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MANAGEMENT | RESEARCH ARTICLE

Factors affecting collaboration in agricultural supply chain: A case study in the North Central region of Vietnam

Thi Dieu Anh Ho¹, Thanh Cuong Dang^{1*}, Van Hao Tran¹, Thi Hang Trinh¹ and Thi Thao Banh¹

Abstract: Based on three fundamental theories, commitment-trust theory of relationship marketing, transaction cost theory, and force field theory, this study has examined the factors affecting collaboration in the agricultural supply chain in the North Central region of Vietnam by analyzing EFA, CFA, and SEM. The research results have shown that trust and commitment are two important antecedents of collaboration, and they have a positive effect on collaboration in the agricultural supply chain. Risk has a negative effect on collaboration and is explained based on the concept of understanding the nature of risk and the characteristics of the research context. The dark side of collaboration is opportunistic behavior, testing the influence of this factor and concluding that it is necessary to limit opportunistic behavior to enhance collaboration in the agricultural supply chain. It is shown that there is a difference in the level of collaboration among specific agricultural sectors in the North Central region, in which collaboration in cultivation and livestock sectors has a low level, but in aquaculture, it is higher. Similarly, contractual relationships are essential for promoting collaboration in the agricultural supply chain. From these research results, the study has proposed some practical solutions to increase collaborations in the agricultural supply chain in the North Central region of Vietnam.

Subjects: Supply Chain Management; Economic Psychology; Supply Chain Management; Corporate Social Responsibility & Business Ethics;

Keywords: supply chain; agricultural supply chain; collaboration in supply chain

JEL classification: P25; P32; Q11; Q12

1. Introduction

In the current global business environment, enterprises that want to build a sustainable competitive position in the market need to master the stages before and after the production process.

ABOUT THE AUTHOR

The research team consists of five members from the Department of Management and Department of Banking and Finance of the College of Economics, Vinh University. The research fields are all the issues involved in business administration, management, financial management, and financial economics. The research reported in this paper is related to logistics and supply chain management applied in agriculture sectors in Vietnam.

The supply chain can meet the above goal, but it can only be effective when the collaboration of parties in the chain is close.

Practice shows that, in the supply chain of the agricultural sector in Vietnam, the relationship between buyers and sellers is mainly transacted with each other in a “hand-to-hand” manner, lacking in building long-term cooperative relationships.

Collaboration between parties in the supply chain is loose, information exchange and knowledge sharing are simple and clear, and transactions between partners are based on market prices. In recent years, the weakest link in the agricultural supply chain has been the collaboration between enterprises and supply establishments, especially farmers. The cooperation between enterprises and these institutions has been built but often falls apart after a short time. The link is not tight, the parties often unilaterally break the contract whenever the market has a fluctuation in price or output. Enterprises blame farmers for breaking contracts and selling products on their own, while farmers blame enterprises for forcing prices and causing difficulties by demanding too high-quality standards. As a result, despite having strengths in some agricultural products, Vietnam lags behind other countries in the region in terms of production efficiency and effective use of land and water resources. This is the cause of the decline in agricultural growth in recent years. Therefore, it is necessary to well solve the relationship between enterprises and agricultural product suppliers when building a cooperative relationship in the supply chain.

The North Central of Vietnam includes six provinces (Thanh Hoa, Nghe An, Ha Tinh, Quang Binh, Quang Tri, and Thua Thien Hue) with great potential for agricultural development. With many natural and social characteristics similar to other regions in the country, the North Central region can partly bring a common perspective to the entire agricultural sector of Vietnam. The degree and forms of cooperation in the agricultural supply chain in the North Central region are relatively diverse:

Buy-and-sell relationship form: this is the main form of collaboration in the agricultural supply chain of the North Central region. In this relationship, the cooperation is relatively loose, dominated by market relations, and the most affected and disadvantaged people are production households with fragmented scales, outdated technology, and low economic returns. In the opinion of many experts, more than 80% of the production facilities are farmers in the region who are implementing this simple cooperation.

