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Research paper

The effects of supply chain viability on supply chain performance and marketing performance in case of large manufacturing firm in Ethiopia

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ABSTRACT

Goal: COVID-19 has put the supply chain (SC) through exceptional shocks and disruptions that have never been seen before. It put existing SCs' capabilities to a severe test. Moreover, due to the pandemic, demand and supply have been imbalanced, which has led to questions about societal and SC survivability. This study examines the effects of firms' SC viability on SC and marketing performance.

Design/Methodology/Approach: An explanatory research design was employed to examine the relationship between the antecedents of SC viability, SC, and marketing performance using partial least squares (PLS) structural equation modeling (SEM). Moreover, 5-point Likert scale questionnaires are used as a data collection instrument.

Results: The finding shows that both SC resilience, SC agility, and sustainable SC have a positive effect on SC performance. Further, SC viability [SC resilience + SC agility + sustainable SC] has a positive effect on SC performance. SC performance also play partial mediation between SC viability and marketing performance.

Limitations of the investigation: The study focused only on a limited number of large manufacturing companies in Ethiopia, which excluded other medium- and small-sized firms due to the ongoing war in the northern part of the country. Moreover, the study focused only on one dimension of sustainability (social aspect).

Practical Implications: The study shows firms that the traditional risk assessment methods are insufficient and will no longer be enough to overcome severe disruption. Instead, the study recommends firms work using anticipatory failure determination (AFD) and a red teaming approach to prepare for 'unknown unknown' events. Besides, the study brings a practical and holistic model that shows the relationship between SC viability and SC and marketing performance.

Originality/ Value: None of the studies so far in SC have tested the concepts of viability systems in SCM by adopting from disciplines such as ecological modeling, biological, and cybernetics using PLS-SEM. Consequently, it contributes to existing literature by showing new empirical evidence of a strong relationship between SC viability, SC performance, and marketing performance.

Keywords: Supply chain viability; Supply chain agility; Supply chain resilience; Sustainable supply chain; Structural equation modelling.

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1. INTRODUCTION

The supply chain has been revolutionized in dealing with nature and societal interest through becoming more sustainable, strengthening resilience during disturbances, recovering and controlling the ripple effects, and leveraging digital technology (Dolgui et al., 2018; Ivanov, 2020a; Pavlov et al., 2019).

The recent coronavirus (COVID-19) pandemic has put the leagility, resilience, sustainability, and digitalization of SCs to test (Ivanov, 2020b), showing that SCs have suffered an exceptional series of shock and disruption never seen before (Choi, 2020; Currie et al., 2020; Ivanov, 2020b; Ivanov and Das, 2020; Ivanov and Dolgui, 2020; Sarkis et al., 2020). This SC's disruption resistance must work at the level of survivability and viability in order to survive and sustain supply chain and marketing operations(Ivanov, 2020b).

The pandemic breakout has left global supply chains and corporations under extreme stress (Araz et al., 2020), causing production to halt due to a lack of raw materials and spares components, and firms to face uncertain recovery time (Cai and Luo, 2020). The epidemic in Ethiopia, in particular, causes production shutdowns and supply chain disruptions, with repercussions across all economic sectors. For example, the textile, garment, and leather industries have all suffered financial difficulties (Geda, 2020; Lemi et al., 2020). The demand for facial masks, hand sanitizer, and disinfectant sprays skyrocketed during the coronavirus, and the supply side couldn't keep up; as a result, commercial and societal survival concerns arose (Ivanov, 2020b). Besides its impact on SC activities, Cardoso et al., (2022) indicates that the COVID-19 pandemic also had significant social challenges (e.g., food insecurity).

As per Zelalem and Abebe (2021), the outbreaks of COVID-19 significantly harmed the enterprise supply chain by 48%. Furthermore, the results of their study statistically demonstrate that the cost of raw materials increased significantly as a result of a shortage in the market (i.e., 59% of the 346 micro and small businesses in southwest Ethiopia experienced a shortage of raw materials as a result of the quarantine measure). Besides, Zou et al., (2020) found that more than half of businesses saw a considerable increase in operational costs. Furthermore, Fortune (2020) report that 94% of it 1000 companies have been affected by coronavirus-driven SC disruptions. Again. according to the Business Continuity Institute (BCI, 2019), more than 56% of firms worldwide experience a SC disruption yearly. Using data from the resilience system, Linton and Vakil (2020) show that the world's largest 1,000 SCs possess more than 12,000 facilities (i.e., factories, warehouses, and other operations) in COVID-19 quarantine regions.

Furthermore, Wilkinson (2020) indicates that due to COVID 19, 11.1 percent of working hours were lost in low-income countries in 2020 as opposed to 2019, which means the pandemic has had a significant effect on businesses' ability to retain employees. According to Zelalem and Abebe (2021), the average number of full-time workers has decreased by 27%. Bloom et al., (2021) conducted survey research on the impacts of COVID-19 on more than 2,500 US firms have found a significant negative sales impact, with an average loss of 29% in sales.

On the other hand, as a result of production pauses, demand and supply of other SCs (e.g., automobile sector and tourism service) had decreased dramatically, raising the question of SC survivability(Harbour, 2020; Ivanov, 2020b). Since the existing state of the art and practical application in each of individual frameworks (i.e., agile, lean, sustainable, resilient, and digital SC)(Ivanov, 2020b) has been tested and those individual SC strategies will not lead to viable SCs, and there has been a lack of a comprehensive view within those individual frameworks as a specific research, a new and larger level of supply chain paradigm is required to solve those survivability questions.

