International Journal of Innovation, Creativity and Change. www.ijicc.net
Volume 13, Issue 11, 2020

Exposure to Different Supply Chain Risks: What Matters the Most to Supply Chain Resilience and Supply Chain Performance?

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Supply chain risks (SCRs) are a critical managerial issue. Their recurrence is elevated, with extreme ramifications for the existence and survival of the firm and its supply chain. This study focuses on how different SCRs influence supply chain resilience (SCRES) and ultimately supply chain performance (SCP). A quantitative methodology was chosen, with 182 respondents from large scale manufacturing organisations in Pakistan. The results show that, except for customer-oriented risk exposure, all risk types significantly influence SCR, while SCRES has a massive influence on SCP. Further, SCRES significantly mediates all other risk factors towards SCP. The results also pointed to the importance of investing and having certain resilient capabilities which enable firms to improve capability in anticipating, responding and recovering, at times of disruptions, and facilitating the enhancement of SCP.

Key words: *Supply Chain Risks, Disruptions, Supply Chain Resilience, Supply Chain Performance, PLS-SEM.*

Introduction

Today's supply chains experience major shifts. This is due to increasingly global business activities, technological advancements, intense competition, shorter product cycles, and a tempestuous business environment. Thus, the supply chain is becoming more complicated and volatile than ever before. This complexity and dynamism not only increases supply chain risks (SCRs) but also hampers the capability of a firm, in anticipating and preparing for unforeseen disruptions (de Oliveira, Augusto, Marins, Salomon, & Martins, 2017; Pettit, Croxton, & Fiksel, 2019). These supply chain disruptions have significantly impacted on the strategic, tactical and operational performance of individual companies (Handfield, Blackhurst, Craighead, & Elkins, 2011; Revilla & Saenz, 2017). One approach to lessen the impact of such disruptions is to develop a resilient supply chain system. Supply chain resilience (SCRES) echoes firms' capability to rebound from supply chain disruptions, and return to their original state after disturbances (Christopher & Peck, 2004; Sheffi, 2005). Hence, reconstructing a resilient supply chain deemed necessary to meet a timeline, as it enables firms in the supply chain to readily prepare, adapt and respond to unforeseen events. Moreover, it aids when taking quick measures to recover from those disruptions (Blackhurst et al., 2007; Sáenz & Revilla, 2014).

In the recent past SCRES has been imperative, not only for firms' survival but also when growing and gaining competitive advantage (Ambulkar, Blackhurst, & Grawe, 2015; Carvalho, Azevedo, & Cruz-Machado, 2012; Dubey et al., 2019). Thus, resilience has been well studied recently, especially as to both developed and developing economies. However, the extant literature directs us to believe that developing countries are the most vulnerable to supply chain disruptions. Specific events like terrorism, political unrest, strikes, rebellion military exercises, poor infrastructure, and malpractices in business, are some of the problems that tend to be acute in emerging economies (Tukamuhabwa, Stevenson, & Busby, 2017). Therefore, India and China for example have made a considerable contribution to the field of supply chain resilience. The Asian region has recently been the centre of economic activity. Further, the majority of disruptions, especially external risks like the war against terrorism and disasters like earthquakes and tsunamis, have happened in this part of the world.

In 2005, Pakistan's large scale manufacturing sector share of GDP was at around 18.5 %. Yet it slipped to 12% over the last decade because of political unrest, the war against terrorism, its law and order situation, and its lack of business-friendly policy. These sources of risks and challenges create vulnerabilities in the supply chain, making the environment less resilient. According to the 2017 Resilience Index Annual Report, Pakistan is ranked 118th out of 130 rankings. That compares with neighbouring countries like Sri Lanka (81), India (68), China (59) and India (54). Despite this, and numerous studies related to emerging economies like India and China, resilience in Pakistan has not been studied. In general, supply chain risks have been related to performance (Wagner & Bode, 2008a). Moreover, SCRES and SCP (Mandal, Sarathy, Korasiga, Bhattacharya, & Dastidar, 2016a) have been studied. However, the relationship between SCRs and SCRES has not been examined empirically. Hendricks and Singhal (2005) pointed out the importance of establishing resilience during disruptive environments. Resilience may play a pivotal role in managing supply chain risks. Nevertheless, to the best of the researchers' knowledge, there is limited research on how different types of supply chain risks influence resilience. Furthermore, the intermediary role of SCRES in between SCRs and SCP is yet to be explored. Hence, there is a pressing need to examine how supply chain risks influence SCRES, which ultimately improves the supply chain performance in a developing country like Pakistan.

Literature Review and Hypotheses Development

The present study is based on the research framework in Figure 1. The extant literature has established the importance of SCRES in eras of extreme dynamism, or where firms experience severe supply chain risks.

Supply Chain Risks and Supply Chain Performance

Risk is considered an indescribable phenomenon that can be defined in numerous ways, depending upon the research carried out (Jemison, 1987). Supply chain risks evolve from the environment. It can be categorised differently; demand risk, supply risk and environmental risks (Jüttner, 2005). It was most recently categorised into sourcing, making, delivering and storage risks in a study related to organic rice supply chains (Pakdeenarong & Hengsadeekul, 2020). This study conceptualises supply chain risks into internal risk exposure (INRE), supplier - oriented risk exposure (SORE), customer-oriented risk exposure (CORE) and external risk exposure (EXRE). The four categories have been supported and recognised in various researches which include Jüttner et al. (2003), Park et al. (2016); Tang (2006); and Trkman and McCormack (2009).

INRE results from the direct and indirect impact of the event in the organisation, which hampers or disrupts the product or service operations. These risks may involve labour strikes, product obsolescence, machine breakdown or system failure (Chopra & Sodhi, 2004; Jüttner et al., 2003). The disruptions flow from the supplier side are *SORE*. Several risk factors related to supply disruptions have been reported over the years. For example, failure to meet delivery timelines and quality issues could be the major reason behind supply disruptions (Zsidisin & Wagner, 2010). *CORE* are those disruptions that flow from problems in the downstream end of the supply chain. These disruptions generally back up from unpredictable requirements in the downstream channel member, and volatility in customer demand (Trkman & McCormack, 2009). Finally, *EXRE* are those risks which flow or create disruption from outside the supply chain network. Trkman and McCormack (2009) referred to these risks as exogenous. They are either continuous risks (e.g macro-economic uncertainty factors) or discrete risks (e.g political instability, natural disasters or calamity, strikes).

Wagner and Bode (2008) studied the effect of different risks on supply chain performance (SCP). They found demand and supply risks, considered as significant risk factors that negatively influence SCP. For instance, demand uncertainty may arise from a lack of coordination among the supply chain partners leading to a difference in projected and actual sales. This would lead to severe consequences in terms of shortages, lost sales, obsolescence, and disproportionate capacity utilisation, resulting in increasing operations costs and reduced sales volumes (Tang & Tomlin, 2008). Similarly, supply side risks like inappropriate quality, delivery issues, and 'on time' provision of required quantity may affect the buyer-supplier relationship. This may hamper the continuity of operations. Furthermore, it has been reported that manufacturing operations were interrupted in 2011 by earthquakes and tsunamis in Japan (Pettit, Croxton, & Fiksel, 2013), by a horrifying fire in a Pakistani clothing factory in 2012 (Rehman, Walsh, & Maqsood, 2012), and again in Bangladesh in 2013 (Jacobs & Singhal, 2017) that stopped supplies to some European and American customers including Walmart and Sears (Revilla & Saenz, 2017). The most recent lockdown ceased global supply chain operations after the COVID 19 global pandemic (Kilpatrick & Barter, 2020). All of these internal, network and external disruptions have serious consequences for supply chain continuity. Hence, SCRs negatively influence SCP.

H1: (a) Internal risks exposure (b) Supplier oriented risks exposure (c) Customer-oriented risks exposure (d) External risks exposure, negatively influence supply chain performance.

Supply Chain Resilience and Supply Chain Performance

Supply chains operate in a global business environment. They experience complexity and dynamism; thereby it is critical for firms to infuse resiliency into their system to tackle sudden and unforeseen disruptions (Ali, Mahfouz, & Arisha, 2017; Yu et al., 2019). Furthermore, they need to acclimatise as changes occur in the internal and external environment, if they are to sustain and stay alive in the global business environment (Adobor and McMullen, 2018). The dynamic capability is key in building supply chain resilience (Ambulkar et al., 2015; Yu et al., 2019). Through it, firms can be able to adapt to micro and macro-environmental changes in a lively, erratic and unpredictable global business environment (O'Reilly III & Tushman, 2008). Sheffi (2005) views SCRES as the network or system ability to return to the desired performance level, after experiencing a shock or vulnerability in a supply chain. It is also viewed as the firm's ability to quickly respond to disruptions, and return to its normal state after the risk has occurred (Brandon-Jones et al., 2014). This study conceptualises SCRES, as defined by Ponomarov and Holcomb (2009, p.131), as "the adaptive capability of the supply chain to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function".

The literature also confirms the stance that SCRES greatly influence the attainment of superior performance (Akgün & Keskin, 2014; M. Chowdhury, Quaddus, & Agarwal, 2019; Gölgeci & Kuivalainen, 2020; Mandal, 2017b; Mandal, Bhattacharya, Korasiga, & Sarathy, 2017). Resilient supply chain networks not only improve firms' capability to absorb disruptions, but also supports them in swiftly returning to a normal state, thus influencing firms' performance (Pettit et al., 2013; Sheffi & Rice, 2005). Furthermore, firms that take more time to respond to turbulence will more likely experience a greater level of damage, lowering firms' performance (Hohenstein et al., 2015). Liu and Lee (2018) studied the resilience phenomenon concerning service performance in 3PL companies. They found a positive, significant influence on service performance. Increased supply chain resilience also reinforces supply chain performance (Chowdhury et al., 2019). SCRES enhances firms' capability in preparing for unforeseen changes in the environment. Through this they are able to take swift and appropriate measures during volatile times. This would facilitate their reduction of the negative effects of disruptive events, thus increasing firm and supply chain level performance. Hence it is inferred that:

H2: SCRES positively influence SCP

Supply Chain Risks and Supply Chain Resilience

Resilience is considered effective in managing and countering supply chain risks. The firm can benefit greatly from the outcomes of established resilience systems, even in stringent and volatile times. However, SCRs can directly influence firms' ability to continue and sustain operations (Jüttner, 2005). These risks not only stop operations, which may reduce the firm's ability to prepare and respond to sudden disruptions (Pettit, Croxton, & Fiksel, 2019). They also hampers their capacity to quickly recover to normality (Hendricks & Singhal, 2005; Sheffi & Rice, 2005). Uncertainty in the business environment may shake up the firm's effort to anticipate, and its ability to achieve the desired level of readiness and response performance. Hence, it is assumed that exposure to different types of SCRs negatively influences SCRES.

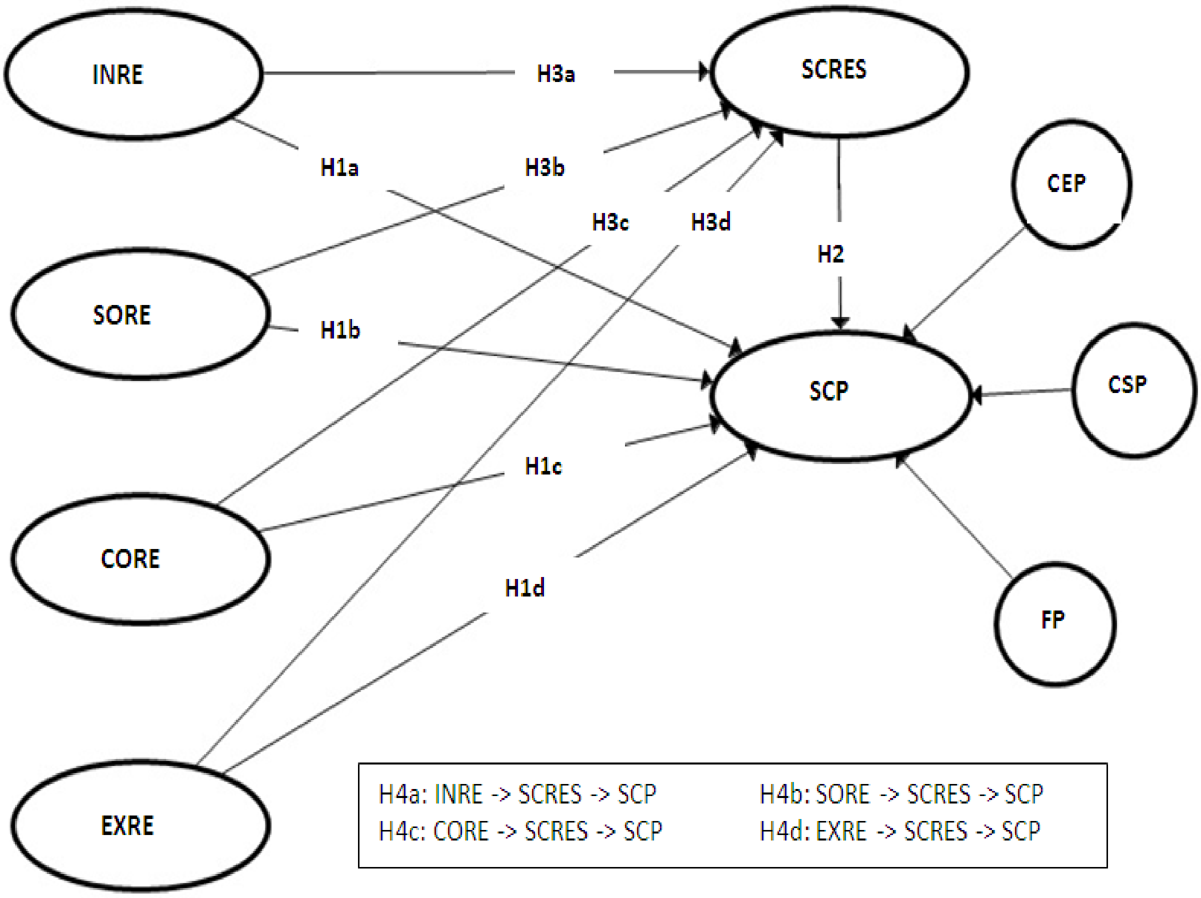
H3: (a) Internal risks exposure (b) Supplier oriented risks exposure (c) Customer-oriented risks exposure (d) External risks exposure, negatively influence supply chain resilience.

Mediating Effect of Supply Chain Resilience

It is evident from recent literature that the performance of the firm and its supply chain greatly depend upon how well it establishes resilience into its system. Evidently, the more time that firms take to respond to any turbulences, the greater will be the damage because these disruptions decrease firm performance (Hohenstein et al., 2015). Furthermore, the negative effect of the risks on the company's short and long term performance can be greatly reduced. The firm need to establish strong roots by having readiness, response, and recovery mechanisms in their organisations, and attaining the desired level of resilience performance, to produce meaningful supply chain performance outcomes. Hence, SCRES mediates the relationship between different types of risks and SCP.

H4a: SCRES mediates the relationship between internal risks exposure and SCP
H4b: SCRES mediates the relationship between supplier oriented risks exposure and SCP
H4c: SCRES mediates the relationship between customer-oriented risks exposure and SCP
H4d: SCRES mediates the relationship between external risks exposure and SCP

Figure 1. Research Framework



Research Methodology

The study adopted quantitative data methodology, to collect data from the large scale manufacturing industries of Pakistan. That data were utilised to evaluate the measurement models, structural model, and testing of hypotheses. A total of 515 questionnaires was sent to the company via email and through personalised contact. After sending telephone and email reminders, 182 useable and valid sets of questionnaires were received and included in data analysis, with a response rate of 35.3%. The respondents consisted of supply chain professionals under the supply chain umbrella, or who are in core supply chain activities. During the instrument development, all possible measures were taken to curtail common method biases, as suggested by Podsakoff et al. (2003). For statistical analysis, Herman's single-factor analysis was carried out. The results indicated that the maximum variance explained by a single factor is 30.7%. This suggests no issue related to common method variance in the dataset.

For instrument development, the four different types of exposure to supply chain risks are operationalised through the product of risk occurrences and risk severity. A 1 – 5 Likert scale is used for both risk occurrences and risk consequences. Risk occurrences were ranged from rare, unlikely, possible, likely to almost certain. Insignificant, minor, moderate, major and catastrophic are used for risk consequence, matching values 1 to 5. Supply chain resilience is operationalised through four items on a 7 – point Likert scale (1 = 'strongly disagree'; 7 = 'strongly agree'). Finally, supply chain performance is categorised into three dimensions which are cost efficiency, customer service and flexibility performance; operationalised through various items on a 5-point scale (1 = 'poor'; 5 = 'excellent'). The measures are presented in Table 2.

Research Results

As proposed by Hair et al. (2017), a two-stage process is adopted. In the first stage, the measurement model is assessed, followed by a structural model assessment, to analyse the hypothesis as stated above.

Measurement Model Assessment

The study constitutes both formative and reflective constructs, and the measurement model assessment for both formative and reflective constructs is different, as suggested by (Hair et al., 2017). The convergent validity assessed through redundancy analysis, assessment of multi-collinearity using VIF and significance of outer weights are assessed for SCP construct. Figure 2 demonstrates the results for the redundancy analysis, for the formative construct supply chain performance. It is measured formatively and denoted as SCP, whereas global assessment of SCP is measured by a single item. The construct is labelled as Global SCP. The analysis result shows that the path coefficient between the original formative construct and global reflective construct is 0.857. This is greater than the threshold value of 0.7. Further, R^2 is greater than 0.5, thus establishing strong support for the convergent validity of SCP as a formative. It is then followed by multi-collinearity assessment through VIF values. The VIF of CEP, CSP, and FP of three dimensions of SCP is less than the threshold value of 3.3. This indicates that there is no multi-collinearity issue formative construct, and it would not create a problem for the assessment of PLS path modelling. Finally, the significance and relevance of formative items are evaluated through the assessment of respective outer weights and outer loadings. The bootstrapping results indicate that outer weights of all the formative construct items (dimensions) are significant at 5%, thus representing these three dimensions truly contributes to the development of the SCP construct. The results are presented in Table 1.

Figure 2. Redundancy analysis

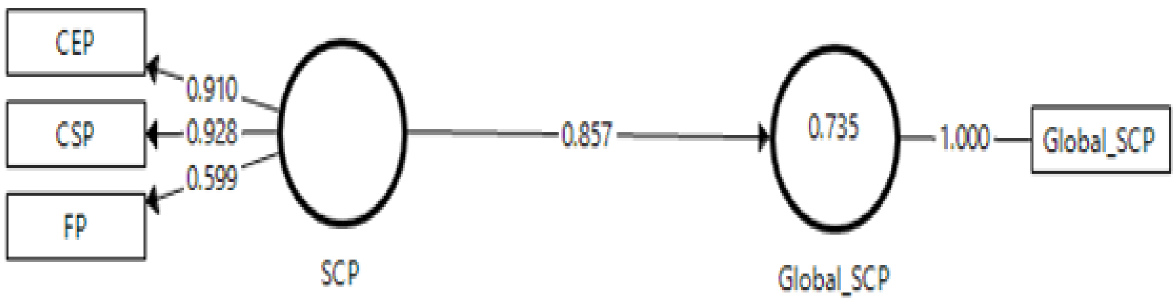


Table 1: Formative measure model assessment results

Constructs	VIF	Outer weights (Outer loadings)	T value	P value	95% Confidence Interval	Significance
CEP	2.347	0.320 (0.819)	2.236	0.025	[0.006, 0.573]	Yes
CSP	2.590	0.457 (0.897)	3.262	0.001	[0.195, 0.741]	Yes
FP	1.258	0.435 (0.754)	3.069	0.002	[0.165, 0.719]	Yes

Concerning reflective measurement model assessment, the routine indicator reliability and construct validity, indicator consistency reliability and discriminant validity were assessed. The indicator reliability of the measurement items is analysed through items loading. Construct validity is analysed through AVE. The item loading of 0.5 is acceptable (Chin, 1998), while the construct should have at least 0.5 to establish convergent validity (Hair et al., 2017).

In this study, eight reflective constructs are involved and the result presented in Table 2 indicates that three items INRE2, CORE2, and EXRE2 are deleted because of unmet criteria, as discussed above. Moreover, internal consistency reliability is assessed through composite reliability. The results indicated in Table 2 demonstrate that the value is in the acceptable range of 0.7 to 0.95 (Hair et al., 2017), thus signifying convincing evidence for scale reliability of reflective constructs.

Table 2: Measurement items and reliability and validity assessment

Scale items	Source(s)	Loadings	Composite reliability	AVE
Customer efficiency performance	Adapted from Um, Lyons, Lam, Cheng and Dominguez-Pery (2017)		0.903	0.701
CEP1: minimise material cost		0.804		
CEP2: to minimise storage cost		0.840		
CEP3: to minimise the total cost of distribution (including transportation and handling costs)		0.856		
CEP4: minimise the total cost of manufacturing (including labour, maintenance, and re-work costs)		0.847		
Customer service performance	Um et al. (2017)		0.922	0.702
CSP1: Customer order fill rate		0.837		
CSP2: On-time delivery		0.849		
CSP3: Customer response time		0.834		
CSP4: Product Quality		0.795		
CSP5: Customer satisfaction		0.873		
Flexibility performance			0.864	0.614
FP1: Flexibility to change the volume	Hallgren and Olhager (2009)	0.789		
FP2: Flexibility to change product mix	Hallgren and Olhager (2009)	0.735		
FP3: Flexibility to adjust capacity in short time	Chavez, Gimenez, Fynes, Wiengarten and Yu (2013)	0.822		
FP4: Flexibility to introduce new products into production in short time	Chavez, Gimenez, Fynes, Wiengarten and Yu (2013)	0.788		
Supply chain resilience			0.956	0.847
SCRES1: Our firm's supply chain is well prepared for unexpected events	Gölgeci and Ponomarov (2015); Mandal et	0.927		