Co-operative model form: the number of agricultural and fishery cooperatives in the whole region in 2019 was 1757 (GSO, 2019). Agricultural cooperatives play a role in the cooperation of farmers, as a focal point for vertical cooperation with both upstream, such as seeds, technology, capital, and information, and downstream of the supply chain, such as services, logistics, preservation, and consumption of agricultural products. As a result, quality and efficiency have increased. However, the number of cooperatives is still small in size, and management level is much backward compared to private enterprises.

The forms of offsetting output products and providing input services: implementing the policy of agricultural restructuring towards increasing added value and sustainable development. Many mechanisms and policies are issued to encourage and promote production in the chain in the form of agricultural product consumption contracts between farmers, cooperatives, and enterprises. Currently, in the North Central provinces, many areas of concentrated raw materials for processing and export have been established. These are areas with advantages to develop the province’s agriculture under the model of supply chain cooperation. For example, Vinamilk’s model of buying milk from farmers, businesses providing feed and consuming products in the shrimp farming supply chain, and sugar factories in the region signing contracts to support seed, technology, and buying raw sugarcane, etc., have helped increase the efficiency of agricultural production.

Closed supply chain form: Currently, the North Central region has been attracting some large domestic and foreign enterprises to invest in the agricultural sector, forming a closed, large-scale supply chain with high technology, contributing to improving quality and efficiency such as TH Group, Masan, and Vinamilk. For example, TH Group is one of the leading enterprises in the investment trend in the supply chain of high-tech agricultural products. Not only TH Group, many large domestic and foreign enterprises have invested in agriculture in the North Central region according to a closed supply chain model such as Vinamilk in the field of animal husbandry and milk processing, Masan in the field of meat processing, Nafoods Group JSC in the field of fruit product processing, and Jafa Company in the field of animal husbandry.

Compared with other regions in the country, the agricultural sector of the North Central region is still at a low level of development, especially the ability to participate in domestic and international supply chains. The essence of this weakness is the lack of collaboration in the supply chain. The practice also shows that the cooperation between businesses and suppliers, especially farm households, seems to be the weakest. This study contributes to the explanation of why it can be improved.

Most research on collaboration has focused on the supply chains of traditional industries, services, or retail in the context of developed countries. It is needed to study more about supply chains in agriculture sectors and in the context of less developed regions. The conceptual inconsistency of the antecedents of supply chain collaboration with the measures of supply chain collaboration also opens a space for research. Many of the interrelationships between cause-and-effect variables in supply chain collaboration have been proposed or not yet examined.

There is still some controversy about the nature of the risk factor and hence the impact on supply chain collaboration. The research context suggests the need to add risk factors and opportunistic behavior into the research model. Through qualitative interviews, many respondents said that collaboration in the agricultural chain is greatly influenced by environmental risks, information risks, and supply risks. This greatly reduces the effectiveness of cooperation. On the other hand, some acts of non-compliance with the agreement's commitments in the agricultural sector occur quite often, many partners participating in the supply chain aim to take advantage of each other's names, take advantage of resources such as information, trust, relationship as an opportunistic behavior (Ho Que Hau, 2015; Singh, 2007). These have suggested the research team to examine the impact of these factors on the relationship in the agricultural supply chain in the North Central region.

2. Literature review and hypotheses

Theories such as Relational Theory, Resource-Based Perspective or Extended Resource-Based Perspective are widely used in research on supply chain collaboration to explain the role of cooperation through influence effects on competitive advantage and supply chain performance. Theories such as Transaction Cost Theory and Force Field Theory have also been used to explain the mechanism of supply chain cooperation from different perspectives.

The theory of commitment-trust in relationship marketing is very commonly used in research on the relationship between businesses and customers. This is a potential theory to explain collaborative mechanisms in supply chain research.

For a broader view of the premise of supply chain collaboration. In this study, the author uses a combination of perspectives from all three theories, including Theory of Commitment—Trust, Theory of Transaction Costs, and Theory of Force Fields to understand the factors affecting the agricultural supply chain in the North Central region. The research model is formed based on these theories in accordance with the characteristics of the industry and the research context.

