchi-Levi, D., Wang, H., Wei, Y. (2018): Increasing Supply Chain Robustness through Process Flexibility and Inventory. – Production and Operations Management 27(8): 1476-1491.

[34] Shin, N., Park, S.H., Park, S. (2019): Partnership-Based supply chain collaboration: impact on commitment, innovation, and firm performance. – Sustainability 11(2): 19p.
[35] Song, H., Song, Y. (2009): Impact of Inventory Management Flexibility on Service Flexibility and Performance: Evidence from Mainland Chinese Firms. – Transportation Journal 48(3): 7-19.
[36] Tchamy, J., Peihua, F., Osabutey, W., Yoboue, W. (2018): Supply Chain Finance analysis. – International Journal of Academic Research in Business and Social Sciences 8(12): 385-395.
[37] Tien, N.H., Anh, D.B.H., Thuc, T.D. (2019): Global supply chain and logistics management. – Academic Publication 177p.
[38] Walter, A. (2020): Organisational agility: ill-defined and somewhat confusing? A systematic literature review and conceptualisation. – Management Review Quarterly 71(2): 343-391.
[39] Wang, M., Chan, R.Y.K., Kumar, M., Tsolakis, N. (2024): Does increasing supply chain flexibility contribute to the enhancement of a firm's sustainability performance? – IEEE Transactions on Engineering Management 71: 8606-8622.
[40] Wang, M., Wang, B. (2023): Supply chain agility as the antecedent to firm sustainability in the post-COVID-19 era. – The International Journal of Logistics Management 35(1): 281-303.
[41] Yusuf, Y.Y., Sarhadi, M., Gunasekaran, A. (1999): "Agile manufacturing: The drivers, concepts and attributes." – International Journal of Production Economics 62(1-2): 33-43.
[42] Zhu, X., Liu, J. (2024): The effect of inventory flexibility on financial performance: Moderating role of firm size and growth. – Engineering Economics 35(1): 119-132.
[43] Zaman, S.I., Khan, S.A., Kusi-Sarpong, S. (2023): Investigating the relationship between supply chain finance and supply chain collaborative factors. – Benchmarking an International Journal 31(6): 1941-1975.