	al. (2016b)			
SCRES2: Our firm's supply chain is able to adequately respond to unexpected disruptions by quickly restoring operations	Gölgeci and Ponomarov (2015); Mandal et al. (2016b)	0.921		
SCRES3: Our firm's supply chain has the desired level of connectedness among its members during disruptions	Mandal et al. (2016b); (Ponomarov and Holcomb (2009).	0.914		
SCRES4: Our firm's supply chain has the ability to maintain control over structure and function during disruptions	Gölgeci and Ponomarov (2015); Mandal et al. (2016b)	0.919		
Internal risks exposure			0.791	0.560
INRE1: machine breakdowns	Park et al. (2016)	0.632		
INRE3: equipment operating out of specification	Park et al. (2016)	0.778		
INRE4: labour strikes/suspension of operations	Cardoso, Paula Barbosa-Póvoa, Relvas and Novais (2015); Carvalho et al. (2012)	0.822		
Network risks exposure	Park et al. (2016)		0.801	0.503
SORE1: abrupt suppliers' capacity fluctuations	(Park et al., 2016)	0.688		
SORE2: inconsistent product quality from suppliers		0.713		
CORE1: inaccurate information from the customer about order quantities		0.770		
CORE4: customer orders for different product combinations		0.661		
External risks exposure			0.759	0.519
EXRE2: macroeconomic	Park et al. (2016)	0.558		

uncertainties (e.g., currency fluctuation, inflation)				
EXRE3: legislation or international standards changes for supply chain operations (e.g., ISO9000, transportation laws)	Park et al. (2016)	0.859		
EXRE4: Unrest situations like terrorism, strikes and / or political instability	(Carvalho, Maleki, et al., 2012; Trkman & McCormack, 2009)	0.712		

Next, discriminant validity is analysed in two ways. First, it is analysed through Fornell and Larcker (1981) criteria, in which square root of AVE (diagonal values) of each construct is greater than the correlation (off-diagonal values) with other constructs. The results presented in Table 3 give enough evidence in establishing that there is no discriminant validity issue in the model.

Table 3: Fornell Larcker Results

	CEP	**CR**	**CSP**	**ER**	**FP**	**IR**	**SCRES**	**SR**
CEP	0.837							
CR	-0.261	0.756						
CSP	0.758	-0.263	0.838					
ER	0.287	0.197	0.220	0.743				
FP	0.351	-0.051	0.453	0.026	0.783			
IR	-0.037	0.401	-0.131	0.416	-0.159	0.725		
SCRES	0.551	-0.27	0.606	0.263	0.534	-0.164	0.920	
SR	-0.030	0.289	-0.074	0.135	-0.134	0.477	-0.182	0.734

The study also employed a contemporary approach in analysing discriminant validity. It is done through Heterotrait-monotrait ratio (HTMT), the contemporary approach for determining discriminant validity. Table 4 reveals the HTMT value and significance of each construct. The result reveals that all HTMT values are less than conservative HTMT0.85 criteria, and their confidence interval values are less than 1 (Henseler, Ringle, & Sarstedt, 2015). This proves there are no discriminant validity issues among the constructs.

Table 4: HTMT Results

	CEP	CR	CSP	ER	FP	IR	SCRES	SR
CEP								
CR	0.335							
CSP	0.859	0.358						
ER	0.393	0.368	0.287					
FP	0.415	0.111	0.519	0.145				
IR	0.127	0.709	0.220	0.706	0.245			
SCRES	0.606	0.340	0.658	0.324	0.620	0.229		
SR	0.185	0.511	0.132	0.303	0.206	0.839	0.242	

Structural Model Assessment

The structural model assessment as suggested by Hair et al. (2019) is carried through the bootstrapping procedure, with 5000 re-samples performed. The results of structural model assessment through R^2, Q^2, f^2 and q^2 are presented in Table 5. The R^2 value of supply chain resilience is greater than 0.19, while the R^2 value of supply chain performance is greater than 0.33; hence considered as weak and moderately explained the endogenous variables respectively (Chin, 1998). Furthermore, the Q^2 values are assessed through the cross-validated redundancy approach which covers the prediction from both the measurement and structural model (Geisser, 1975; Stone, 1974). The results reveal that the Q^2 value of SCRES and SCP are 0.190 and 0.296 respectively which is greater than 0 (see table 5), indicating that the model has a reasonable level of predictive relevance for these constructs. Further assessment related to f^2 and q^2 was carried out to evaluate how much change in R^2 and Q^2 occurs, when a specific exogenous variable is omitted from the model. The value of f^2 and q^2 is reported as 0.02, 0.15 and 0.35 as small, medium and large effects respectively (Cohen, 1988). The results revealed that effect size (f^2) of SCRES towards SCP is large, while the effect size (f^2) of INRE and SORE towards SCRES is weak and EXRE is the medium. On the other hand, the relative measure of predictive relevance (q^2) of SCRES is considered as a medium, while q^2 of INRE and SORE towards SCRES is weak, and EXRE is a medium level of relative predictive relevance. The results are presented in Table 5.

Table 5: Structural model assessment through R^2, Q^2, f^2 and q^2

Construct	R^2	Q^2	f^2		q^2	
			SCP	SCRES	SCP	SCRES
INRE	-	-	0.004	0.028	0.000	0.020
SORE	-	-	0.018	0.070	0.003	0.007
CORE	-	-	0.019	0.005	0.001	0.063
EXRE	-	-	0.025	0.177	0.000	0.162

SCRES	0.225	0.190	0.612	-	0.280	-
SCP	0.473	0.296	-	-	-	-

The path coefficient estimation results revealed a direct and negative significant influence of INRE, SORE, and EXRE on SCRES. However, no effect is observed for CORE towards SCRES, providing support for H1a, H1b and H1d. The strength of the influence shows that EXRE ($\beta = -0.409$, $p < 0.01$) is greatly influenced to SCRES followed by SORE ($\beta = -0.258$, $p < 0.01$) and INRE ($\beta = -0.192$, $p < 0.05$). Concerning the effect of SCRES towards SCP, the results demonstrate that SCRES is positively and significantly influenced to SCP ($\beta = 0.645$, $p < 0.01$), providing support to H2. The direct effect of exposure to different types of supply chain risks revealed that all the risk types significantly influence the performance of the supply chain except INRE. This supports H3b, H3c, and H3d.

The bootstrapping procedure was also used to analyse the mediating effect of SCRES, in the relationship between different types of SCRs and SCP. The procedure opted for was suggested by Hair et al. (2017). An indirect effect of SCRES in between all the other four risk factors, and SCP, is significant and negative. This supports H4a, H4c, and H4d. The results indicate that the strength of the mediation effect is greater in EXRE ($\beta = -0.270$, $p < 0.01$), followed by CORE ($\beta = -0.171$, $p < 0.01$), INRE ($\beta = -0.127$, $p < 0.05$) and then SORE ($\beta = -0.114$, $p < 0.05$). That means these risk factors reduce the performance of the resilience efforts in the organisations, lowering supply chain performance. Hence, the overall performance of the supply chain is dependent on the firm's resilience performance. The results of the mediation effect demonstrate that SCRES is the critical element in attaining superior SCP. The firm needs to establish appropriate measures to develop resiliency into its system, to lessen the adverse effect of supply chain disruptions and enhance performance across the supply chain network.

Table 6: Path coefficients of direct and indirect effects for the mediation model

Hypotheses	Direct effect	VIF	Indirect effect	BC (Lower)	BC (Upper)	Supported (Yes / No)
H1a: INRE → SCP	0.057ns	1.727		-0.069	0.212	No
H1b: SORE → SCP	- 0.136*	1.332		-0.237	-0.029	Yes
H1c: CORE → SCP	- 0.134*	1.319		-0.233	-0.022	No
H1c: EXRE → SCP	-0.175**	1.430		-0.337	-0.013	Yes
H2: SCRES → SCP	0.645 ***	1.29		0.508	0.751	Yes
H3a: INRE → SCRES	-0.192**	1.679		-0.371	-0.014	Yes
H3b: SORE → SCRES	-0.258 ***	1.233		-0.404	-0.101	Yes
H3c: CORE → SCRES	-0.070 ns	1.326		-0.227	0.080	No
H3d: EXRE → SCRES	-0.409 ***	1.214		-0.539	-0.262	Yes
H4a: INRE → SCRES → SCP			- 0.127**	-0.255	-0.010	Yes
H4b: SORE → SCRES → SCP			- 0.114*	-0.186	-0.038	Yes
H4c: CORE → SCRES → SCP			- 0.171 ***	-0.283	-0.070	Yes
H4d: EXRE → SCRES → SCP			- 0.270 ***	0.160	0.395	Yes

Notes: INRE: Internal risk exposure, SORE: Supplier oriented risk exposure, CORE:Customer oriented risk exposure, EXRE: External risk exposure, SCP: Supply chain performance, SCRES: Supply chain resilience, BC: Bias corrected
*** $p < 0.01$; ** $p < 0.05$, ns: not supported
Yes: supported with p-value < 0.1, 0.05 or 0.01, No: Not supported

Discussion

The empirical results direct to various key highlights, that better relate SCRs, SCRES and SCP. The results show that all the risk types negatively influence SCP, except internal risks which do not have any significant influence on SCP. The results are somewhat congruent with Hendricks and Singhal (2005), and Wagner and Bode (2008). Among all the significant risks factors, external risks contributed most in reducing SCP. However, the study results contradict the earlier study. Wagner and Bode (2008) reported these factors as exceptional factors that are driven by occasional events. Hence, the effect on the supply chain performance was deemed negligible. However, in the context of Pakistan, external risk factors like terrorism, political uncertainty and resulting macro-economic uncertainties became normal during the last decade, which caused Pakistan a serious economic crisis (Pakistan Economic Survey, 2018). Meanwhile, supplier and customer-oriented risks are significant in influencing performance. However, it is believed that supplier and customer-oriented risks are somehow interlinked (Um et al., 2017). The uncertainties downstream affect the supply side, creating glitches in the supply chain. This not only hampers customer loyalty and dissatisfaction, but also increases the cost of retaining those customers (Hendricks & Singhal, 2005; Simchi-Levi et al., 1999).