Several studies on SC resilience have been undertaken separately; for instance, IT usage on SC and firm performance (Ambulkar et al., 2015); SC resilience on SC performance (Bevilacqua et al., 2018); SC resilience on organizational performance (Ochieng, 2018); dealing with unpredictable through SC resilience (Scholten et al., 2020). However, these existing studies overlook the effects of SC resilience on SC and marketing performance.

Numerous research on supply chain and organizational performance have also been undertaken in relation to SC sustainability (Abubakar, 2014; Baah and Jin, 2019; Flint et al., 2011; Hamdy et al., 2018; Lopes de Sousa Jabbour et al., 2020; Obrenovic et al., 2020; Wu et al., 2018; Sánchez-Flores et al., 2020).

Furthermore, previous research examine how SCM practices improve environmental sustainability (Jum'a et al., 2021); the relationship between lean green practices, sustainability-oriented innovation, and the triple bottom line (Jum'a et al., 2022). Dias and Silva (2022) also conducted a study on the performance factor on SC sustainability using social capital theory; providing model to ranking supplier in sustainable SC using gross efficiency method (Tabatabaei and Bazrkar, 2019); examine the relationship between sustainable SCM and sustainable competitive advantage (Vafaei et al., 2019). In this regard, of the three pillars of sustainability, the current study considered the social aspects because during the COVID-19 pandemic, a number of organizations reduced their employees due to manufacturing shutdown. Thus, the present study tried to investigate how they treat their employees (socially inclusive practice for employees) and how they treat the community (socially inclusive practice for the community).

Many studies on SC agility have been undertaken in conjunction with lean, adaptability, and alignment, while also separately on supply chain performance (for example, (Ali, 2021; Attia, 2016; Gilaninia et al., 2011; Hasegan, 2013; Konecka, 2010; Whitten et al., 2012; Wilujeng et al., 2022; Zhang et al., 2012). Despite this, no research has been done on the influence of combining the three-supply chain viable antecedents (i.e., SC resilience, SC agility, and SC sustainability) in a single and unified study on SC performance and marketing performance in general around the world, and in Ethiopia in particular.

Furthermore, while the idea of viability is well-known and applied in ecological modeling and biological systems (Béné et al., 2001) as well as cybernetics (Beer, 1981), it is new to supply chain literature and practical study. Furthermore, Queiroz et al., (2020) also show that there are research gaps in understanding pandemic consequences on economic and supply chains. Moreover, existing studies did not empirically cover the interrelationship between supply chain viability and supply chain performance. Besides, the COVID-19 pandemic has presented a set of innovative decision-making scenarios that have not before been examined in resilience theory and largely beyond its scope. When SCs truly collapsed, the question was no longer how to bounce back and recover to some "normal" state, but rather how to adapt and live in drastically altered internal and external environments which led to the concepts of supply chain viability (Ivanov, 2021). As a result, the primary motivation for conducting this research is the absence of empirical research on the topic, and even if there are two or three studies, they have also methodological gaps. For example, (Ivanov, 2020b) used simulation-based analysis to forecast COVID-19's short and long-term effects on global supply networks.

As a result, this study aimed to: 1) investigate the impacts of SC resilience on SC performance of a large manufacturing firm in Ethiopia, 2) evaluate the impacts of SC agility on SC performance, 3) investigate the impacts of SC sustainability on SC performance, 4) investigate the impacts of SC viability on supply chain performance, 5) determine the impacts of SC viability on marketing performance through SC performance.

2. LITERATURE REVIEW

2.1 Theoretical foundation

2.1.1 Supply chain Viability

Supply chain viability is defined as "the ability of a supply chain to sustain itself and survive in a changing environment through structural redesign and performance planning with long-term consequences" (Ivanov and Dolgui, 2020). Furthermore, a "Viable Supply Chain (VSC) is a dynamically adaptive and structurally changeable value network that is able to (i) respond agilely to positive changes, (ii) be resilient to absorb negative events and recover from disruptions, and (iii) survive in times of long-term global disruption by adjusting capacities, workloads, and their mappings to requirements in response to internal and external changes in line with sustainable developments to secure the future" (Ivanov, 2021).

2.1.2 SC resilience

Ivanov (2021) define SC resilience as the ability to maintain, execute and recover (adapt) planned execution along with achievement of the planned (or adapted, but yet still acceptable) performance. Moreover, Hosseini et al., (2019) noted that supply chain resilience is the firm’s capability to withstand, adapt, and recover from disruptions to meet customer demand, ensure target performance, and maintain operations in vulnerable environments. We also generalize some of the definitions of SC resilience as follows:

Definitions	Authors
The ability to return to its original shape after being bent, stretched, or pressed.	Oxford Advanced Learners Dictionary
“The ability to maintain, execute and recover (adapt) planned execution along with achievement of the planned (or adapted, but yet still acceptable) performance”	Dolgui et al., (2018)

"The firm's capability to withstand, adapt, and recover from disruptions in order to meet customer demand, ensure target performance, and maintain operations in vulnerable environments"	Hosseini et al., (2019)
The ability to anticipate and overcome disruptions in the supply chain.	Pettit et al., (2013)
The adaptability of the supply chain to prepare for, respond to, and recover from unexpected events by maintaining operational continuity at the desired level of connectivity and control over structure and function."	Ponomarov, (2012)

2.1.3 Supply chain Agility

Alfalla-Luque et al., (2018) referred to agility as "the ability to respond quickly to short-term changes in demand or supply [and] to manage external disruptions smoothly." Agility is the ability of the organization to adapt quickly to changes in SC (Abeysekara et al., 2019). Wieland and Wallenburg, (2013) defined agility as "the ability of an SC to respond quickly to change by adapting its originally stable configuration." Supply chain agility is the ability of an organization to gain a strategic advantage by responding to uncertainty in the marketplace, and it enables organizations to manage supply chain disruptions smoothly and cost-effectively (Ali, 2021).

2.1.4 Sustainable supply chain

SSC is defined as the management of supply chain operations, resources, information, and financial resources to maximize supply chain profitability while minimizing environmental impacts and maximizing social well-being (Panigrahi et al., 2019). Sustainable supply chain management (SSCM) is a management process that integrates environmental considerations, social performance, and economic contribution (Raut et al., 2015). A sustainable supply chain is the design, coordination, control, and organization of a supply chain to make it truly sustainable, with the minimum expectation of achieving economic profitability while ensuring that the environment and social systems are not harmed over time (Pagell and Shevchenko, 2014). Furthermore, Carter and Rogers (2008), cited in Amad (2017), defined SSC as "the strategic, transparent integration and realization of an organization's social, environmental, and economic goals within the systemic coordination of key interorganizational business processes to improve the long-term economic performance of the individual organization and its supply chains."

2.2 Empirical review and hypothesis development

2.2.1 Relationship between Supply Chain Resilience and supply chain performance

The ability of a company to quickly recover from supply network interruptions by incorporating flexibility and redundancy is known as supply chain resilience (Zsidisin and Wagner, 2010; Blackhurst et al., 2011). Also, supply chain resilience was defined by Ponomarov and Holcomb (2009); Ponomarov (2012) as the supply chain's adaptive ability to prepare for unexpected events, respond to disruptions, and recover from them by maintaining operations at the desired level of connectedness and control over structure and function. SC resilience play a major role to the failure and success of firms (Ambulkar et al., 2015; Hohenstein et al., 2015; Pereira et al., 2014; Soni et al., 2014; Wieland and Wallenburg, 2013) and useful for immediately assessing the impact of hazards on the SC and the levels of recovery that may be achieved during disruptions (Soni et al., 2014). Liu et al., (2018) also examine SC resilience (agility, integration, SC reengineering) has an effect on firm performance and risk management performance. According to Liu et al., (2018) SC resilience (agility, integration, SC re -engineering) has an effect on company performance and risk management performance. Furthermore, according to Liu et al., (2018), a resilient SC can improve a firm's competitive advantage and performance by allowing it to react to disruptive events faster than its competitors, allowing it to gain market share. Ambulkar et al., (2015) verified that SC disruption orientation is not enough for enterprises to achieve resilience; they must also be able to rearrange resources and risk management infrastructure. As a result, the following hypothesis is put to the test:

H1a: SC resilience has positively related with supply chain performance.

2.2.2 Relationship between Supply Chain Agility and Supply Chain Performance

Supply chain agility, according to Gligor and Holcomb (2012) and Ali (2021), can improve both operational and supply chain performance. In turns, supply chain agility can be improved by acquiring skills that allow the supply chain to respond quickly and differently to environmental and competitive changes (Yusuf et al., 2003). In a similar study, Qrunfleh and Tarafdar (2013) concluded that an agile supply chain strategy is linked to improved supply chain performance. Based on the aforesaid, this study predicts a favourable impact on supply chain performance, including delivery, cost, responsiveness, and flexibility and claims that:

H1b: Supply chain agility has positively influences supply chain performance.

2.2.3 Relationship between Supply Chain Sustainability and Supply Chain Performance

Pullman et al., (2009) shows that environmental and social sustainability initiatives have a positive and indirect impact on business performance. Through green supply chain management, a sustainable supply chain has a significant positive impact on a company's performance(Hamdy et al., 2018). According to Das (2017), sustainable supply chain practices boost firm performance, which in turn improves environmental and social performance. As a result, the following hypothesises is proposed:

H1c: A sustainable supply chain of the manufacturing firm is positively influences to supply chain performance.

H1: Viable supply chains of manufacturing firm are positively influences supply chain performance.

H2: Viable supply chains of manufacturing firms are positively influences marketing performance.

2.2.4 Relationship between Supply Chain performance and Marketing Performance

Whitten et al., (2012) indicates managers are charged and accountable for improving the performance of the organizational entity for which they are directly responsible. Organizational managers must, however, adopt an external emphasis in a supply chain environment and assess the influence of organizational strategies on supply chain partners. Attempts to improve organizational performance directly may have a negative influence on entire supply chain performance, reducing the chain's competitive edge (Chopra & Meindl, 2001). Chopra and Meindl (2001) further suggest that supply chain performance is optimized only when all supply chain participants effectively use an interorganizational and inter-functional strategic approach. At the supply chain level, optimization maximizes the supply chain surplus that may be shared by all supply chain participants. Strategies that improve the supply chain's competitive position improve supply chain performance, which has a beneficial impact on each supply chain partner's organizational performance over time. Also, according to Green et al., (2008), supply chain strategies are positively associated with firm marketing performance, which, in turn, positively impacts supply chain performance, which in turn positively impacts organizational performance: thus, the following hypothesis is developed to be tested:

H3: Supply chain performance is positively influences marketing performance.