2.1. The commitment-trust theory on relationship marketing

The commitment-trust theory on relationship marketing explaining the antecedents, relationships, and outcomes of collaboration was carried out by Morgan and Hunt (1994). This theory claims that

relationship marketing refers to all market activities directed toward establishing, developing, and maintaining successful collaboration. It is hypothesized that the presence of commitment and trust is the key to successful relationship marketing, not the strength and ability in collaborating with partners. Commitment and trust are central concepts of collaboration. Commitment is considered the premise of trust.

2.2. Theory of transaction cost

The theory of transaction cost argues that enterprises' research is required to be put in the comparative correlation between internal transaction costs and external value output (Williamson, 1985). According to this theory, the more transactional contracts are, the more transaction costs are, such as the cost of finding partners, negotiating, exchanging, and signing contracts. It is necessary to reduce the number of focal transactions to reduce transaction costs by internalizing transaction activities. This activity is similar to integrating or building long-term collaboration in supply chain collaboration.

Bromiley and Cummings (1995) argued that as trust increases trust and transaction costs (due to a decrease in transaction frequency) decrease, collaboration increases; as trust decreases, transaction costs increase (due to increased transaction frequency), and collaboration decreases. Williamson (1985) stated that opportunism causes distrust. However, both trust and opportunism are hard to define and costly to be researched.

Regarding opportunism, transaction cost theory claims that opportunism causes doubt and uncertainty about the partner's behavior. The origin of opportunism is information asymmetry (Williamson, 1985). This implies an adversarial relationship between opportunistic behavior and collaboration.

2.3. Force field theory

Force field theory (Lewin, 1951) argued that organizations are balanced between the forces of change and the ability to resist change, and that it correlates with how managers can offer in changes in their organization. In relationships, managers must consider the dynamics and resistances when pursuing a collaboration possibility. The driving force of collaboration is the benefits obtained when members participate such as increased competitiveness, shared goals, information sharing, and increased trust. Resistance of collaboration is the risk when entering a relationship; is the dependence on information and power; is the cultural, organizational or goal mismatch; and is opportunism.

To clarify the factors affecting collaboration in the supply chain, the commitment-trust theory of relationship marketing can be applied as a suitable and applicable theoretical foundation.

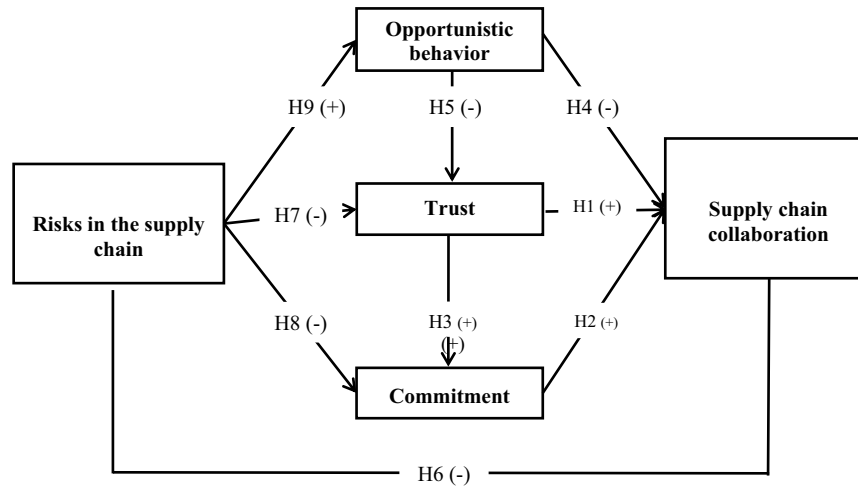
Based on the above theoretical model, combined with the research gaps and practical problems of the research context, the research team proposed a research model with the following research hypotheses in Figure 1:

Chen et al. (2011) considered trust and commitment as a measure of collaboration. Trust has been established as a core component of sustainable business partnerships and strategic alliances (Ganesan, 1994).

Some other studies considered trust and commitment as a prerequisite for cooperation not only in business relations but also in supply chain collaboration (Bäckstrand, 2007; Cao & Zhang, 2011; Huynh Thi Thu Suong, 2013; