



## Article

# An Empirical Examination of Sustainable Supply Chain Risk and Integration Practices: A Performance-Based Evidence from Pakistan

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**Abstract:** In today's emerging environment sustainable supply chain risks play a vital role in firms' performance more than ever, because risks tend to disrupt sustainable operations, which ultimately reduces a firm's performance, but these risks can be managed through supply chain integration practices, which leads to higher firms' performance. Therefore, this paper examines the relationship between sustainable supply chain risks, supply chain integration, and firm's financial performance. This study employs 296 survey observations along with financial data of published annual statements to estimate the quantitative causal-effects of three dimensions of sustainable supply chain risks on supply chain integration and financial performance. The findings of the study suggest that sustainable internal business process risks, sustainable supply risks, and sustainable demand risks have a negative relationship with supply chain integration. Furthermore, results of the study explored that all the three supply chain integration practices have a positive impact on firms' financial performance, which suggests that implementing supply chain integration practices reduces the effect of supply chain risks and increases the firm's performance.

**Keywords:** sustainable supply chain; supply chain risks; supply chain integration; supply chain management; Pakistan

## 1. Introduction

Recently, the concept of sustainable supply chain (SSC) emerged and within no time has turned out to be an essential part of supply chain management literature. The concept links firms' supply chains not only to their main goals that is shareholders wealth maximization but also has solid connection to the environmental, social, and economic aspects [1]. Therefore, firms turn their supply chain process into sustainable and get more opportunities in the market through competitive advantage, and in turn performance is also improved [2]. Generally, firms try to reduce the carbon footprints by implementing green raw material [3] that is a part of green innovation and is related to the sustainable efforts, which in turn increase socioeconomic and financial performance [4]. Sustainable supply chain is different from traditional supply chain and follows the guidelines of environmental management system (EMS) [5]. According to Hart [6], core competencies of sustainable practices can be created through the natural resource-based view (NRBV), which proposes that organizations should consider environmental and sustainability issues in their strategic planning. Doing so enhances the organizations ability to deal with environmental uncertainties, which, in return, increase the firm's performance [7]. Rather a new concept circular economy (CE) is often used to aid the sustainable production and consumption, which

is a system that mediates firms' economic and environmental performance through elimination of waste and continuous use of the resources. CE business models is based on reduce, reuse, and recycle, which allows firms in reducing emissions and lowers the consumption of scarce resource [8].

Implementation of the sustainable supply chain in firms could lead to competitive advantage such as cost savings of handling waste material and reduction in energy consumptions [9]. Which is the reason; firms like Panasonic, Xerox, HP, Motorola, Wal-Mart, Sony, Ford, IBM, and General Motors encourage their suppliers to environmental aspects according to ISO 14000/14001. International organization for standardization (ISO) 14000 addresses the issues related to environmental management and also has described six tools for regulators, organizations, and consumers, such as facilitating the development of uniform requirements, being technically credible, supporting the regulatory compliance, fulfilling needs of the stakeholders, and enhancing the confidence of the investor [10]. ISO 14000 standards certified firms behave way different from the non-certified firms in their operations, processes, and procedures.

Before, the mid-twentieth century firms were rapidly involved in strategies such as competitive pricing and product differentiations but now it has been replaced with the implementation of sustainable practices along with supplier's collaboration [11]. Afterwards, the green supply chain management (GSCM) concept evolved, which involves implementing green raw material, green production, green processing, green packaging, green distribution, and green marketing [12]. Recently, firms moved from green to sustainable, which not only includes green (environmental) but also the social and economic perspectives.

Mainly, sustainable supply chain management (SSCM) aims at minimizing the effects of environmental damages with the close collaboration of supply chain partners, but due to a rapidly changing environment, firms are exposed to different risks in implementing green supply chain practices, which may lead to supply chain disruptions [13]. The process of implementing SSC is complicated, such as procurement, operations, and services require environmental commitment, and there are least providers when it comes to purchasing green raw material. Therefore, SSC is exposed to different risks such as quality of raw material supplied and supplier delivery delays [14].

Previous studies have discussed the barriers in implementing SSC and developed a framework which distinguishes between traditional supply chain and sustainable supply chain [15,16]. There are several risk factors associated with dimensions of SSC such as, supply, demand, manufacturing, logistics, flexibility, and retailing, which results in lower firms' performance [3]. Therefore, to implement SSCM, it is necessary to estimate risks linked with the implementation of SSC. According to Chopra and Meindl [17], there are five risk factors that a green supply chain firms faces, planning and production, inventory management, product positioning, locations selection, information sharing, and distribution. Furthermore, Luthra [18] classified SSC risk under 26 variables, ranging from procurement to distribution, but green raw material is the most critical factor. SSC implementation is more critical to issues related to internal business process risks, such as operational, organizational, and industry risks [19].

In order to cope with sustainable supply chain risk (SSCR), firms must react quickly to the uncertainties in their supply chain and use their capabilities to achieve a competitive advantage [20]. Managing risk in supply chain is not very easy but several authors have suggested methods and strategies in the previous literature which firms can practice for supply chain risk management (SCRM). To manage supply chain risk, firms need to develop operational approaches such as risk avoidance, risk transferring, risk mitigation, or risk acceptance. Some researchers also proposed SCRM as a holistic approach for risk management, which needs the supply chain to be resilient, robust, or agile [21]. Resilient supply chain is one that is flexible and adaptive to the situation and after experiencing the disturbance it returns back to its original state. Therefore, a firm can create sustainable competitive advantages by developing capabilities triggering supply chain resilience [20]. Supply chain robustness can be achieved through reducing complex structures and developing processes that limits the chances

of occurrence for risks [22]. Furthermore, agile practices refer to the reactive approaches, which allow firms to quickly react to the disruptive situations and adjust the supply chain back to its regular state.

Supply chain integration (SCI) is considered as a powerful concept for managing risks and coping with an uncertain situation; however, there are many questions to be answered regarding proper implementation of SCI [23,24]. Researchers have discussed the relationship of supply chain risk with supply chain integration, but it is ambiguous and is still in the earlier stage (which risks could be managed through integration and which practice of integration could handle them). Such as, Frohlic and Westbrook [25] described that internal management failure leads to risk exposures. Therefore, internal integration could solve the problem. Richey et al. [26] discovered that both external and internal risks are harmful to firm's performance; therefore, both internal and external integrated measures should be taken to avoid disruptions. Both demand and supply variability risks are the most disruptive risks and could be handled through both internal and external integration practices [20,21,27]. Although researchers have thrown a light on the importance of supply chain integration, the concept of supply chain integration is still in infancy, and more research is required to elaborate on the actual outcomes.

SCI demands that the company and all its supply chain partners should work on the similar objective, there should be open communication, resource sharing and, risks and reward system [28]. Similarly, to cope with cross-organizational environmental issues, a term product stewardship was coined, which suggests that the environmental issues outside the organization but affecting the internal process of the firms can be resolved by the mutual collaboration of suppliers and customers [29]. CE also increases competitiveness of the firms and has potential of managing and mitigating risks through integrated activities with supply chain partners [8]. Each management practice either robust, resilient, or agile, costs firms in different ways, so it is required to check the relationship of these practices with risk management and firm performance. Related to risk management practices previous researchers have not reached a consensus yet [30]. Lack of consensus about dimensions and directions of the constructs has made ambiguity in comparing and accumulating the findings [31]. However, despite the importance of SSCR on performance, only a few studies have been conducted to measure the financial performance of firms. Although there are few studies [32,33] which tried to estimate the impact of SCR on firm's performance, they are perceptual based and fail to measure the quantitative financial performance.

According to the author's knowledge, there is no evidence regarding the impact of sustainable supply chain risks on firm's performance along with the dimension of supply chain integration, in view of sustainable firms. Therefore, this study contributes to the literature in multiple aspects. Firstly, this is the first study to empirically testify the impact of SSCR on SCI according to the sustainable firms' point of view. Secondly, this study presents the relationship of three dimensions of SCI (internal, supplier, and customer) on firms' financial performance (FFP). Thirdly, this study presents the relationship between SSCR, SCI, and firms' financial performance through survey and financial statements data of 296 ISO 14001 certified firms. Finally, this study provides managerial implications for the manufacturing firms operating in South-Asian countries, as this is the first study which addresses the issues related to SSCR, SCI, and FFP through a large sample of 296 observations from a South-Asian country.

The remaining part of this research are as follows. Next section provides the overview of related literature to SSCM, SSCR, and resilience, based on which conceptual model and hypothesis are developed. Section 3 presents the data analysis and estimation procedure. Section 4 presents the results of the study. Finally, discussions, conclusions, theoretical, managerial implications, and limitations of the study are presented at the end.

## 2. Review of Literature and Hypotheses Development

This section provides the theoretical background of primary constructs, such as sustainable supply chain risk, supply chain integration, and firms' financial performance. Later, the conceptual framework and hypotheses are developed.

## 2.1. Sustainable Supply Chain

Sustainable supply chain and typical supply chain are not the same; they are different in terms of their goals, operations, processes, tools, procedures, etc. Inclusive definition of sustainable supply chain was presented by Ahi and Searcy [34] which distinguish it from the typical supply chain, and states that “the creation of coordinated supply chains through the voluntary integration of social, environmental, and economic considerations with key inter-organizational business systems designed to effectively and efficiently manage the capital, information, and material flows associated with the production, procurement, and distribution of services and products or in order to improve the resilience of the organization over the long and short-term and increase the profitability and competitiveness and meet stakeholder requirements” [34].