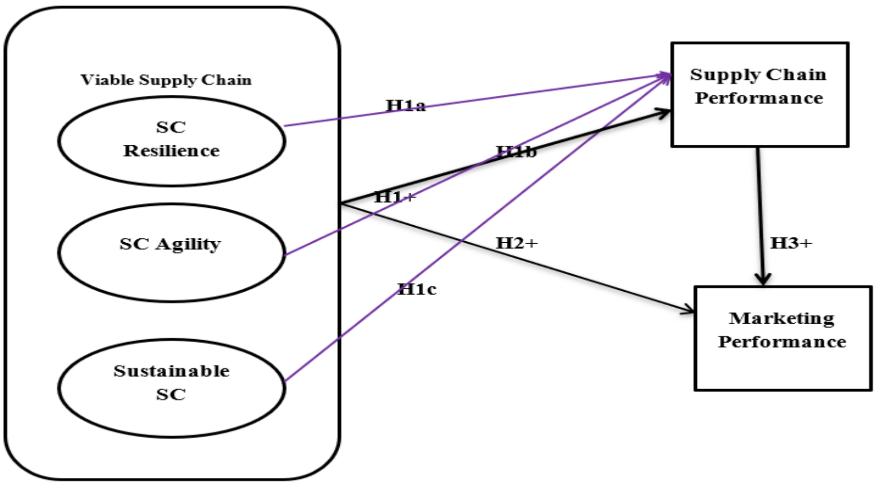

Figure 1 - Conceptual framework of the study (source: authors)

3. METHODOLOGY

Explanatory research design was utilized to investigate the effects of a firm's viable supply chain on supply chain performance and marketing performance in the case of a large manufacturing firm in Ethiopia. We used 5-point Likert scale assessment instruments adapted ranging from (5-strongly agree, 1- strongly disagree) for supply chain viability constructs such as for SC resilience from Ponomarov (2012); SC agility from (Carvalho et al, 2012); Whitten et al, 2012), and instruments for sustainable supply chain from Whitten et al., (2012); Das(2017). We also adapted questionnaires from Tarafdar and Qrunfleh (2017)and Gu et al., (2021) to measure SC performance, as well as Abeysekara et al., (2019) to measure marketing performance.

3.1 Study population and sample selection

In this study, simple random sampling was used to select 10 manufacturing firms from 50 licensed manufacturing firms in Hawassa and 28 licensed manufacturing firms in Adama commercially registered by the Ethiopian Chamber of Commerce, and then stratified sampling was used to reach a homogeneous population due to their different geographical locations. Finally, proportionate allocation was utilized to choose sample representatives from each company, distribute questionnaires, and collect data. As a result, 1168 people were targeted, and 298 people were chosen using Yamane's 1973 sample size determination formula. Fifty (50) out of the total 298 questionnaires were rejected owing to errors, and the study used 248 responses for further data analysis.

$$n = \frac{\mathrm{N}}{1+\mathrm{N}(e)^2}$$

$$n = \frac{1168}{1+1168(0.05)^2} = 298$$

Table 1 - Target Population

Large Manufacturing firms					
No.	**Hawassa**	**N**	**No.**	**Adama**	**N**
1.	Moha soft drink Co.	143	**1.**	Adama Steel Factory	200
2.	Hawassa chip-wood factory	125	**2.**	Nazareth edible oil	79
3.	BGI St. George Co.	170	**3.**	East African industry (tea)	32
4.	ETAB soap factory	135	**4.**	Africa macaroni	82
5.	Tabor Ceramic Factory	105	**5.**	Nazareth Soap PLC.	97
Total		**678**	Total		**490**
Overall total population		**1168**			

Source: Survey (2022).

4. RESULT AND DISCUSSION

4.1 Explanatory Factor Analysis (EFA)

Prior to doing EFA, the authors investigated Kaiser-Meyer-Olkin indices of sample adequacy (KMO). As a result, the KMO statistic was 0.860, demonstrating that the KMO value is greater than 0.6, indicating that the sample adequacy is appropriate for analysing EFA (Taherdoost et al., 2014). As a result, the current study's KMO value is greater than 0.8, indicating that our data is sufficient for EFA. Then, using principal component analysis (a variable reduction approach), we did factor analysis to find the structural relationship between variables and to remove redundancy among variables. Table 2 reveals that each variable was loaded on its own five factors, with 27 items having a factor loading value of larger than 0.704 and above.

Table 2 also shows that the variable's composite reliability and Cronbach alpha were tested. Hair et al., (2011) indicate that both Cronbach alpha and composite reliability should be higher than 0.70. Hence our study results show an acceptable level of reliability. We also test validity of variables on convergent validity using Average Variance Extracted (AVE) and discriminant validity. Convergent validity indicates that the amount of variance captured by the latent variables and that AVE value of the construct should be greater than 0.50 (Hair et al., 2017). As a result, our study support convergent validity.

Table 2 - Explanatory factor analysis, Construct Reliability and Convergent Validity

Constructs	Indicators	Factors loading				
Marketing performance (MP)		1	2	3	4	5
	MP1	0.886				
	MP2	0.874				
	MP3	0.84				
	MP4	0.856				
	MP5	0.877				
Supply Chain Agility (SCA)	SCA1		0.756			
	SCA2		0.797			
	SCA3		0.872			
	SCA4		0.88			
	SCA5		0.85			
Supply Chain performance (SCP)	SCP1			0.78		
	SCP2			0.799		
	SCP3			0.764		
	SCP4			0.875		
	SCP5			0.869		
	SCP6			0.864		
Supply chain Resilience (SCR)	SCR1				0.79	
	SCR2				0.789	
	SCR3				0.704	
	SCR4				0.765	
	SCR5				0.743	
Sustainable supply chain (SSC)	SSC1					0.808
	SSC2					0.842
	SSC3					0.822
	SSC4					0.799
	SSC5					0.748
	SSC6					0.757
Reliability and Convergent Validity	Cronbach α	0.919	0.926	0.964	0.932	0.857
	CR	0.938	0.953	0.977	0.956	0.903
	AVE	0.751	0.871	0.934	0.88	0.702

The current study also examines discriminant validity (DV) to see the constructs are distinct from other constructs. This implies a construct is radically distinctive which are not represented by other (Hair et al., 2017). In doing so, we assessed it using the Fornell-Larker criterion by comparing the square roots of the AVE value that should be greater than its highest correlation with any other variables. Thus, the present study established DV sufficiently as table 3 presents.

Table 3 - Discriminate Validity- using Fornell-Larker Criterion

Constructs	MP	SCA	SCP	SCR	SSC
Marketing Performance	***0.867***				
Supply Chain Agility	0.618	***0.832***			
Supply Chain Performance	0.816	0.628	***0.826***		
Supply Chain Resilience	0.649	0.689	0.595	***0.759***	
Sustainable Supply Chain	0.584	0.438	0.682	0.423	***0.797***

4.2 Hierarchical Regression

In this study, we employed a hierarchical or fixed order regression analysis using partial least structural equation model. In a hierarchical analysis the exogenous latent variables are entered into the path regression equation in a prespecified order when the exogenous variables are highly correlated that leads to multicollinearity issues(Jong, 1999), and typically used to test specific, theory-based hypotheses (Petrocelli, 2003).

4.2.1 Coefficients of Determination (R^2)

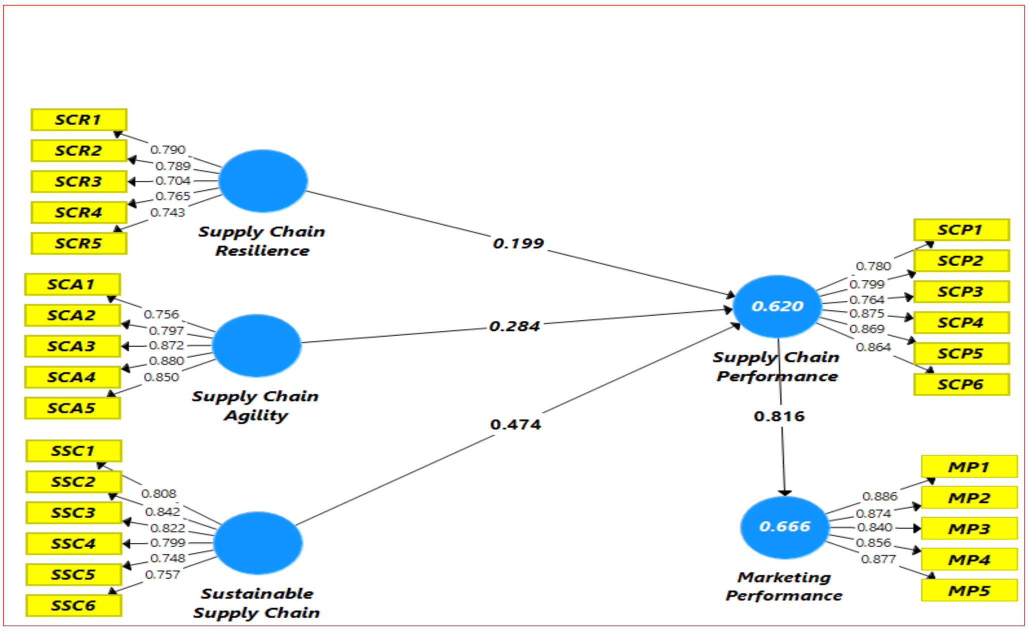

Figure 2 - Coefficient of determination(R^2) output of Supply Chain Performance and Marketing performance

Hair et al., (2017) argue that the coefficient of determination or explanatory power R^2 is the key criterion for structural model estimate in partial least-structural equation modelling. Thus, in this study, the coefficient used to estimate and measure the model's predictive accuracy and to show the exogenous latent variables combined effects such as supply chain resilience, supply chain agility, and sustainable supply chain on the exogenous latent variable naming supply chain performance and marketing performance. In doing so, Hair et al., (2011); (2012); (2017) noted that a rule of thumb as R^2 values for the dependant variables 0.75(substantial) 0.50(moderate), and 0.25(weak). Hence, it is evident from figure 2 shows that the endogenous construct supply chain performance and marketing performance has a moderate predictive accuracy of R^2 =0.62 and 0.666 respectively. It means that the combined effect of SC resilience, SC agility, and sustainable supply chain have an improvement impact of 62% on SC performance and 66.6% on marketing performance.

4.2.2 Predictive Relevance (Q^2)

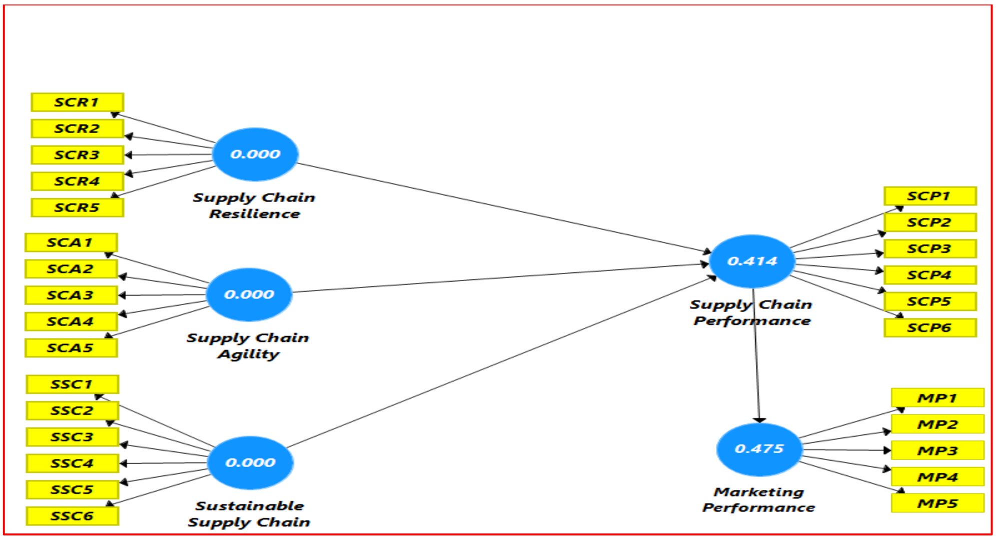

Figure 3. Predictive relevance (Q^2)- output for Supply Chain Performance and Marketing performance

After the assessment of the coefficients of determination, this study examined the predictive relevance (Q^2) using the blindfolding technique as shown in figure 3. To this end, after performing the blindfolding technique at the omission distance case seven, the Q^2 result were stable and different from zero. Finally, it is proved that a medium effect size at 0.414 for supply chain performance and 0.475 for marketing performance is recorded.

