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Inbound, Outbound Disturbances and Supply Chain Vulnerability of Firms Operating in Post-conflict Zones: The Case of Somalia

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Abstract. Supply chain management is a determinant of success in today's globalized business. This has created a greater risk that can ultimately lead to deviations in the supply chain. The purpose of this study was to investigate both the inbound and outbound quantitative and qualitative disruptions that lead to supply chain vulnerability in Somalia. Vulnerability assessment is the best tool that can help practitioners proactively deal with such risks and avoid disturbances in the supply chain. This study employs a cross-sectional research design to test the hypotheses generated in the previous sections. A quantitative method was used to collect and analyze the data for this study. The population of this study comprises the business managers and logistics departments of small and medium-sized firms in Somalia. The proportional method was used to calculate the sample size. Inferential statistics using least squares regression were utilized to analyze the data collected from the study respondents. Partial least squares were used to calculate the model parameters and to test the hypothesis. The study found that inbound quantitative disturbances have a significant impact on supply chain vulnerability in the context of Somalia; in contrast, inbound qualitative disturbances have no significant relationship with supply chain vulnerability. This study found that the supply chain of the manufacturing industry in Somalia is more vulnerable than that of the merchandise industry. The findings of this study imply that managers should consider upstream activities to promote performance at the interface with current and potential customers, based on the fact that consumers are more demanding than suppliers. The findings of this study present scientific data on the inbound and outbound quantitative and qualitative disruptions that lead to supply chain vulnerability in Somalia, which are especially important to practitioners to understand how to mitigate such disturbances, and academicians to find this study to be of practical use, given there has been very little research done on the topic in the context of Somalia.

Keywords: Supply chain vulnerability, supply chain management, disturbances

1. Introduction

The COVID-19 pandemic has brutally demonstrated the importance of restructuring business models, behaviors, and supply chain management (Belhadi et al., 2021). As the pandemic crisis has progressed, several institutions have briefed the appropriate authorities on the course of the pandemic scenario in an effort to lessen the severity of its effects (Liu et al. 2022). In 2020, the scarcity of the supply of money items was a frequent topic of concern in the media, policy debates, and everyday discourse. The demand structure shifted significantly, and the supply side witnessed shuttered industries, barred storefronts, and empty shop shelves. The pandemic's consequences were immediately obvious in the food supply chain as the variety of available foodstuffs changed (Deaton and Deaton, 2020). Early in the epidemic, shortages of some items frightened consumers and prompted them to purchase more than they needed (Centobelli and Cerchione, 2020).

Supply chain management is a complex business function in today's globalized marketplace. Local firms in developing markets usually suffer from the countless challenges of this globalized marketplace (Ali and Shamsuddoha 2007). The flow of materials and information is critical in ensuring that consumers receive genuine but not counterfeit products in the right place and at the right price. Large sums of money may be lost due to mistakes and inconsistencies (Čerkauskienė and Meidutė-Kavaliauskienė 2023). Therefore, the approaches, strategies, and processes of managing the global supply chain are regarded as indicators of business success.

Firms usually seek supply chain performance gains through integrated global sourcing strategies It is necessary to foresee the risks as well as assess the supply opportunities alike (Mayo 2009). Firms seek an economy of scale and competitive advantage in their inbound logistics; therefore, the adoption of a single-sourcing strategy is common. However, this approach will negatively impact supply, and the occurrence of disruptions may increase (Wagner and Bode 2006). The study of associated risks in the supply of materials and its assessment has assumed significance among scholars and practitioners (Zsidisin and Wagner 2010). Studies reveal that the supply chain is vulnerable due to the low implementation of risk assessment techniques and instruments. Globalization is also considered a major contributor to the development of risks that increase the supply chain's vulnerability (Thun and Hoenig 2011).

Although it is impractical to prevent and manage all possible risks, firms strive for secure, less vulnerable, and more resilient supply chains. It has significantly affected their strategies, whereby a fair amount of concern is given to risks and their relevant assessments (Liu, Daniels, and Hofman 2013). To mitigate supply chain disturbances, a better understanding of the potential vulnerability and its impact on the supply chain is needed. This will facilitate the development of concrete strategies and plans that ensure the provision of quality services to consumers (Oke and Gopalakrishnan 2009). There is a need to protect supply chains from various types of disruptions to make them less vulnerable (Peck 2005).