The empirical result also signifies the negative influence of supply chain risks on supply chain resilience. External risks are again the significant contributor in reducing resilience performance, followed by supplier oriented risks and internal risks. Interestingly, customer-oriented risks do not have any influence, which may be due to the characteristics of sampling firms. The samples consist of both types of companies which are producing a functional and innovative product. The level of uncertainty increases with changing from a functional to an innovative product category (Fisher, 1997; Lee, 2002). The inclusion of both types of companies may be the reason for the insignificant effect of customer-oriented risks in influencing resilience performance. The results also confirmed the strong positive influence of SCRES on SCP as found in extant literature (Chowdhury et al., 2019; Mandal, 2017c, 2017b; Mandal et al., 2017). In a dynamic business environment, SCR considered as a key organisational resource enables the firm to inculcate adaptability for sustainable development (Ponomarov & Holcomb, 2009). With enhanced resilience, a firm can find better operational efficiency (Mandal, 2017a), delivering better service to customers (Liu & Lee, 2018), and ultimately improve a firm's financial and business performance (Gölgeci & Kuivalainen, 2020; Li, Wu, Holsapple, & Goldsby, 2017).

Finally, the study offers interesting insights into the indirect effect of SCRES in between different types of SCR and SCP. The study found a significant negative mediating effect in the relationship between SCR and SCP. This demonstrates the given samples may lack certain resilient capabilities which facilitate them to safeguard their resilience performance. Firms with a lack of established resilience systems often fail to anticipate, prepare, respond and recover from disruptions (Pettit et al., 2019). The downside of a poor or weak resilient system is that performance of the supply chain is greatly reduced if a firm fails to improve its resilience capabilities. Firms with a greater level of resilient supply chain capabilities are more likely to survive and sustain in volatile and tempestuous times. Hence, firms operated in a dynamic business environment, especially experiencing greater occurrences of external risk, need to establish appropriate risk management systems and invest in certain resilient capabilities which would not only enable them to improve resiliency but also enhance short and long term business performance.

Conclusion, Implications and Future Directions

Firms operate in a highly globalised business environment. Each day they are exposed to various disruptive events that can threaten their ability to run their business operations effectively, thereby jeopardising their long term business performance and survival. The significance of supply chain resilience in the era of extreme dynamism and vulnerabilities should not be understated. Firms that have more capability in dealing with supply chain disruptions are more likely to sustain in tempestuous or volatile times. This study envisaged the influence of exposure to different types of supply chain risks on supply chain resilience, and in turn supply chain performance. The study contributed to highlighting the mediating role of supply chain resilience, in influencing the relationship between risks and supply chain performance. The results could benefit the managers and practitioners in local manufacturing organisations, as to how resilience can allow them to prepare for any disruptive event and respond through reconfiguring their resources with the changing business environment. This would enable them to gain a competitive advantage in the global environment, and also position themselves competitively as to their supply needs. The study also underlines the impact of various supply chain risks on supply chain resilience.

This study, therefore, appears to provide a concrete basis for analysing how it is important for manufacturing firms in Pakistan to strengthen supply chain resilience, to enhance supply chain performance. Performance adaptation, in terms of ability to prepare, respond and recover, can only be possible by investing in those capabilities which would enable them to cement resilient systems across the supply chain network. The extant literature reported various readiness, response and recovery capabilities (Ali et al., 2017; Chowdhury & Quaddus, 2016). Through this, firms not only survive in disruptive times but also prepare the organisation to grow and achieve competitive advantage (Dubey et al., 2019). However, the study has limitations. First, it is limited only to the impact of different supply chain risks on supply chain resilience. Capabilities needed to inculcate resilience into the organisation are ignored. Hence, in future it would be interesting to evaluate how certain resilient capabilities reduce the negative effect of supply chain disruptions, and transcend the performance of the establishment of supply chain resilience. In addition, the study is limited to Pakistan. The findings are more relevant to those firms operating in same kind of risk environment. Hence, future studies could collect larger sample sizes from multiple data sources of different countries, which would also improve the generalisability of the research findings.

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