4.3 Structural Model (Hypothesis Testing)

To assess the hypotheses developed in the conceptual model, the study used SEM. The analysis of the structural model accepts or rejects the mentioned hypotheses depending on the significance of the relationship between the study's variables using the bootstrapping method to estimate the structural model (Byrne, 2010; Schumacker and Lomax, 2004). Furthermore, to test hypotheses, the t value should be statistically significant (Hair et al., 2017). To be statistically significant, from the structural model, all paths should result in a t-statistics value greater than 1.96(significance level at 5%), 2.57 (1%), and 1.65(10%) significance level. In order to produce t value and β-value, PLS-bootstrapping technique was employed by using 500 bootstrap samples.

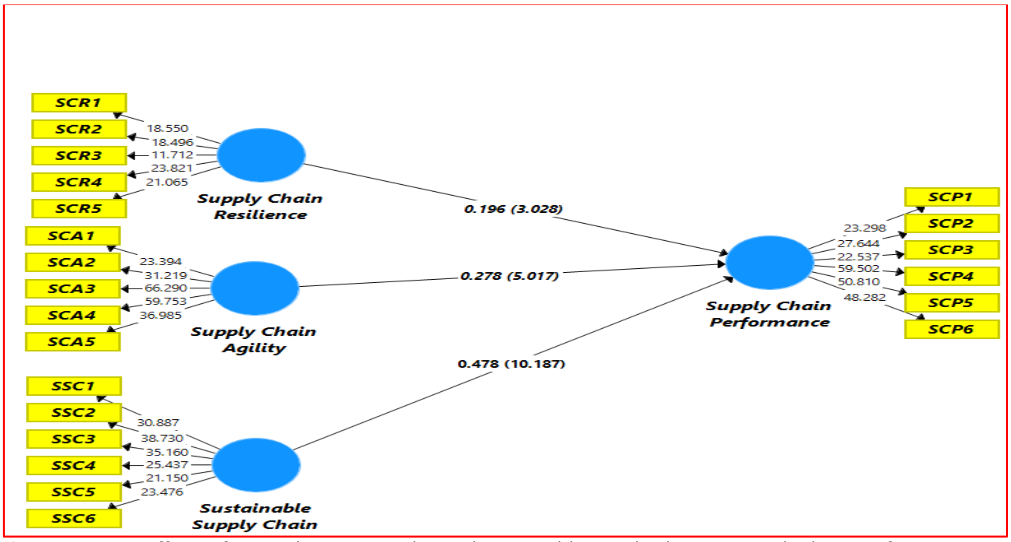

Figure 4 - Direct effects of SC Resilience, SC Agility and Sustainable Supply Chain on Supply chain performance

After performing all the preliminary analysis, this study proceeds for testing the relationship between the study variables. We examined the direct effects of SC resilience, SC agility, and sustainable SC on supply chain performance.

It is found that SC resilience (H1a) has a positive direct effect on supply chain performance as shown in figure 4 and table 3 at path coefficient=0.196 and the critical t-value of 3.028 which is above the threshold value of 1.96. Thus, the study result is consistent with the work of Katsaliaki et al., (2021); Macdonald et al., (2018); Abeysekara et al., (2019) that firms that build SC resilience capabilities can detect, adapt, and continue to respond their business operation in unpredictable events. A report of Accenture (2021) indicates that due to coronavirus 75% of companies have experienced negative or severely negative impacts on their business. Therefore, to overcome this, the redesigned and reconfigured supply chains of the future must be characterized by both resilience and responsiveness. They will help communities to cope with the short-term crisis and enable businesses to adapt to their customers and help the economy recover. Therefore, a continuous cycle of risk mobilization, identification, analyse what-if scenarios, design and operation will help optimize outcomes and mitigate risks. Once again Ivanov and Dolgui (2020) found similar result in which supply chain resilience enables the system to explicitly perform some recovery/adjustment in order to restore disrupted operations and performance.

Moreover, as shown in the path diagram SC agility (H2a) has a positive direct effect on SC performance at $path\ coffiecent = 0.278\ and\ t - value\ of\ 5.017$. The study's findings are consistent with the findings of Kumar and Anbanandam (2019) that supply chain agility helps organizations respond quickly to catastrophic conditions due to unexpected disruptions. It is also consistent with Ali (2021) findings that successful implementation of agility can improve a company's supply chain performance, help them remain competitive and gain market share over their competitors.

Moreover, we also argue that in case of black swans' event that led to a strong imbalance between supply and demand, response should be to ensure that products and services are available to those who need them most. Data-driven decisions can support an effective response, but require insight into demand, inventory, capacity, supply, and finances across the ecosystem. To achieve this, SC planner should (1) creating supply maps of available inventory, supply options, and capacity availability across the network. (2) evaluate SC scenarios that should run simulations to predict when and where surpluses and shortages are likely to occur and (3) simulate strategic positioning and movement of existing, in-transit, and ordered inventory to meet forecasted demand.