The vulnerability of the supply chain in today's global marketplace is caused by the reduced life cycle of products and the volatility and unpredictability of the market. Although it is quite complex to safely overcome the risks associated with supply chain disturbance, some firms seek to overcome these challenges more effectively than others (Briano, Caballini, and Revetria 2009). Despite the fact that scholars are studying supply chain vulnerability in general, few have empirically examined its effects in post-conflict countries such as Somalia. Firms operating in war-torn countries suffer from the effects of supply chain disturbances and disruptions. Moreover, the literature on the supply chain has largely disregarded black swan events such as the COVID-19 pandemic. The COVID-19 shocks disrupted demand structures more than supply structures and even impacted financial institutions. In contrast to past interruptions, the COVID-19 epidemic struck without warning or prior experience and took the entire world by surprise (Moritz, 2020).

The study investigates the inbound and outbound quantitative and qualitative disruptions that lead to supply chain vulnerability in Somalia. The findings of this study present scientific data on the inbound and outbound quantitative and qualitative disruptions that lead to supply chain vulnerability in Somalia. These findings are particularly important to practitioners who wish to understand how to mitigate such disturbances and to academicians who wish to find this study to be of practical use given the limited amount of research that has been done on the topic in the context of Somalia. The rest of this paper is structured as follows: the first section reviews the related literature, the third section presents the research methods, the fourth section presents the results and the discussion, and the final section provides the conclusion and recommendations.

2. Review of the Literature

Several previous studies have examined the vulnerability of supply chain management, and there is a large amount of empirical literature in this field. Such studies include Christopher and Peck (2004), who argue that vulnerability is an experience of a variety of supply disturbances. Bode and Wagner (2015) present supply chain vulnerability as those characteristics of the chain that cause disturbances, leading to firm deficits. Jüttner, Peck, and Christopher (2003) suggest that the vulnerability of the supply chain relates to the partiality of sources and drivers of risk that cause adverse consequences in the supply chain.

Vulnerability in the SC of a given firm is caused by several factors, including natural and manmade crises. For instance, Blaikie et al. (2004) stated that vulnerability requires the competence to foresee, deal with, defy and recover from the hazard. In the context of a strategic supply chain, disturbances occur when there is a mismatch between a firm's projections and actual demand. Moreover, the poor coordination of the supply chain results in disruptions in both inbound and outbound logistics. In this context, the forecast quality affecting demand will influence inbound logistics by creating an amplification of demand volatility(Christopher and Lee 2004).

Factors that contribute to supply chain disruptions are usually categorized into either internal or external factors. Many scholars have proposed this classification of these disruptions (Chopra and Sodhi 2004, Christopher and Lee 2004, Hallikas and Virolainen 2004, Wagner and Bode 2006, Nowakowski, Werbińska-Wojciechowska, and Chlebus 2015). Disruptions in the supply chain are categorized differently by different scholars; for instance, Svensson (2000) classifies supply chain disturbances as qualitative (i.e., lack of product/service reliability, quality or precision) and quantitative (i.e., deviations that will result in stock-outs or back-orders). However,Vakharia and Yenipazarli (2009) categorize disturbances as being caused by either act of nature (e.g., flooding, earthquakes, and hurricanes) or by humans (e.g., political instability, terrorism, and quality problems).

Supply chain management in today's marketplace is more complex than ever. This complexity is driven by many factors, such as outsourcing, supplier relations, supply chain networks, technology, regulations, globalization, customer expectations, and product life cycle (Fazli and Masoumi 2012). The vulnerability of the supply chain can be measured differently by looking at the economy, industry, supply networks, or management approaches (Wagner and Neshat 2010). For this study, we will examine the impacts of upstream and downstream disturbances on supply chain vulnerability.

3. Hypothesis Development

Supply chain management (SCM) is the overall theoretical foundation of this study. SCM highlights the interdependencies between firms 'activities. It is based on the systems and processes that consider the functional and time dependencies between a firm's overall pursuits (Svensson 2002). Pratyameteetham and Atthirawong (2017)argue that the supply chain is managing firms 'upstream and downstream business

functions, while considerable attention is given to the relationship between suppliers and consumers. According to Bunnoiko and Atthirawong (2017), properly managed supply chain activities will create value-added connections between suppliers and consumers.

This study considers the importance of creating a collaboration and integration platform whereby different business functions are related and fostered via strategic collaborations to facilitate smooth supply chain processes (Henseler 2015, Allred and Ross-Davis 2011, Hilman and Mohamed 2011, Pratyameteetham and Atthirawong 2017, Bunnoiko and Atthirawong 2017, Ali and Shamsuddoha 2007, Wagner and Bode 2006). The vulnerability variable of this study is examined with quantitative and qualitative inbound disturbances, quantitative and qualitative outbound disturbances, and type of industry constructs (see Figure 1). The study examines how these constructs influence supply chain vulnerability. The vulnerability construct of our study is examined under qualitative disturbances and quantitative disruptions in inbound and outbound logistics. Thun and Hoenig (2011)argue that vulnerability in both inbound and outbound logistics is affected by the occurrence of supply chain disruptions.

The construct of inbound and outbound disturbances of this study is derived from the vulnerability model developed by (Svensson 2000). Inbound quantitative disturbances refer to quantifiable deviations of components and materials from suppliers, while qualitative disturbances are related to the eminences of these components and materials. Likewise, outbound disturbances are categorized into quantitative and qualitative disruptions that occur during the delivery of components and materials to consumers.

Thun and Hoenig (2011)classify the inbound and outbound vulnerability into qualitative deviations and quantitative disturbances. Quantitative deviations are believed to occur when there are events that lead to stockouts, for instance, breakdowns or delays in the flow of material caused by unforeseen conditions. Therefore, the following hypothesis is proposed:

H1: Inbound quantitative disturbances negatively influence supply chain vulnerability across Somalia.

H2**:** Outbound quantitative disturbances negatively influence supply chain vulnerability across Somalia.

Qualitative disturbances occur when there are deficiencies in components and materials, such as color, size, and malfunction. Vakharia and Yenipazarli (2009), argue that the supply chain is an evolutionary cycle where the goal is to create a chain that can deliver high-quality and customized offerings to satisfy the demands of consumers. Consequently, disruptions in quality are a primary concern. Hence, the following hypotheses are proposed:

H3: Inbound qualitative disturbances negatively influence supply chain vulnerability across Somalia.

H4: Outbound qualitative disturbances negatively and positively influence supply chain vulnerability across Somalia.

Bode and Wagner (2015), argue that supply chain disruptions are unforeseen events that occur in inbound logistics that can impact the normal course of business, such as defaults, problems of quality, and delivery outages. Uncertainty in the upstream supply will significantly influence the downstream supply chain, as illustrated by many scholars. For instance, Svensson (2000), argues that deviations in the inbound logistics flow will consequently influence firms 'outbound logistics; therefore, upstream and downstream activities of the supply chain should be coordinated to avoid and reduce vulnerabilities. Hence, the following hypotheses are proposed:

H5: Inbound quantitative disturbances positively influence outbound quantitative disturbance across Somalia.

H6: Inbound qualitative disturbances positively influence outbound qualitative disturbances across Somalia.

The manufacturing industry usually faces several challenges on different fronts(Hilman and Mohamed 2011). Oke and Gopalakrishnan (2009), argue that 20 percent of disturbances are generally caused by the manufacturing process and sometimes could reach as high as 50 percent. The firm's success in the preventive activities of the manufacturing process will depend on its ability to deal with unexpected changes in the inbound and outbound logistics flow (Bode and Wagner 2015). Therefore, the construct of the industry type is examined, looking at its influence on supply chain vulnerability. Hence, the following hypothesis is proposed:

H7: Industry type negatively influences outbound qualitative disturbances across Somalia.

4. Research Methodology

This study employs a cross-sectional research design to test the hypotheses generated in the previous sections. A quantitative method was used to collect and analyze the data of this study. The population of this study comprises the business managers and logistic departments of small and medium-sized firms in Somalia. The proportional method was used to calculate the sample size. A confidence interval of 95% and an error term of 5% were used to obtain the sample size.

To evaluate the reliability scale of the questionnaire, a pilot test was carried out. This study used 138 sample subjects who were business managers and heads of logistics departments. A purposive sampling technique was used to reach the respondents of this study. This study used a structured questionnaire to collect the data. A Likert scale was used to construct the questionnaire. Inferential statistics using least square regression was utilized to analyze the data collected from the study respondents. Partial least squares are used to calculate the model parameters and to test the hypothesis. Discriminant validity and convergent validity were evaluated to test the measurement model.

5. Results and the Discussion

This study targeted 138 business managers and the heads of logistics of small and medium-sized enterprises. After the questionnaire was returned, data were cleaned from the missing data and outliers, and we found a response rate of more than 90 percent. The reliability and validity of the variables are examined through discriminant validity and convergent validity. The results are presented in Table 1:

Table 1: Convergent Validity of the Constructs

Construct	Items	Loadings	AVE	CR	Cronbach's Alpha
IQM	ITEM1	0.9410	0.4450	0.6819	0.8909
IQLM	ITEM5	0.9184	0.6700	0.8550	0.8682
OQM	ITEM8	0.8666	0.6424	0.8996	0.7608
OQLM	ITEM15	0.9273	0.8205	0.9013	0.7972
SCV	ITEM17	0.8640	0.6947	0.9006	0.8649

Source: Authors'Calculation

This study found that the AVE was above 0.5 and the value of CR was more than 0.7, while

the item loadings were higher than 0.6, as shown in Table 1. These results illustrate that all criteria met the recommended threshold values. This study employed theheterotrait-monotrait ratio of correlations (multitrait-multimethod matrix). We first assessed whether theheterotrait-monotrait ratio value was greater than the HTMT value of 0.90 or the HTMT value of 0.85 (Wagner and Neshat 2010). All HTMT values passed the HTMT 0.90 and HTMT 0.85 threshold values, as shown in Table 2, establishing the discriminant validity of this study.

Table 2: Heterotrait-Monotrait (HTMT) of Constructs

Construct	IQM	IQLM	OQM	OQLM	SCV
IQM					
IQLM	0.5082				
OQM	0.4110	0.3517			
OQLM	0.3429	0.0497	0.1547		
SCV	0.5980	0.2787	0.2720	0.6893	
Q1	0.0109	0.0308	0.0873	0.0434	0.1148

Source: Authors'Calculation

5.1. Factor analysis of the variables

This study utilized factor analysis to examine the latent factors related to the observed variables. The confirmatory method and an R factor analysis were used. This implies that the degree to which the data conformed to the predicted underlying structure was established and that a correlation matrix of the variables was utilized to summarize the obtained data's properties. A component model was utilized to summarize the variables' original variance in the fewest possible elements.

The factors were extracted using an orthogonal solution, which preserved the factor axes at right angles to one another. Varimax's orthogonal technique was utilized to rotate the initial factor solution, to reduce the factor matrix's columns. Additionally, the orthogonal rotation approach was used, as it eliminates factor collinearity.

Table 3: Factor Analysis of the Variables

	Factors					
Items	1	2	3	4	5	Communality per variable
IQM1	.188	.082	.524	-.461	.001	.529
IQM2	.334	.504	.431	.011	-.222	.601
IQM3	.158	.575	.421	-.413	.036	.704
IQM4	.041	.310	.412	-.432	.004	.454
IQL1	-.508	-.319	.529	.222	-.484	.923

IQL2	-.575	-.324	.482	.188	-.494	.947
IQL3	-.586	-.080	.516	.186	.496	.896
IQL4	-.595	-.079	.520	.166	.463	.872
OQM1	.027	.393	.017	.445	.157	.378
OQM2	.305	.667	-.004	.315	-.256	.703
OQM3	.398	.736	.153	.286	.001	.805
OQM4	.310	.602	.176	.268	.105	.573
OQL1	.778	-.467	.229	.149	-.001	.898
OQL2	.801	-.408	.192	-.055	-.019	.849
OQL3	.759	-.473	.245	.143	.082	.887
OQL4	.719	-.519	.278	.152	.138	.905
Total EV	25.92	20.55	13.35	7.728	6.980	
CEV	25.92	46.47	59.82	67.54	74.52	

Source: Authors'Calculation

Significance factors were defined as those with eigenvalues larger than one. These factors were chosen and incorporated into the final factor solutions. Approximately 74.5 percent of the overall variation was accounted for by factor solutions. Communalities for the variables ranged between 0.378 and 0.947. In the tables, factor loadings greater than 0.3 were considered significant (Hair et al., 1992, p. 239). A factor analysis was used to validate the pre-specified dimensions of the phase one incoming vulnerability items (see Table 3). The component analysis of the inbound and outbound questionnaire questions on dyadic vulnerability revealed good results (KMO:.681; Bartlett's Test: Approx. Chi-Square: 1417.721: df 78: Sig: 0.000). The factor analyses consisted of the variables IQM1, IQM2, IQM3, and IQM4, which represent inbound quantitative disturbances, while IQL1, OQM2, IQL3, and IQL4represent standard inbound quantitative disturbances. OQM1, OQM2, OQM3, and OQM4 show outbound quantitativedisturbances, while OQL1, IQL2, OQL3, and OQL4 represent outbound disturbances.

5.2. The structural model of the study

This study utilized a partial least square (PLS) regression model. PLS is an extension of the classical multiple linear regression model. According toHair Jr and Lukas (2014), R-squared, predictive relevance (Q2), t values via a bootstrapping procedure with resampling of 999, the effect size (f2), and standard beta have to be examined to evaluate the structural model. All of these matrices and parameters have been assessed as illustrated in Table 3.

The study found that inbound quantitative disturbances have a significant impact on supply chain vulnerability (β = -0.3939, p <0.0000, f2 = 0.2103). Therefore, H1 is supported. Moreover, outbound quantitative disturbances have a significant impact on supply chain vulnerability (β = -0.1514, p <0.0000, f2 = 0.0528). Hence, H3 is supported. Similarly, the results of this study revealed a significant relationship between inbound quantitative disturbances and outbound quantitative disturbances (β = 0.3132, p <0.0012, f2 = 0.0879). Thus, H5 is also supported. The

findings of this study show that the type of construct of a firm has a significant impact on supply chain disturbances (β = 0.1180, p <0.0488, f2 = 0.0346). Therefore, H7 is also supported.

The findings revealed that inbound qualitative disturbances have no significant relationship with supply chain vulnerability (β = -0.0942, p <0.1869, f2 = 0.0226); thus, H2 is not supported. Likewise, outbound qualitative disturbances have no significant impact on supply chain vulnerability (β = -0.5253, p <0.0000, f2 = 0.5508); hence, H4 is not supported. Likewise, our results indicate that inbound qualitative disturbances have no significant relationship with outbound qualitative disturbances (β = 0.0338, p>0.3795, f2 = 0.0023); therefore, H6 is not supported.

Table 4: Structural Model of the Constructs

Hs	Path Relations	Coefficients	STD	t value	P value
H1	IQM -> SCV	-0.3939	0.0950	-4.1300	0.0000
H2	IQLM -> SCV	-0.0942	0.0923	-0.8899	0.1869
H3	OQM -> SCV	-0.1514	0.0798	-2.0041	0.0227
H4	OQLM -> SCV	0.5253	0.0845	6.1271	0.0000
H5	IQM -> OQM	0.3132	0.0931	3.0528	0.0012
H6	IQLM -> OQLM	0.0338	0.1548	0.3070	0.3795
H7	Q1 -> SCV	0.1180	0.0718	1.6579	0.0488

Source: Authors'Calculation

Note: (1) IQM =Inbound quantitative measures; IQLM= Inbound qualitative measures; OQM= outbound quantitative measures; OQLM= outbound qualitative measures; SVC= Supply Chain Vulnerability; Q1= Type of industry.

The value of the R-squared indicates 0.6023, as shown in Table 3, which indicates that all 7 predictors together can explain 60% of the variance in supply chain vulnerability. The multicollinearity of the variables was evaluated using the variance inflation factor (VIF). As illustrated in Table 3, all of the constructs have VIF values less than 5.00. The blindfolding procedure was adopted to measure the models 'predictive relevance. The results, as shown in Table 3, reveal that the model developed in this study has predictive relevance. Inbound quantitative disturbances have a negative significant impact on supply chain vulnerability (β = -0.3939, p < 0.0000, f^2 = 0.2103). Therefore, H1 is supported.

Hence, this study reveals that the existence of inbound quantitative disturbances leads to supply chain vulnerability. Hence, inbound quantitative disturbances should be eliminated.

Outbound quantitative disturbances have a significant impact on supply chain vulnerability as per these values (β = -0.1514, p < 0.0000, f2 = 0.0528). Hence, H3 is supported. Our study found that those outbound disruptions will subsequently lead to a vulnerable supply chain across Somalia. There is a significant relationship between inbound quantitative disturbances and outbound quantitative disturbances (β = 0.3132, p < 0.0012, f2 = 0.0879). Thus, H5 is also supported. Our study found that quantitative deviations in inbound logistics will have a quantitative impact on

outbound logistics.

The findings of this study show that the nature of a firm's business has a significant relationship with the vulnerability of supply chains ($\beta = 0.1180$, $p < 0.0488$, $f2 = 0.0346$). Therefore, H7 is also supported. Our study found that the supply chain of the manufacturing industry in Somalia is more vulnerable than that of the merchandise industry. Somali policymakers should develop legal frameworks to strengthen and support the sector's investment opportunities and the removal of trade barriers. Somali practitioners should rethink their inventory practices so that they can manage their operations and their relationships with customers.

This study did not find any impact of inbound qualitative disturbances on supply chain vulnerability ($\beta = -0.0942$, $p < 0.1869$, $f2 = 0.0226$); thus, H2 was not supported. Our study found that in the context of Somalia, inbound qualitative disturbances have no influence on supply chain vulnerability across Somalia. To ensure the safety of imported products, policymakers should develop and enforce policies regarding the inspections, investigations, and monitoring of products coming across our nation's borders.

This study did not find any impact of outbound qualitative disturbances on supply chain vulnerability ($\beta = -0.5253$, $p < 0.0000$, $f2 = 0.5508$); hence, H4 was not supported. Our study revealed that outbound qualitative disturbances have no influence on supply chain vulnerability in Somalia. This study found that inbound qualitative disturbances have no significant impact on outbound qualitative disturbances ($\beta = 0.0338$, $p > 0.3795$, $f2 = 0.0023$); therefore, H6 was not supported. Our study found that qualitative disruption in inbound logistics does not influence the qualitative disruptions that occur in outbound logistics.

6. Conclusion

The purpose of this study was to investigate the inbound quantitative and qualitative disruptions and outbound quantitative and qualitative disruptions that lead to supply chain vulnerability in Somalia. This study employs a cross-sectional research design to test the hypotheses generated in the previous sections. A quantitative method was used to collect and analyze the data of this study. The population of this study is composed of the business managers and the logistic department of small and medium-sized firms in Somalia.

The proportional method was used to calculate the calcite sample size. This study found that inbound quantitative disturbances have a significant impact on supply chain vulnerability; in contrast, qualitative disturbances have no significant impact on supply chain vulnerability.

The value of the R-squared indicates 0.6023, as shown in Table 3, which indicates that all 7 predictors together can explain 60% of the variance in supply chain vulnerability. The multicollinearity of the variables was evaluated using the variance inflation factor (VIF). As illustrated in Table 3, all of the constructs have VIF values less than 5.00. A blindfolding procedure was adopted to measure the models 'predictive relevance. This study found that the supply chain of the manufacturing industry in Somalia is more vulnerable than the merchandise industry.

The empirical findings of this study suggest that business managers should assess the trends and occurrences of quantitative disruptions in firms 'outbound logistics and reconsider their transportation modes and routes. Managers should also promote an appropriate logistics institutional framework and policy development so that service level quality increases programmatically. We also suggest that managers adopt supply velocity to measure the resilience of the supply chain. The findings of this study also imply that managers should consider upstream activities to promote performance in the interface concerning the current and potential customers,

given that consumers are more demanding than suppliers.

7. Limitations and future research

This research was limited to assessing the association between firms' quantitative and qualitative inbound, and outbound disturbances and supply chain vulnerability. Data was collected from firms operating in Somalia therefore; the generalization of the output might raise a concern. However, future research may expand the reach whereby respondents from the post-conflict zones in the region will be assessed.

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