Sustainability has three pillars which were presented by Elkington [4]; the concept he coined is known as the triple bottom line (TBL). TBL has three aspects in it, which are environmental, economic, and social. Environmental concept of TBL is about environment-related aspects of the supply chain such as landfill deposits, nonrenewable energy, and reduction in energy and processes that emit carbon and are harmful to the natural environment. The increasing trend about environmental sustainability forces firms to move towards green and apply techniques such as, remake, reuse, resale, and recycle. Economic or sometimes considered as organizational stability refers to when organizations act responsibly about environmental and social concerns keeping aligned with the financial viability [35]. The social side of this concept is about the wellbeing of the society and deals with issues such as wages, ethical behavior with employees, relationship with the labor, gender diversity, and equity [36].

From the above arguments, one thing is clear that sustainable supply chain is different from the typical supply chain and their ways of doing business such as operations, processes, and procedures are also different. Therefore, a sustainable supply chain is exposed to multiple internal and external risks, which could lead to serious disruptions. Regarding the stats, there is little research already published, which deals with sustainable supply chain risk. Therefore, this paper deals with sustainable supply chain risk and the literature is presented in the following section.

## 2.2. Sustainable Supply Chain Risk

Although supply chain risk is a well-known phenomenon and the topic has gained popularity during the past two decades [32,37–41]. Therefore, supply chain risk has become the essential part of supply chain risk management literature, but regarding sustainable firms which takes sustainability in action, there is less attention paid to the topic [35].

In order to realize the sustainability issues and associated risks with it, the current literature of supply chain risk management is not enough and clear [41,42]. On supply chain risk and sustainability together, there is no or very less attention that is paid by researchers [32,37,43,44]. Lee and Vachon [45], in their research investigated that the disruptions in sustainable supply chain are caused by environmental related issues, such as greenhouse gas emission, natural disaster, energy usage, packaging waste, logistics, and supports; which are typically sustainability-related risks and are not covered by the recent literature on supply chain risk. Therefore, to practice sustainable supply chains in full manners, it is compulsory to track down and cope with sustainable supply chain risks by developing a comprehensive framework [44–46].

Organizations face uncertainty at all levels in their business operations throughout the supply chain, and this uncertainty can influence the organization objectives in both negative and positive ways. If the organization has a proper risk identification and assessment framework, they can manage risks arising at any level, [47] distinguished SC risks into two categories internal risks and external risks. Zhao et al. [32] classified supply chain risk into three categories, internal risks, supply-driven risks, and demand-driven risks. Internal risks are the risks which occur inside the firms and can be divided into two sublevels such as, strategic and operational level. Strategic risk is associated with firms' policies and decisions, e.g., if top management of the firms is committed towards green practices

the organization finds innovative ways to keep the business running, and it ultimately leads to higher performance [2,44].

Alternatively, operational risks are related to firm's day to day operations such as machine break down, lead times, IT problems, human errors, and technological shifts [37]. Internal supply chain risks are widely explored and explained by the previous researchers, and most of them are classified into three major categories, industry-related risks, organizational risks, and operational risks [48]. Some of the critical sustainable firms internal risks discussed in the previous literature are green design risk, production capacity risk, quality risk, machines and equipment's risks, green technological risk, and long lead times due to green products and materials [3,21,35].

Another major category of the sustainable supply chain risk is external risks, which are further classified into two categories, sustainable supply risks and sustainable demand risks. Most of the manufacturing firms are affected by their distribution and supply structure [35]. In most cases, this happens because of the low or no coordination among various units of the supply chain [49]. In the organization, it is vital to select appropriate suppliers' selection. From supplier to the production process to distributions, there are continuous risks at different levels in the supply chain. In the existing economic scenario and competition among firms on sustainable practices, organizations must tackle risks in their supply chains to achieve goals. The supplier performs a vital role in success of an organization but is one of the primary sources of risks [35] such as, quality problems in green raw material, capacity constraints, supplier delivery failure, supplier financial instability, and limited number of green suppliers. If anyone of these is triggered it disrupts the whole supply chain of the firms.

In addition to the supply side of the risk, the demand side is also associated with risks which could lead the firms towards disruptions. Researchers have explained that demand-driven risks are very harmful to sustainable firms' operations but compared to supply-driven risks, they have less damage observed. Primary risks related to demand-side in the supply chain are distribution risks, inventory shortage, demand forecasting error, targeting the market/customer for the green products, uncertainty in the price, and change in customers' taste [32]. Demand risk could turn into the most harmful risk if the company is operating as a just-in-time [50].

### 2.3. Supply Chain Integration

Due to the turbulent changing environment, supply chain risks are critical for firms in maintaining a competitive advantage. Therefore, close coordination among supply chain partners at all levels is required [49]. In SC literature, collaboration and coordination among its supply chain partners (e.g., customers and suppliers) and managing processes (both internal and external) are referred to as supply chain integration. While the literature of supply chain integration is developed from inconsistent and divergent perspectives [51], but still it has given a lot to supply chain managers to understand the need of partners and work in collaboration. The concept of supply chain risk is inconsistent in the previous literature and researchers have not reached a consensus about SCI definition, dimensions, and directions [52–55]. Despite the differences among researchers about SCI, the definition presented by Zhao et al. [49] is comprehensive and helps in understanding the concept better. According to him "the degree to which an organization strategically collaborates with its supply chain partners and manages inter- and intra-organization processes in order to achieve effective and efficient flows of products and services, information, money, and decisions with the objective of providing the maximum value to the customer at low cost and high speed" [49].

Different researchers have a different point of view among supply chain integration, some suggest it is about sharing information with supply chain partners at all levels [56] and regard it as information integration [57,58]. Others suggest that supply chain integration is about joint activities, processes, and procedures among different partners in the supply chain [59,60]. Researches [61,62] coined a term relationship integration which suggests that the firm's collaboration is based on trust, mutual commitment, mutual understanding, and continuing orientation among supply chain partners. In contrast, a bunch of recent researchers [23,24,32,49] tried to sort out the SCI classification issue and



came up with two primary dimensions internal and external integration while external integration is further divided into two categories supplier and customer integration.

Internal integration refers to the “the degree to which a manufacturer structures its own organizational strategies, practices and processes into collaborative, synchronized processes, in order to fulfill its customers’ requirements and efficiently interact with its suppliers” [23]. On the other hand, external integration is referred as “the degree to which a manufacturer partners with its external partners to structure inter-organizational strategies, practices and processes into collaborative, synchronized processes” [23]. Supplier integration refers to a firm’s collaboration in activities and information sharing among the supply side (key suppliers) of the supply chain [55] while customer integration refers to a “firm’s collaboration and coordination with the customers about the product design, demand and aftersales service” [24].

Keeping in view of sustainable practice, there is no previous literature that links sustainability to the SCI. Therefore, in this study, our focus is on sustainable supply chain integration, we define SSCI as “collaboration and coordination among all partners in the supply chain for the mutually sustainable practices inside and outside the organization, which comprise of three dimensions such as, internal, supplier and customer integration”.

#### 2.4. Linking SSCR to SSCI and Firms Financial Performance

SSCR are considered as barriers for practicing SSCI, while three dimensions of SSCI are considered as enablers for the firm’s financial performance. Therefore, to examine the theoretical and empirical links between these concepts, a comprehensive theoretical framework following the previous literature is developed, which is illustrated in Figure 1.

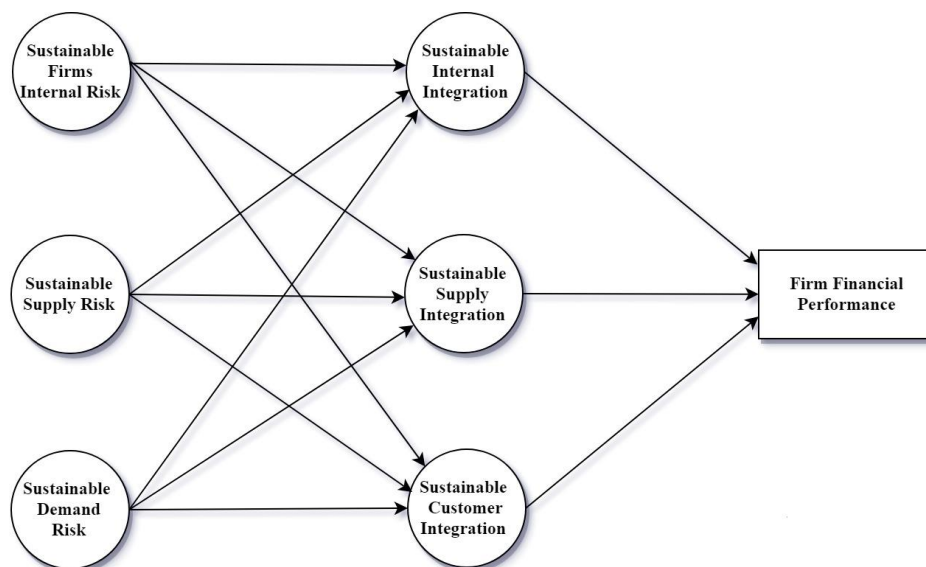


Figure 1. Conceptual model.