Lastly, as path diagram in figure 4 depicts, sustainable supply chain (H3a) also has a positive effect on SC performance at path coefficient =0.478 and t-value of 10.187. The study's result is also supported by the work of Das (2017) that firms actively engaged in social and environmental responsibility would improve their market share over their close competitors. Prior studies have demonstrated the importance of social, environmental, and economic factors in creating sustainable supply chains (Haroon et al., 2021).This can be done by making sure that its suppliers' employees have reasonable working conditions, that the goods or services they acquire are environmentally sustainable, where possible, and that socioeconomic issues, such inequality and poverty, are addressed (Caldera et al., 2022).

Table 4 - Direct effect result

Hypothesis	Constructs	O	M	SD	T-value	P-value	Decision
H2a	SC Agility -> SC Performance	*0.278*	*0.276*	*0.055*	*5.017*	*0*	*supported*
H1a	SC Resilience -> SC Performance	*0.196*	*0.197*	*0.065*	*3.028*	*0.003*	*supported*
H3a	Sustainable SC-> SC Performance	*0.478*	*0.483*	*0.047*	*10.187*	*0*	*supported*

Note: O-original sample, M-sample mean, SD- standard deviation

4.3.1 Mediation analysis

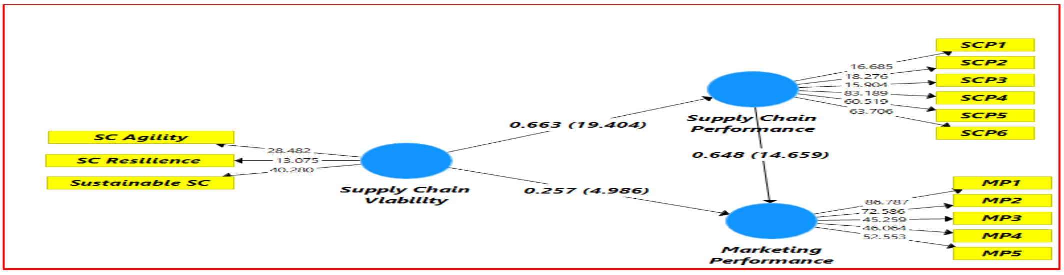

Figure 5 - Mediating relationship between supply chain viability, SC performance, and marketing performance.

As per the call for work of Hofmann and Langner (2020); Ivanov (2020b), the concept of resilience, sustainability, and digitalization individually will not lead to viable supply chains, but rather an integrated dynamic framework is required to be developed. After the examination of the direct effect relationship, this study combined SC resilience, SC agility, and sustainable supply chain to form supply chain viability as per the model developed by Ivanov (2020b); Ivanov and Dolgui (2020) as one research hypotheses. Then, the study assessed the mediating roles of supply chain performance in between supply chain viability and marketing performance. The mediation effect is examined as per the procedures of (Hair et al., 2017; Preacher & Hayes, 2008).

Based on the instruction, we include the mediator variable in the partial least structural-model to assess the levels of significance of the indirect effect. In doing so, the indirect effect is significant then our next estimation is computed the variance account for (VAF) to see whether it is full mediation (VAF>80%), partially mediate ($20\% \leq VAF \leq 80\%$), and no mediation if VAF is less than 20% (Hair et al., 2017).

The variance accounted for (VAF) determines the size of the indirect effect in relation to the total effect (i.e., direct effect+ indirect effect) which mean:

$$VAF = \frac{path\ coefficent\ \ value\ from\ SC\ viability\ to\ SC\ performance * path\ coefficent\ value\ from\ SC\ performance\ to\ marketing\ performance}{(path\ coefficent\ value\ from\ SC\ viability\ to\ SC\ performance * path\ coefficent\ value\ from\ SC\ performance\ to\ marketing\ performance) + (path\ coefficent\ from\ SC\ viability\ to\ marketing\ performance)}$$

$$= \frac{0.663 * 0.648}{(0.663 * 0.648) + (0.257)} \times 100\% = \mathbf{63\%}\ \boldsymbol{which\ is\ partial\ mediation}$$

Table 5 - PLS-SEM Bootstrap output for Mediation Analysis

Direct effect before the inclusion of Mediator construct (SCP) in PLS Model						Confidence interval	
Path	O	M	SD	T-Statistics	P-value	2.50%LI*	97.50%UI*
Supply Chain Viability -> Marketing Performance	0.687	0.689	0.039	17.586	0	**0.25**	**0.58**
Total Effect after the Inclusion of Mediator (SCP) in the PLS Model						**Confidence interval**	
Path	O	M	SD	T-Statistics	P-value	2.50%LI*	97.50%UI*
Supply Chain Performance -> Marketing Performance	0.648	0.646	0.044	14.659	0	0.56	0.725
Supply Chain Viability -> Marketing Performance	0.257	0.26	0.052	4.986	0	0.16	0.359
Supply Chain Viability -> Supply Chain Performance	0.663	0.667	0.034	19.404	0	0.598	0.733
Specific indirect effect						**Confidence interval**	
Path	O	M	SD	T-Statistics	P - value	2.50%LI*	97.50%UI*
Supply Chain Viability -> Supply Chain Performance -> Marketing Performance	0.429	0.43	0.029	14.911	0	0.2	0.43

***LI-lower confidence interval, UI*-Upper interval**

Based on the methodologies recommended by Hair et al., (2017); Preacher and Hayes, (2008) the direct effect of SC viability on marketing performance was investigated without the addition of mediating variable (i.e., SC performance) . As a result, the direct effect in table 5 shows that SC viability has a positive effect on marketing performance with the path coefficient of 0.687, t-value=17.586, and p=0.000. Previous works also indicates resilience, sustainability, and digitalization as being individually will not lead to viable supply chains instead an integrated dynamic framework (Hofmann and Langner, 2020), will lead to viable SC which in turns improve marketing performance (Ali, 2021; Carvalho et al., 2014; Pavlov et al., 2019; Pettit et al., 2013; Queiroz et al., 2020; Whitten et al., 2012).