##### 2.4.1. Impact of Sustainable Supply Chain Risk on Sustainable Supply Chain Integration

Sustainable firms internal risks are those related to the firm’s processes, tools, techniques, and procedures, means that are related to the internal environment of the firms. Internal risks can be classified into operational and strategic levels. Strategic risks are associated with the firm’s strategies and goals, which are ultimately positively or negatively associated with the firm’s profitability. On the other hand, operational risks are associated with the firm’s management and employees, who carry day to day operations [35]. There are multiple risks associated with green manufacturing because it is difficult to find most of the green suppliers, which could initiate manufacturing risks for the sustainable firms.

Moreover, the market and commodities of sustainable firms are different from ordinary firms. Therefore, cutting energy usage, creating by-products, and using green raw material in production creates difficulties for the firms and exposes its operations to different internal risks. Most of the internal risks are machine breakdown, longer lead times, human error, communication risk, underutilized capacity, IT malfunctioning, and change in technology due to green [3,41,63,64].

Sustainable firms do not only focus on profitability; instead, it's core focus is on environmental, economic, and social concerns, which are known as triple bottom line [65]. Therefore, in order to practice sustainability and achieve goals, firms need to practice sustainable supply chain integration. If the coordination among the different departments in the firms are low it will lead to delayed productions, manufacturing faults, labor disputes, and machine breakdowns. Similar things happen when firms are not willing to share information about inventory, processes, products specifications, and requirements with their suppliers and customers [32]. Therefore, the following hypotheses are proposed:

**H1a.** *Sustainable firms internal risk have a negative impact on sustainable internal integration.*

**H1b.** *Sustainable firms internal risk have a negative impact on sustainable supply integration.*

**H1c.** *Sustainable firms internal risk have a negative impact on sustainable customer integration.*

Manufacturing firms are influenced by their own distribution and supply network because the coordination among the firms and its suppliers can reduce or increase the firm's costs and smooth operations of the sustainable firms are also dependent on their supplier. Therefore, the selection of a supplier for manufacturing firms means a lot of strict and limited numbers of green suppliers is an issue for sustainable firms [35]. Supply risks are usually the quality problems, delivery delays, delivery failures, and inability to meet the firm's demand [41]. Manufacturing firms do not like to share much information about their customer orders, inventories, and desired times under the high level of supply risks.

Furthermore, a joint investment program is required for sustainable firms for new product development and improvement of processes with the suppliers, which are quite a low practice among supply chain partners. Therefore, delivery failures and delays restrict firms in creating an alliance with the suppliers, which creates conflicts among supplier–manufacturer and the coordination and collaboration among the supply side becomes difficult. When delivery is unstable, slow, and delayed, it creates trouble for the manufacturing process and also creates difficulties in coordination among firms' various departments [32]. According to Frohlich [25] due to suppliers' failure in delivery manufacturing firms are reluctant in changing their internal business operations. Therefore, sustainable supply risks will lead to failure in the sustainable supply chain integration.

When the supplier is unable to deliver on time, manufacturers are unable to produce on time as their operations are disrupted. Therefore, it is difficult for the firms to deliver the products on time to the customers, and the lead times from supplier–manufacturer will be shifted to the manufacturer–customer. In return, the customer relationship and trust are shattered, and they will be reluctant to integrate with the manufacturing firms under extreme supply risks [41]. Therefore, we propose the following hypotheses:

**H2a.** *Sustainable supply risk have a negative impact on sustainable internal integration.*

**H2b.** *Sustainable supply risk have a negative impact on sustainable supply integration.*

**H2c.** *Sustainable supply risk have a negative impact on sustainable customer integration.*

The changes in the demand trends majorly cause demand risks, market turbulence, demand instability, change in preferences, and customer taste. In the high demand risks environment customer needs changes quickly and it is difficult for the manufacturing firms to track the changes in demand quickly and modify their operations accordingly, which leads to errors in demand forecasting [61]. Sometimes, when demand trends change suddenly, it creates difficulties for firms to maintain the quantity of the products and inventory control becomes difficult. The logistics operations of the firms

disrupt, and the distribution network of the firms becomes slow, which create issues for firms–customer relationship [32].

Furthermore, manufacturing firms are usually unwilling to invest in the quality improvements [66] in collaboration with their suppliers and do not foster green innovation in the environment of high demand risks. Inaccurate information about the demand trends will lead to the disturbance in the internal operations of the firms. Sales functions do not work properly because the customers changing demand patterns becomes obsolete when there are turbulent changing trends in the demand of the green products and the coordination among different departments become difficult [67]. As a result, it becomes difficult to integrate with the customers [38]. Therefore, we propose the following hypotheses:

**H3a.** *Sustainable demand risk have a negative impact on sustainable internal integration.*

**H3b.** *Sustainable demand risk have a negative impact on sustainable supply integration.*

**H3c.** *Sustainable demand risk have a negative impact on sustainable customer integration.*

#### 2.4.2. Impact of Sustainable Supply Chain Integration on Firms Financial Performance

Internal integration refers to the coordination among various departments among the firms about information sharing, processes, procedures, and operations. Studies in the previous literature replicate that internal integration improves the firm's performance through process efficiency, efficient material handling, and demand management [53]. Internal integration improves firm's performance through coordination among various departments, working collaboratively, time management, demand scheduling, and order management system. Excellent communication among the departments can provide demand information on time, which could reduce the "bullwhip effect" and possibly leads to the attainment of schedule, which reduce the firm's extra cost of changing schedules due to the inaccurate information [68]. Internal integration helps in providing accurate information from supplier to manufacturer and manufacturer to the supplier, which reduce the lead times, delivery delays, and failure of delivery and saves the cost of the firms [69]. Furthermore, internal integration leads to the understanding of the customer's needs and their desired requirements through information sharing or firms marketing channels or SAP. Hence, internal integration leads to information sharing at all levels inside the firms, which reduces firm's cost of operations and increases firm's performance [32]. Therefore, we propose the following hypothesis:

**H4.** *Sustainable internal integration has a positive impact on firm's financial performance.*

Manufacturing capacity of the firms is limited, and they require allocating their scarce resources in meeting the customer's demand at a lower possible cost, but they continuously face the problem of delayed deliveries from the supplier, which creates hurdles in achieving their goals. Firms need their raw material on time to produce goods on time and deliver them to the final user in time. Integrating supplier with firm's needs and requirements decreases the delivery delays and then decreases the longer lead times in production, which saves firm's cost and creates a healthy relationship with the firms. Supplier integration requires firms to share information with their suppliers regarding their inventory, manufacturing needs, and production planning, which could lessen the impact of supply-side risks [68,70,71]. Supplier integration has been proven as a determinant of operational performance in previous studies. Those firms practicing the concept of supply chain integration outperform those not practicing supply chain integration [25]. Furthermore, according to the concept of transaction cost theory (TCT), supplier integration reduces firm's cost through managing uncertainties. Moreover, the production cost is also decreased through supplier integration. As manufacturing firms and suppliers build a relationship of trust and collaborate in all matters, creating a joint research and development center increases firm's product quality and decreases the cost [72]. Thus, we propose the following hypothesis:

**H5.** *Sustainable supply integration has a positive impact on firm's financial performance.*



Customer integration enhances the firm's relationship with its customers. Sharing information with customers gives firms the benefit of knowing their preferences and helps to improve the demand forecasts. Working together with the customers reduces the requirements of changing in schedules, and also the bullwhip effect is removed [51]. Sharing information with the downstream partners of the supply chain increases the firm's performance. Clark and Hammond [73] found out in their study that when manufacturing firms started sharing information with their retailers, a reasonable increase in their performance was seen. It is also seen that customer integration increases the firm's logistic support [74]. Swink et al. [54] found out in his study that customer integration creates competitive advantages for the firms and decreases their cost of operations, which in turn increases firm's financial performance. Customer integration enhances firm's operational performance through process innovation and flexible distribution structure. Financial performance of the firms is also increased through customer integration as it creates new opportunities for sales, which are associated with better knowledge of markets and customer demands and increases firm's revenue [75]. Therefore, we propose the following hypothesis:

**H6.** *Sustainable customer integration is positively related to the firm's financial performance.*

### 3. Methodology

#### 3.1. Sample Selection

In order to achieve research objectives, 460 manufacturing companies listed on the Pakistan Stock Exchange were selected. In order to comply with sustainable compatibility, we have only selected firms which are consistent with ISO 14000/14001 ("Specifies the requirements for an environmental management system that an organization can use to enhance its environmental performance [10]), PSQCA (Pakistan Standard and Quality Control Authority (PSQCA) was established in 1996 and is a member of the International Organization for Standardization (ISO). PSQCA is a responsible body that checks the quality and environmental standards of manufactured products) and NPSWM 2015 (National Policy on Solid Waste Management (NPSWM) 2015, which required firms to adhere to environmental practices. According to the policy, the Pakistan Environmental Protection Council (PEPC) was developed to cooperate with firms for sustainable practices.). The selected firms belong to 18 different sectors such as, automobile, textile, cement, chemical, electric goods, engineering, fertilizers, food and personal care, paper and board, pharmaceutical, sugar and allied, synthetic and rayon, technology and communication, tobacco, transport and logistics, glass and ceramics, leather and tanneries, and Vanaspati. These firms adhere to sustainable practices and work efficiently to achieve environmental sustainability in different processes of manufacturing.

#### Why ISO 14000/14001 Firms?

The reason behind choosing ISO 14000/14001 firms is that it is an internationally agreed standard that sets out the requirements for an environmental management system. It allows firms to enhance their performance through waste reduction and productive use of sacred resources, which in turn results in providing competitive advantage and increases stakeholders trust. Standards of the ISO 14000 family addresses the issues related to environmental management and also has described six tools for regulators, organizations, and consumers, such as facilitating the development of uniform requirements, being technically credible, supporting the regulatory compliance, fulfilling needs of the stakeholders, and enhancing the confidence of the investor [10]. Therefore, selection of ISO 14001 firms helps in achieving our research goal that is examining the relationship between sustainable supply chain risk, sustainable supply chain integration, and firm's financial performance.

### 3.2. Questionnaire Design and Data Collection

We collected data from companies listed on the Pakistan Stock Exchange. The reason behind choosing the listed companies are; first, strict governance according to Pakistan Standard Association (PSA) rules related to environmental issues, secondly, they are mostly larger firms and are required to publish their audited annual reports, which made our goal of measuring firms' performance possible.

The survey instrument was generated after the close intact with SCR and SSCR literature, theory and field practices, and consultation with the experienced researchers and practitioners of the supply chain. Nine-point Likert scale questionnaire (e.g., 1 = strongly disagree to 9 = strongly agree at both ends) was designed and sent to five academicians and a panel of supply chain practitioners were consulted to analyze the questions and their compatibility with the research goals.

The questionnaire has four parts; the first part is about company information, respondent information, sector and their knowledge about SSCM and SSCR, and integration. The second section consists of questions regarding SSCR, for which the respondent indicates the level of risk on a 9-point Likert scale during the year 2018. The third part consists of questions related to three dimensions of SSC integration (internal, supply, customer), which measures the certain firm's level of modification in operations and strategies according to the situation. Finally, the fourth part consists of a number of employees in the firms and the amount spent on supply chain activities.

The target respondents for our study are supply chain/procurement/logistic/production manager. We sent out 460 questionnaires, out of which 296 companies participated in the study with a response rate of 64%, this is considered extraordinary. The response distribution for the final sample size is presented in Figure 2. Details of the sample and respondents' profile are presented in Table 1.

**Table 1.** Sample and respondents' profile.

Sr. No.	Industry	No.	No. of Employees	No.
1	Automobile	20	<100	45
2	Textile	103	101–500	71
3	Cement	17	501–1000	69
4	Chemical	24	1001–5000	95
5	Electric Goods	6	5000–10,000	10
6	Engineering	15	>10,000	6
7	Fertilizers	7		
8	Food and Personal Care	20	<b>Respondents Profile</b>	
9	Paper and Board	8	Supply chain manager	68
10	Pharmaceutical	12	Procurement manager	80
11	Sugar and Allied	23	Production manager	112
12	Synthetic and Rayon	9	Logistics manager	36
13	Technology and Communication	11		
14	Tobacco	3	<b>Experience</b>	
15	Transport and Logistics	3	1–5 years	56
16	Glass and Ceramics	7	5–10 years	95
17	Leather and Tanneries	5	>10 years	145
18	Vanaspati	3		
	Total	296		

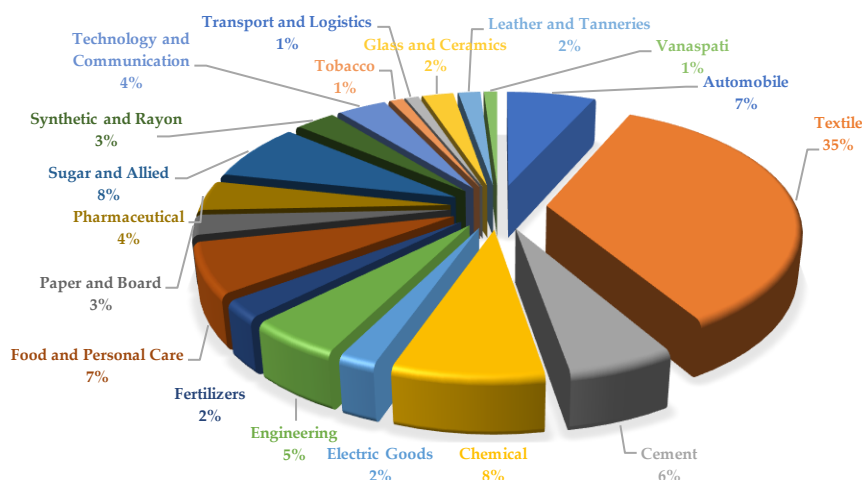


Figure 2. Response distribution.

### 3.3. Measurements

In this section, we have explained the details about constructs used in this study, such as sustainable supply chain risk, sustainable supply chain integration, and firm's financial performance. Three risk variables based on the risk classification of Christopher and Peck [47] are used in this study, which are the firm's internal risks, sustainable supply risks, and sustainable demand risks. SCR variables are taken after careful examination of the prior literature [76,77], which was turned into questions to identify their impact on SSCI and firm's financial performance. All the constructs are explained in Table 2.

Table 2. Survey items for the final measurement model.

Constructs	Factor Loadings	Measures
<b>Sustainable Firms Internal Risk (SFIR), CR = 0.85, AVE = 0.54, SRMR = 0.02</b>		
SFIR1	0.84	Our firm faces machine breakdown and bad equipment handling issues
SFIR2	0.72	Our firm planning and scheduling did not disturb due to SSCR *
SFIR3	0.61	Our firm faces issues due to rapidly changing green technology
SFIR4	0.80	Our sustainable process is slow, which takes long lead times
SFIR7	0.64	Our firm faces issues in sustainable product design for our products
<b>Sustainable Supply Risk (SSR), CR = 0.93, AVE = 0.74, SRMR = 0.01</b>		
SSR1	0.85	Our firm faces difficulties in finding a green supplier
SSR2	0.83	Our firm faces supplier quality issues for green raw material
SSR3	0.88	Our firm faces green supplier delivery failures
SSR4	0.87	Our firm faces supply issues due to poor communication with the supplier
SSR5	0.87	Our firm faces supply issues due to the financial instability of the supplier
<b>Sustainable Demand Risk (SDR), CR = 0.85, AVE = 0.60, SRMR = 0.01</b>		
SDR1	0.83	Our firm faces huge variations in demand for green products
SDR2	0.86	Our firm does not face inventory shortage due to demand variations *
SDR3	0.55	Our firm faces market price decline uncertainties
SDR5	0.80	For our firm, it is difficult to predict customers changing the taste

Table 2. Cont.

Constructs	Factor Loadings	Measures
<b>Sustainable Internal Integration (SII), R = 0.92, AVE = 0.70, SRMR = 0.009</b>		
SII1	0.92	Our firm management is committed to environmental practices
SII2	0.86	Our firm actively communicate environmental issues within different departments
SII3	0.90	Our firm implement audits to comply with environmental compliance
SII4	0.65	Our firm engages in cross-cultural cooperation to improve the environment
SII5	0.83	Our firm works in a team for the development of new projects and products
<b>Sustainable Supply Integration (SSI), CR = 0.96, AVE = 0.84, SRMR = 0.01</b>		
SSI1	0.95	Our firm collaborates with suppliers to achieve green supply chain goals
SSI2	0.88	Our firm provide complete design specifications to suppliers according to environmental specifications
SSI3	0.91	Our firm encourage suppliers to take environmental certification such as ISO 14000/140001
SSI4	0.94	Our firm selects suppliers following environmental aspects
SSI5	0.90	Our firm helps suppliers in improving quality of the sustainable products
<b>Sustainable Customer Integration (SCUI), CR = 0.93, AVE = 0.81, SRMR = 0.001</b>		
SCUI1	0.93	Our firm collaborates with its customers to jointly achieve environmental goals
SCUI2	0.90	Our firm collaborates with its customers to reduce the harmful impact of its products on the environment
SCUI3	0.88	Our firm cooperate with its customers for green distribution and green packaging
<b>Firm Financial Performance (FFP), CR = 0.96, AVE = 0.93, SRMR = 0.03</b>		
FFP1	0.99	Return on assets
FFP2	0.93	Return on equity

\* Reverse coded items.

On the basis of the previous literature [35,38,78], sustainable firms internal risks are measured through seven-points (e.g., “SFIR1: Our firm faces high uncertainty of green product markets”, five items for sustainable supply risks (e.g., “SSR1: Our firm faces difficulties in finding green supplier”), five items for sustainable demand risks (e.g., “SDR1: Our firm faces huge variations in demand of green products”). Sustainable supply chain integration is measured through three dimensions classified in [44,58] such as internal integration, supply integration, and customer integration. Sustainable internal integration is measured through three-points (e.g., “SII1: Our firm management is committed to environmental practices”), five points for sustainable supply integration (e.g., “SSI1: Our firm collaborates with suppliers to achieve green supply chain goals”), five points for sustainable customer integration (e.g., “SCUI1: Our firm collaborates with its customers to jointly achieve environmental goals”).

We have taken two accounting-based measures to return on assets (ROA) and return on equity (ROE), to measure the financial performance of the sustainable firms. ROA suggests how much a firm is efficient in terms of generating profits from its applied resources [79]. ROE is the measure of firm efficiency in generating profits from shareholder’s investments [80]. We have calculated ROA and ROE by using the following formulas:

$$\text{Return on assets} = \text{Profit after tax} / \text{total assets} \quad (1)$$

$$\text{Return on equity} = \text{Profit after tax/shareholder's equity} \quad (2)$$

### 3.4. Analysis of Constructs Validity and Reliability

In order to get stable factor solutions, we have checked the constructs validity through two steps. At first, we performed the exploratory factor analysis (EFA) and all the items having factor loading lower than 0.30 were excluded from the study. All the factor loadings range between 0.55 and 0.99, which are high factor loadings and are significant at  $p < 0.001$ , suggesting that convergent validity exists for the particular overall measurement model. According to Harrington [81], high factor loading suggests, factors are convergent on the same point, which shows high convergent validity. Similarly, the composite reliability (CR) of the constructs are computed by the sum of squared factor loadings, divided by the sum of squared factor loadings plus the sum of errors extracted, which states does the measurement of the construct have consistency. Secondly, we performed the confirmatory factor analysis (CFA) using Amos 26 in order to get the discriminate validity.

We checked the convergent validity of the constructs through standardized factor loadings, CR and AVE. The obtained CRs for the overall measurement model are 0.85, 0.93, 0.85, 0.93, 0.96, 0.92, 0.96 which are greater than 0.60 a threshold value [82,83]. In order to check the discriminant validity, we have calculated the average variance extracted (AVE) for all constructs, which suggests how much a construct is distinct from the other construct. The AVEs for the overall measurement model are 0.54, 0.74, 0.60, 0.81, 0.84, 0.70, and 0.93, which are higher than the threshold value of 0.50 [82,84]. The fit indices for the current isolated model showed a good fit with the particular observed data. The SRMRs of the isolated model is smaller than or equal to 0.03, which shows a good model fit [81].

Reliability of the constructs is checked through Cronbach's alpha (0.89, 0.93, 0.93, 0.94, 0.95, 0.95) which are greater than the threshold value of 0.70 [85]. The fit indices of the factors in an isolated model is, ( $\chi^2/\text{df} = 1.650$ , CFI = 0.998, TLI = 0.998, NFI = 0.960, PCFI = 0.86, PNFI = 0.83, and RMSEA = 0.013). The correlations, CR, AVE, Cronbach's alpha, mean, and SD are presented in Table 3.

**Table 3.** Correlations, composite reliability (CR) and average variance extracted (AVE).

	SFIR	SSR	SDR	SII	SSI	SCUI	FFP
<b>SFIR</b>	1.000						
<b>SSR</b>	0.464	1.000					
<b>SDR</b>	0.195	−0.029	1.000				
<b>SII</b>	0.133	−0.024	0.197	1.000			
<b>SSI</b>	−0.622	−0.644	−0.188	−0.136	1.000		
<b>SCUI</b>	−0.479	−0.428	−0.022	−0.128	0.605	1.000	
<b>FFP</b>	−0.182	−0.153	0.078	0.020	1.198	0.123	1.000
<b>AVE</b>	0.545	0.743	0.601	0.816	0.845	0.702	0.936
<b>CR</b>	0.854	0.932	0.849	0.931	0.963	0.924	0.964
<b>Mean</b>	3.259	3.72	6.02	5.86	4.45	4.38	5.59
<b>SD</b>	2.04	1.62	0.90	0.88	0.99	2.06	29.81
<b>N</b>	296	296	296	296	296	296	296

## 4. Results

### Analysis of Overall Measurement Model

The objective of this measurement model is to create a valid SSCR measurement model for testing the hypothesis's represented in Figure 1. The measurement model includes firms' internal risk, sustainable supply risk, sustainable demand risk, sustainable internal integration, sustainable supply integration, sustainable customer integration, and firms' financial performance.

This section describes the results of the final measurement model. We test the hypothesis in the model using SEM in AMOS 26. The fit indices of the seven-factors are, ( $\chi^2/\text{df} = 1.075$ , CFI = 0.997, TLI = 0.996, NFI = 0.956, PCFI = 0.86, PNFI = 0.83, and RMSEA = 0.016).  $\chi^2/\text{df} = 1.075$  that is smaller than



2.00, which is a threshold value [82] CFI = 0.998, TLI = 0.998, and NFI = 0.964, are greater than 0.900, which is a threshold value described by Fornell and Larcker [84]; RMSEA is 0.016, which is smaller than 0.080, a threshold value suggested by [38,82,83]. The SRMRs of the isolated model is smaller than or equal to 0.03, which shows a good model fit [81].

Figure 3 presents the results of five hypotheses (H1–H6), and summary of hypotheses results are presented in Table 4.

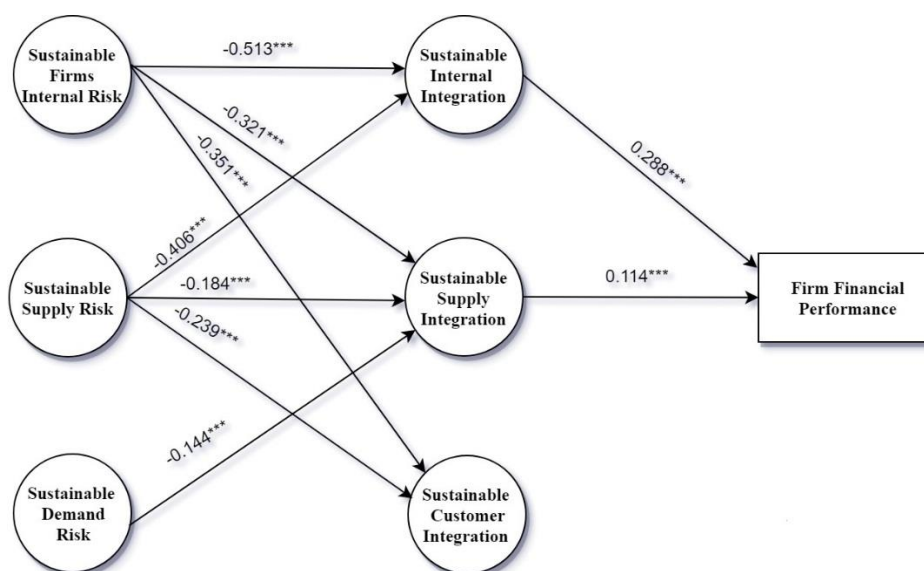


Figure 3. Hypothesized results.

Table 4. Summary of hypotheses results.

Hypotheses	Standardized Path Coefficient	Results
H1a: Sustainable firms internal risk (SFIR) $\geq$ Sustainable internal integration (SII)	−0.513 ***	Supported
H1b: Sustainable firms internal risk (SFIR) $\geq$ Sustainable supply integration (SSI)	−0.321 ***	Supported
H1c: Sustainable firms internal risk (SFIR) $\geq$ Sustainable customer integration (SCUI)	−0.351 ***	Supported
H2a: Sustainable supply risk (SSR) $\geq$ Sustainable internal integration (SII)	−0.406 ***	Supported
H2b Sustainable supply risk (SSR) $\geq$ Sustainable supply integration (SSI)	−0.184 **	Supported
H2c: Sustainable supply risk (SSR) $\geq$ Sustainable customer integration (SCUI)	−0.239 ***	Supported
H3a: Sustainable demand risk (SDR) $\geq$ Sustainable internal integration (SII)	−0.057	Not Supported
H3b Sustainable demand risk (SDR) $\geq$ Sustainable supply integration (SSI)	−0.144 **	Supported
H3c: Sustainable demand risk (SDR) $\geq$ Sustainable customer integration (SCUI)	−0.069	Not Supported
H4: Sustainable internal integration (SII) $\geq$ Firm's financial performance (FFP)	0.288 ****	Supported
H5: Sustainable supply integration (SSI) $\geq$ Firm's financial performance (FFP)	0.114 **	Supported
H6: Sustainable customer integration (SCUI) $\geq$ Firm's financial performance (FFP)	0.055	Not Supported

First, hypotheses measure the impact of the sustainable firm's internal risks on sustainable integration practices. Results ( $\beta = -0.513$ ,  $p = 0.000$ ) of H1a exhibit that the firm's internal risks have a negative association with sustainable internal integration. H1b exhibits that sustainable firms' internal risks, has a direct negative association with sustainable supply integration ( $\beta = -0.321$ ,  $p = 0.000$ ), H1c

exhibits that sustainable firms' internal risks, has a negative association with sustainable customer integration ( $\beta = -0.351, p = 0.000$ ). We used the maximum likelihood method, which calculated the total effects of the firm's internal risks through sustainable supply chain integration on the firm's financial performance that is  $-0.050$ , shown in Table 5.

**Table 5.** Direct, indirect and total effects.

	SFIR			SSR			SDR			SII			SSI			SCUI		
	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE
SII	-0.51		-0.51	-0.40		-0.40	-0.05		-0.05									
SSI	-0.35		-0.35	-0.23		-0.23	-0.06		-0.06									
SCUI	-0.32		-0.32	-0.18		-0.18	-0.14		-0.14									
FFP		-0.050			-0.35			-0.3		0.29		0.29	0.15		0.15	0.011		0.011

Second hypotheses measure the impact of sustainable supply risk on sustainable integration practices. H2a exhibit that sustainable supply risks have a negative association with sustainable internal integration ( $\beta = -0.406, p = 0.000$ ). H2b exhibits that sustainable supply risk, have a direct negative association with sustainable supply integration ( $\beta = -0.184, p = 0.000$ ), H1c exhibits that sustainable supply risk, have a negative association with sustainable customer integration ( $\beta = -0.239, p = 0.000$ ). We used the maximum likelihood method, which calculated the total effects of the firm's internal risks through sustainable supply chain integration on the firm's financial performance that is  $-0.035$ , shown in Table 5.

Third hypotheses measure the impact of sustainable demand risks on sustainable integration practices. H3a exhibit that sustainable demand risks have a negative association with sustainable internal integration; however, the relationship is insignificant ( $\beta = -0.057, p = 0.176$ ). H3b exhibits that sustainable demand risks, have a direct negative association with sustainable supply integration ( $\beta = -0.211, p = 0.018$ ), H1c exhibits that sustainable demand risks, have a negative association with sustainable customer integration however the relationship is insignificant ( $\beta = -0.069, p = 0.176$ ). We used the maximum likelihood method, which calculated the total effects of the firm's internal risks through sustainable supply chain integration on the firm's financial performance that is  $-0.03$ , shown in Table 5.

Results of H4 suggest a significant positive relationship between sustainable internal integration and firm's financial performance ( $\beta = 0.288, p = 0.000$ ). Results of H5 suggest a significant positive relationship between sustainable supply integration and firm's financial performance ( $\beta = 0.114, p = 0.047$ ). Results of H6 suggest a significant positive relationship between sustainable customer integration and firm's financial performance; however, the relationship is insignificant ( $\beta = 0.055, p = 0.833$ ).

## 5. Discussion and Conclusions

Results of this study are two-fold; first, they present the connection between sustainable supply chain risk and sustainable supply chain integration and provide the implications for supply chain integration practices and theories. Secondly, results show that sustainable supply chain risks are creating barriers for the implementation of sustainable supply chain integration. Moreover, findings of the study indicated that sustainable firms' internal risks and sustainable supply risks have a negative impact on all three practices of integration. Which means that sustainable integration practices allow firms to track and tackle sustainable supply chain risks and reduces the impact of harmful consequences. Moreover, findings of this study indicate that management practices of SCRM enables firms to manage risks in their supply chains, which in turn improves their performance. Results of our study are following the findings of [25,32].

SFIR has a significant negative impact on all three types of sustainable supply integration practices, which suggests that firms are not adequately engaged in handling the risks and their processes and operations and leads to difficulty in implementation of sustainable supply integration practices. Risks

such as machine breakdowns, increasing lead-times, not adapting changing technology, and poor sustainable product designs are the key barriers in practicing sustainable integration. The findings are congruent with the results of [23]. SSR directly effects sustainable supply integration due to issues from the supplier side such as delivery delays, delivery failures, quality problems, and financial instability. According to [41], risks associated with a supplier could lead to inconsistency in meeting customers' requirements.

Moreover, delays in raw material delivery or delivery failure can disrupt manufacturing processes and delays in delivery to customers, which leads to poor customer relationship and less customer integration [32]. In contrast, SDR has a negative relationship with all three practices of integration, but the relationship is only significant with supply integration. The results suggest that firms are good at interacting with supplier firms, but they are not good at measuring customer demand accurately, meeting in changing the taste and could not adapt to changing market prices.

The findings of the study indicated that the firm's internal risks and sustainable supply risks are the key hindrances in practicing sustainable supply chain integration. Most of the firms are operating through a just-in-time inventory system, and the delays from the supplier can create severe issues for the firms. Therefore, our study has managerial implications and suggests that managers assess and manage the supply side risks in their supply chains and properly implement sustainable supply integration practices, because reducing the barriers from the supplier side are the first step in implementing SCI [25].

Furthermore, this study also examined the relationship of sustainable supply chain integration and firm's financial performance. It is the first study to contribute the literature of sustainable supply chain risk, sustainable supply chain integration and firm's financial performance. The results of the study indicated that sustainable internal integration and sustainable supply integration have a significant positive relationship with firm's financial performance; however, sustainable customer integration remained insignificant. Our results are compatible with the findings of [24,25,54,86]. According to Power [86] as soon as a company implements supply chain integration it develops a network of communication among different associated members in the supply chain, and they realize the requirements of each other; therefore, a collaborative effort restricts supply chain risks to disrupt the normal operations and in turn the firm's performance increases.

This investigation contributes to the literature of sustainable supply chain risks and sustainable supply chain integration through an empirical investigation of the relationship between SSCRs, SSCI, and firm's financial performance using data of 296 manufacturing firms from Pakistan. Results of this study propose that sustainable supply chain risks are barriers in the implementation of sustainable supply chain integration. The firm's internal risks are negatively related to all aspects of sustainable supply chain integration in the current study, and the relationship is statistically significant. Moreover, sustainable supply risks are also negatively and significantly associated with sustainable supply chain integration practices. Sustainable demand risks are negatively and significantly related to sustainable supply integration. Results of the study enumerate that different types of risks have a different impact on sustainable supply chain integration, but sustainable supply risks have been founded as the most vulnerable risks. The study used the data on annual financial statements to measure the relationship between supply chain integration and firm's financial performance. The results of the survey indicate that the firm's internal risks and sustainable supply risks are negatively and significantly related to firm's financial performance. However, the finding of this research shows no significant relationship between sustainable customer integration and firm's financial performance.

### 5.1. Theoretical and Practical Implications

This study contributes to the literature of SCRM through empirical investigation of the relationship between SSCR, SSCI, and firm's financial performance. The above discussed results of the study provide guidelines to managers to develop and integrate risk management practices in accordance with sustainable integration practices, which could tackle risks in the supply chains and improve

firm's overall performance. The study provides a number of theoretical contributions. First, this study connected two disjointed literatures such as sustainable supply chain risk and sustainable supply chain integration and showed the impact of SSCR on SSCI and FFP. A framework for better understanding the relationship between SSCR, SSCI, and FFP is provided through theoretical integrated perspectives, more specifically the influence of SSCR is presented on FFP through mediation of SSCI. Furthermore, we have contributed through explaining the influence of each SSCR on each dimension of SSCI and FFP. It explains that not all SSCR have influence on SSCI, and SSCI on FFP. Therefore, this study provides insights of each dimension of SSCI to the managers to understand and enable it during the time of need. The indirect effects of SSCR on FFP suggests that if the relationship would not be mediated through SSCI, then SSCR (especially SDR and SSR) would have more worse impact on FFP. Therefore, this study recommends supply chain managers to consider practicing supply chain integration in order to develop a collaborative system through supplier–customer relationship for risk mitigation, which in turn increases firm's financial performance.

## 5.2. Limitations and Future Implications

Although, this study brought some good guiding principles for the managers in the organization to increase firm's financial performance through proper implementation of sustainable supply chain integration. However, similar to every study, this study is prone to limitations which could open future research avenues. First, supply chain risks have multiple dimensions, and we have taken only three dimensions in our studies such as the firm's internal risks, sustainable supply risks, and sustainable demand risks. Further studies with different dimensions such as environmental risks, industry risks, and macro risks could provide different insights. Second, the study only used data from a single country (Pakistan), a cross-country study could give better insights of the relationship of sustainable supply chain risk, sustainable supply chain integrations, and firm's financial performance. Finally, this study proposes to future researchers to include suppliers of the firms and customer as respondents to see the three-fold effects of sustainable supply chain risks, sustainable supply chain integration and firm's financial performance. Moreover, this study only accounts the manufacturing firms in Pakistan, therefore its implication is limited to other industries and countries due to behavioral and country specific peculiarities. In general, this research provides a better ground for future research in South-Asian countries, because researches conducted in western countries couldn't be implemented in these countries due to different behavioral peculiarities from the western countries. Therefore, this research provides companies a better solution for mitigating risk in their supply chains through proper implementation of SSCI which in turn improves performance.

**Author Contributions:** M.W.S. contributed to developing the conceptual model, analysis of the data, and compilation of the results. M.J. contributed to refining the conceptual model, development of the hypotheses and manuscript writing. J.Z.L. and X.Y. contributed to proofreading and manuscript editing. M.Z. helped in data collection and data management process.

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## References

1. Zimon, D.; Domingues, P. Proposal of a Concept for Improving the Sustainable Management of Supply Chains in the Textile Industry. *Fibers Text. East. Eur.* **2018**, *26*, 8–12. [[CrossRef](#)]
2. Burki, U.; Ersoy, P.; Najam, U. Top management, green innovations, and the mediating effect of customer cooperation in green supply chains. *Sustainability* **2019**, *11*, 1031. [[CrossRef](#)]
3. Nazam, M.; Xu, J.; Tao, Z.; Ahmad, J.; Hashim, M. A fuzzy AHP-TOPSIS framework for the risk assessment of green supply chain implementation in the textile industry. *Int. J. Supply Oper. Manag.* **2015**, *2*, 548–568. [[CrossRef](#)]

4. Elkington, J. Triple bottom line. *Environ. Qual. Manag.* **1998**, *8*, 37–51. [[CrossRef](#)]
5. Curkovic, S.; Sroufe, R. Using ISO 14001 to promote a sustainable supply chain strategy. *Bus. Strategy Environ.* **2011**, *20*, 71–93. [[CrossRef](#)]
6. Hart, S.L. A natural-resource-based view of the firm. *Acad. Manag. Rev.* **1995**, *20*, 986–1014. [[CrossRef](#)]
7. Guang, V.S.; Lenny Koh, S.C.; Baldwin, J.; Cucchiella, F. Natural resource based green supply chain management. *Supply Chain Manag. Int. J.* **2012**, *17*, 54–67. [[CrossRef](#)]
8. Fonseca, L.; Domingues, J.; Pereira, M.; Martins, F.; Zimon, D. Assessment of circular economy within Portuguese organizations. *Sustainability* **2018**, *7*, 2521. [[CrossRef](#)]
9. Zhu, Q.; Sarkis, J.; Cordeiro, J.J.; Lai, K.H. Firm-level correlates of emergent green supply chain management practices in the Chinese context. *Omega* **2008**, *36*, 577–591. [[CrossRef](#)]
10. International Organization for Standardization. Environmental Management: The ISO 14000 Family of International Standards. 2018. Available online: [https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/theiso14000family\\_2009.pdf](https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/theiso14000family_2009.pdf) (accessed on 14 July 2019).
11. Mathiyazhagan, K.; Govindan, K.; Noorul Haq, A. Pressure analysis for green supply chain management implementation in Indian industries using analytic hierarchy process. *Int. J. Prod. Res.* **2014**, *52*, 188–202. [[CrossRef](#)]
12. Mangla, S.K.; Kumar, P.M.; Barua, K. Risk analysis in green supply chain using fuzzy AHP approach: A case study. *Resour. Conserv. Recycl.* **2015**, *104*, 375–390. [[CrossRef](#)]
13. Silbermayr, L.; Minner, S. A multiple sourcing inventory model under disruption risk. *Int. J. Prod. Econ.* **2014**, *149*, 37–46. [[CrossRef](#)]
14. Ortegoli, A.; Ghadim, M.R.K. The effect of risk factors on the green supply chain and prioritizing of the effects by using AHP. *Int. J. Humanit. Cult. Stud.* **2016**, *special issue (March)*, 1478–1493. Available online: <https://www.ijhcs.com/index.php/ijhcs/article/view/2303/2096> (accessed on 20 July 2019).
15. Qianlei, L. The study on the risk management of agricultural products green supply chain based on systematic analysis. In Proceedings of the IEEE 2nd International Conference in Business Computing and Global Informatization (BCGIN), Shanghai, China, 12–14 October 2012; pp. 250–253. Available online: <http://louisville.edu/purchasing/sustainability/greenpurchasingsupplychain> (accessed on 15 July 2019).
16. Ruimin, M.; Yao, L.; Huang, R. The green supply chain management risk analysis. *Adv. Mater. Res.* **2012**, *573–574*, 734–739. [[CrossRef](#)]
17. Chopra, S.; Meindl, P. Supply Chain Management. Strategy, Planning & Operation. In *Das Summa Summarum des Management*; Springer: Berlin/Heidelberg, Germany, 2007; pp. 265–275.
18. Luthra, S.; Garg, D.; Haleem, A. An analysis of interactions among critical success factors to implement green supply chain management towards sustainability: An Indian perspective. *Resour. Policy* **2015**, *46*, 37–50. [[CrossRef](#)]
19. Kumar, S.; Luthra, S.; Haleem, A.; Mangla, S.K.; Garg, D. Identification and evaluation of critical factors to technology transfer using AHP approach. *Int. Strateg. Manag. Rev.* **2015**, *3*, 24–42. [[CrossRef](#)]
20. Riley, J.M.; Klein, R.; Mille, J.; Sridharan, V. How internal integration, information sharing, and training affect supply chain risk management capabilities. *Int. J. Phys. Distrib. Logist. Manag.* **2016**, *46*, 953–980. [[CrossRef](#)]
21. Andrea, W.; Wallenburg, C.M. Dealing with supply chain risks: Linking risk management practices and strategies to performance. *Int. J. Phys. Distrib. Logist. Manag.* **2012**, *42*, 887–905.
22. Handfield, R.B.; Blackhurst, J.; Elkins, D.; Craighead, C.W. A framework for reducing the impact of disruptions to the supply chain: Observations from multiple executives. *Supply Chain Risk Manag.* **2007**, *29–49*. Available online: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.515.944&rep=rep1&type=pdf> (accessed on 12 June 2019).
23. Flynn, B.B.; Huo, B.; Zhao, X. The impact of supply chain integration on performance: A contingency and configuration approach. *J. Oper. Manag.* **2010**, *28*, 58–71. [[CrossRef](#)]
24. Zhao, X.; Huo, B.; Selen, W.; Yeung, J. The impact of relationship commitment and internal integration on external integration. *J. Oper. Manag.* **2011**, *29*, 17–32. [[CrossRef](#)]
25. Frohlich, M.T.; Westbrook, R. Demand chain management in manufacturing and services: Web-based integration, drivers and performance. *J. Oper. Manag.* **2002**, *20*, 729–745. [[CrossRef](#)]
26. Richey, R.G., Jr.; Chen, H.; Upreti, R.; Fawcett, S.E.; Adams, F.G. The moderating role of barriers on the relationship between drivers to supply chain integration and firm performance. *Int. J. Phys. Distrib. Logist. Manag.* **2009**, *39*, 826–840. [[CrossRef](#)]



27. Mohamed, A.-B.; Gunasekaran, M.; Mohamed, M.; Chilamkurti, N. A framework for risk assessment, management and evaluation: Economic tool for quantifying risks in supply chain. *Future Gener. Comput. Syst.* **2019**, *90*, 489–502.
28. Soosay, C.A.; Hyland, P.W.; Ferrer, M. Supply chain collaboration: Capabilities for continuous innovation. *Supply Chain Manag.* **2008**, *13*, 160–169. [[CrossRef](#)]
29. Vachon, S.; Klassen, R.D. Environmental management and manufacturing performance: The role of collaboration in the supply chain. *Int. J. Prod. Econ.* **2008**, *111*, 299–315. [[CrossRef](#)]
30. Wieland, A.; Marcus Wallenburg, C. The influence of relational competencies on supply chain resilience: A relational view. *Int. J. Phys. Distrib. Logist. Manag.* **2013**, *43*, 300–320. [[CrossRef](#)]
31. Pettit, T.J.; Croxton, K.L.; Fiksel, J. Ensuring supply chain resilience: Development and implementation of an assessment tool. *J. Bus. Logist.* **2013**, *34*, 46–76. [[CrossRef](#)]
32. Zhao, L.; Huo, B.; Sun, L.; Zhao, X. The impact of supply chain risk on supply chain integration and company performance: A global investigation. *Supply Chain Manag. Int. J.* **2013**, *18*, 115–131. [[CrossRef](#)]
33. Bavarsad, B.; Boshagh, M.; Kayedian, A. A study on supply chain risk factors and their impact on organizational Performance. *Int. J. Oper. Logist. Manag.* **2014**, *3*, 192–211.
34. Ahi, P.; Searcy, C. A comparative literature analysis of definitions for green and sustainable supply chain management. *J. Clean. Prod.* **2013**, *52*, 329–341. [[CrossRef](#)]
35. Rostamzadeh, R.; Ghorabae, M.K.; Govindan, K.; Esmaili, A.; Nobar, H.B.K. Evaluation of sustainable supply chain risk management using an integrated fuzzy TOPSIS-CRITIC approach. *J. Clean. Prod.* **2018**, *175*, 651–669. [[CrossRef](#)]
36. Buddress, L. Managing Supply Chain Sustainability and Risk. In Proceedings of the Conference Board, New York, NY, USA, 23 January 2014.
37. Chopra, S.; Sodhi, M.S. Managing risk to avoid supply-chain breakdown. *MIT Sloan Manag. Rev.* **2004**, *46*, 53–61.
38. Chen, H.L. Supply chain risk's impact on corporate financial performance. *Int. J. Oper. Prod. Manag.* **2018**, *38*, 713–731. [[CrossRef](#)]
39. Christopher, M.; Lee, H. Mitigating supply chain risk through improved confidence. *J. Phys. Distrib. Logist. Manag.* **2004**, *34*, 388–396. [[CrossRef](#)]
40. Peck, H. Drivers of supply chain vulnerability: An integrated framework. *J. Phys. Distrib. Logist. Manag.* **2005**, *35*, 210–232. [[CrossRef](#)]
41. Zsidisin, G.A. Managerial perceptions of supply risk. *J. Supply Chain Manag.* **2003**, *39*, 14–26. [[CrossRef](#)]
42. Hofmann, H.; Busse, C.; Bode, C.; Henke, M. Sustainability-related supply chain risks: Conceptualization and management. *Bus. Strategy Environ.* **2014**, *23*, 160–172. [[CrossRef](#)]
43. Harwood, I.; Humby, S. Embedding corporate responsibility into supply: A snapshot of progress. *Eur. Manag. J.* **2008**, *26*, 166–174. [[CrossRef](#)]
44. Wu, G. The influence of green supply chain integration and environmental uncertainty on green innovation in Taiwan's IT industry. *Supply Chain Manag.* **2013**, *18*, 539–552. [[CrossRef](#)]
45. Lee, K.H.; Vachon, S. Supply Chain Sustainability Risk. In *Business Value and Sustainability*; Palgrave Macmillan: London, UK, 2016; pp. 245–280.
46. Xu, M.; Cui, Y.; Hu, M.; Xu, X.; Zhang, Z.; Liang, S.; Qu, S. Supply chain sustainability risk and assessment. *J. Clean. Prod.* **2019**, *225*, 857–867. [[CrossRef](#)]
47. Christopher, M.; Peck, H. Building the Resilient Supply Chain. *Int. J. Logist. Manag.* **2004**, *15*, 1–14. [[CrossRef](#)]
48. Ceryno, P.; Scavarda, L.; Klingebiel, K.; Yüzgülec, G. Supply chain risk management: A content analysis approach. *Int. J. Ind. Eng. Manag.* **2013**, *4*, 141–150.
49. Zhao, X.; Huo, B.; Flynn, B.B.; Yeung, J.H.Y. The impact of power and relationship commitment on the integration between manufacturers and customers in a supply chain. *J. Oper. Manag.* **2008**, *26*, 368–388. [[CrossRef](#)]
50. Chen, I.J.; Paulraj, A. Towards a theory of supply chain management: The constructs and measurements. *J. Oper. Manag.* **2004**, *22*, 119–150. [[CrossRef](#)]
51. Woojung, C.; Alexander, E.E.; Kim, K.; George, R.F. Supply chain integration and firm financial performance: A meta-analysis of positional advantage mediation and moderating factors. *Eur. Manag. J.* **2016**, *34*, 282–295. [[CrossRef](#)]
52. Lee, H.L.; Whang, S. Winning the last mile of e-commerce. *Sloan Manag. Rev.* **2001**, *42*, 54–62.

53. Stevens, G.C. Integrating the supply chain. *J. Phys. Distrib. Logist. Manag.* **1989**, *19*, 3–8. [\[CrossRef\]](#)
54. Swink, M.; Narasimhan, R.; Wang, C. Managing beyond the factory walls: Effects of four types of strategic integration on manufacturing plant performance. *J. Oper. Manag.* **2007**, *25*, 148–164. [\[CrossRef\]](#)
55. Vickery, S.K.; Jayaram, J.; Droge, C.; Calantone, R. The effects of an integrative supply chain strategy on customer service and financial performance: An analysis of direct versus indirect relationships. *J. Oper. Manag.* **2003**, *21*, 523–539. [\[CrossRef\]](#)
56. Leuschner, R.; Rogers, D.S.; Charvet, F.F. A meta-analysis of supply chain integration and firm performance. *J. Supply Chain Manag.* **2013**, *49*, 34–57. [\[CrossRef\]](#)
57. Hill, C.A.; Scudder, G.D. The use of electronic data interchange for supply chain coordination in the food industry. *J. Oper. Manag.* **2002**, *20*, 375–387. [\[CrossRef\]](#)
58. Holweg, M.; Disney, S.; Holmström, J.; Småros, J. Supply chain collaboration: Making sense of the strategy continuum. *Eur. Manag. J.* **2005**, *23*, 170–181. [\[CrossRef\]](#)
59. Saeed, K.A.; Malhotra, M.K.; Grover, V. Examining the impact of interorganizational systems on process efficiency and sourcing leverage in buyer supplier dyads. *Decis. Sci.* **2005**, *36*, 365–396. [\[CrossRef\]](#)
60. Ireland, R.D.; Webb, J.W. A multi-theoretic perspective on trust and power in strategic supply chains. *J. Oper. Manag.* **2007**, *25*, 482–497. [\[CrossRef\]](#)
61. Johnson, J.L. Strategic integration in industrial distribution channels: Managing the interfirm relationship as a strategic asset. *J. Acad. Mark. Sci.* **1999**, *27*, 4–18. [\[CrossRef\]](#)
62. Chen, I.J.; Paulraj, A.; Lado, A.A. Strategic purchasing, supply management, and firm performance. *J. Oper. Manag.* **2004**, *22*, 505–523. [\[CrossRef\]](#)
63. Thun, J.-H.; Hoenig, D. An empirical analysis of supply chain risk management in the German automotive industry. *Int. J. Prod. Econ.* **2011**, *131*, 242–249. [\[CrossRef\]](#)
64. Gautam, A.; Prakash, S.; Soni, U. Supply chain risk management and quality: A case study and analysis of Indian automotive industry. *Int. J. Intell. Enterp.* **2018**, *5*, 194–212. [\[CrossRef\]](#)
65. Amrina, E.; Vils, A.L. Key performance indicators for sustainable manufacturing evaluation in cement industry. *Procedia* **2015**, *26*, 19–23. [\[CrossRef\]](#)
66. Ijomah, W.L.; McMahon, C.A.; Hammond, G.P.; Newman, S.T. Development of design for remanufacturing guidelines to support sustainable manufacturing. *Robot. Comput. Integr. Manuf.* **2007**, *23*, 712–719. [\[CrossRef\]](#)
67. Trkman, P.; McCormack, K. Supply chain risk in turbulent environments—A conceptual model for managing supply chain network risk. *Int. J. Prod. Econ.* **2009**, *119*, 247–258. [\[CrossRef\]](#)
68. Lee, H.L.; Padmanabham, V.; Whang, S. The bullwhip effect in supply chains. *Sloan Manag. Rev.* **1997**, *38*, 93–102. [\[CrossRef\]](#)
69. Hendricks, K.B.; Singhal, V.R.; Stratman, J.K. The impact of enterprise systems on corporate performance: A study of ERP, SCM, and CRM system implementations. *J. Oper. Manag.* **2007**, *25*, 65–82. [\[CrossRef\]](#)
70. Das, A.; Narasimhan, R.; Talluri, S. Supplier integration—Finding an optimal configuration. *J. Oper. Manag.* **2006**, *24*, 563–582. [\[CrossRef\]](#)
71. Devaraj, S.; Krajewski, L.; Wei, J.C. The value of production schedule integration in supply chains. *Decis. Sci.* **2001**, *32*, 601–634. [\[CrossRef\]](#)
72. Wong, W.Y.C.; Lai, K.H.; Shang, K.C.; Lu, C.S.; Leung, T.K.P. Green operations and the moderating role of environmental management capability of suppliers on manufacturing firm perspective. *Int. J. Prod. Econ.* **2012**, *140*, 283–294. [\[CrossRef\]](#)
73. Clark, T.H.; Hammond, J.H. Reengineering channel reordering process to improve total supply chain performance. *Prod. Oper. Manag.* **1997**, *6*, 248–265. [\[CrossRef\]](#)
74. Germain, R.; Iyer, K.N.S. The interaction of internal and downstream integration and its association with performance. *J. Bus. Logist.* **2006**, *27*, 29–52. [\[CrossRef\]](#)
75. Mackelprang, A.W.; Robinson, J.L.; Bernardes, E.; Webb, G.S. The relationship between strategic supply chain integration and performance: A meta analytic evaluation and implications for supply chain management research. *J. Bus. Logist.* **2014**, *35*, 71–96. [\[CrossRef\]](#)
76. Tranfield, D.; Denyer, D.; Smart, P. Towards a Methodology for Developing Evidence Informed Management Knowledge by Means of Systematic Review. *Br. J. Manag.* **2003**, *14*, 207–222. [\[CrossRef\]](#)
77. Colicchia, C.; Strozzi, F. Supply chain risk management: A new methodology for a systematic literature review. *Supply Chain Manag. Int. J.* **2012**, *17*, 403–418. [\[CrossRef\]](#)

78. Miller, K. A framework for integrated risk management in international business. *J. Int. Bus. Stud.* **1991**, *23*, 311–331. [[CrossRef](#)]
79. Mahajan, P.; Singh, F. How do pre-slowdown financial characteristics impact the firms' relative financial performance during economic recession? An empirical investigation. *Asia-Pac. J. Manag. Res. Innov.* **2013**, *9*, 369–378. [[CrossRef](#)]
80. Lau, C.M.; Sholihin, M. Financial and nonfinancial performance measures: How do they affect job satisfaction? *Br. Account. Rev.* **2005**, *37*, 389–413. [[CrossRef](#)]
81. Harrington, D. *Confirmatory Factor Analysis*; Oxford University Press: New York, NY, USA, 2008.
82. Kline, S.J.; Rosenberg, N. An overview of innovation. In *Studies on Science and the Innovation Process*; World Scientific: Singapore, 2010; pp. 173–203. [[CrossRef](#)]
83. Lee, S.-Y. *Structural Equation Modeling: A Bayesian Approach*; John Wiley & Sons: Hoboken, NJ, USA, 2007; Volume 711.
84. Fornell, C.; Larcker, D.F. Evaluating structural equation models with unobservable variables and measurement error. *J. Mark. Res.* **1981**, *18*, 39–50. [[CrossRef](#)]
85. Byrne, B.M. *Structural Equation Modeling with LISREL, PRELIS and SIMPLIS: Basic Concepts, Applications and Programming*; Lawrence Erlbaum Associates: Mahwah, NJ, USA, 1998.
86. Power, D. Supply chain management integration and implementation: A literature review. *Supply Chain Manag.* **2005**, *10*, 252–263. [[CrossRef](#)]



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