The next task for this study was to include SCP as a mediating variable in a PLS model to test whether SC performance will play a mediating role between SC viability (SCV) and marketing performance to estimate the magnitude of the indirect effect and determine the size of the indirect effect in relation to the total effect using the computation of variance accounted for (VAF). In this regard, the findings reveal that SC performance acts as a mediator between SC viability and marketing performance. Specifically, as figure 5 shown that the path coefficient of SCV-SC performance is 0.663 and t=19.404, SC performance-marketing performance is 0.648, t=14.659 and SCV-marketing performance =0.257, t=4.986 was measured and significant. Hofmann and Langner (2020); Ivanov and Dolgui (2020) revealed similar results in which a SC can maintain and recover in the presence of long-term disturbances. To measure the levels of mediation, the computation for VAF is 63%. The VAF is larger than 20% but smaller than 80%. This situation can be characterized as *partial mediation.*

5. CONCLUSION, IMPLICATIONS, AND FUTURE RESEARCH DIRECTIONS

This study investigated the antecedents of SC viability that have a significant impact on firms' SC performance and marketing performance. Following that, the study attempted to develop an integrated dynamic framework recommended by a call for further research (Hofmann and Langner, 2020; Ivanov and Dolgui, 2020) by borrowing elements from SCM literature, biological and ecological literature, and cybernetics viability models that are widely used. The study developed a conceptual model that examined the relationships between SC viability as a multidimensional construct by conceptualizing the effects of SC resilience, SC agility, and sustainable SC with endogenous variable SC performance and marketing performance. Secondly, we also illustrate the concepts of supply chain viability using structural equation modelling inspired by biological systems. Besides, the mediating effect of SC viability and marketing performance was investigated.

The study has examined the direct effect of SC resilience on the SC performance of manufacturing firms. As a result, it was found that SC resilience has a positive effect on SC performance at a path coefficient of 0.196 and a t-value of 3.028. Moreover, the study tested the direct effect of SC agility on SC performance. Thus, the result of PLS-path analysis shows that SC agility has a positive effect on SC performance (path coefficient = 0.278). Besides, we investigated the direct effect of sustainable SC on SC performance. It was also found that sustainable SC has a strong positive effect on SC performance with a path coefficient of 0.478 and a t-value of 10.87. Finally, the study confirmed that SC performance has a significant partial mediating role between marketing performance and SC viability.

The study has many implications for academicians and SC managers in manufacturing companies. Firstly, the study presents a practical and holistic model by adopting the concepts of viability from the ecological, biological, and cybernetics systems to the concepts of SCM that shows the relationship between SC viability and both SC performance and marketing performance. It also contributes to existing literature by showing new empirical evidence of a strong relationship between SC viability and SC performance and marketing performance.

Secondly, the study suggests that manufacturing companies should works hard to improve end-to-end supply chain visibility and close the gaps between physical and digital information by re-globalizing their supply chains and constructing robust supply chains. Accelerating supply chain digitalization by capturing real-time data is also required in this fragile business environment to mitigate current supply chain disruptions.

Our study also believes that there needs to be a move away from the traditional supply chain risk management assessment method, which focuses on risks and uncertainties based on assumptions, because this strategy focuses on what might happen rather than what will happen.

Furthermore, typical risk assessment methodologies are insufficient, particularly for black swan catastrophes, which can have high and severe consequences and weaken the entire supply chain's operations and performance.

Thus, manufacturing firms should use anticipatory methods such as anticipatory failure determination (AFD) and red teaming to prepare for 'unknown unknown' events. Anticipatory failure methods give emphasis on how a failure occurs rather than how that failure happened(Jessica & Alejandro, 2021); gives proactive insights into future unexpected events with a description of situations that would enable them to occur. Further, the second approach recommended by our finding for firms is a red teaming approach, which help firms identify and overcome risks by considering alternative interpretations and looking outside the box (Jessica & Alejandro, 2021). Thus, manufacturing firms have been working in an unstable environment due to the ongoing pandemic and deadly conflict in the northern parts of the country as well as economic sanctions imposed by the US and the termination of the African Growth and Opportunity Act (AGOA), which put significant marketing and supply chain pressures on the country's manufacturing sector and jeopardized firms' performance. Furthermore, by focusing on methodical thinking about inconceivable occurrences, this study proposes that manufacturing organizations consider alternative marketing to export products, as well as full scenario planning and analysis using AFD(Heijden, 2005).

Moreover, raising inclusive questions and forcing themselves to think about the future and stimulating solutions through deep and meaningful dialogue to overcome supply disruption in anticipation and tackle unexpected events and reach strategic decision making is also required to maintain performance. The governments bodies should offer both reactive and proactive solutions to maintain firm supply chain viability in the face of major disruptions such as the repeating and ongoing COVID-19 epidemic and to mitigate the consequences of Ethiopia's termination from AGOA export duty-free marketing.

Lastly, the study has several limitations. First, the study does not incorporate all manufacturing firms in Ethiopia because of the extensive war in the northern majority parts of the country. It also only focused on large manufacturing firms, which don't include medium- and small-scale manufacturing firms. Thus, using this small sample size, the generalization of the results to a larger context may be a challenge, which can be overcome by future studies through the application of wide-ranging coverage of studies. Secondly, the current study focused only on one dimension of sustainability (i.e., the social aspect), and to maintain and survive in the long run, being only resilient, agile, and sustainable will not be sufficient in the survivable business world. Thus, future research should focus on and contribute to research output that focuses on society and the environment, which in turn helps manufacturing firms focus on the planet and society. Besides, this study focused only on three antecedents of supply chain viability; hence, it is better that future studies cover other dimensions of SC viability, such as stability and robustness.

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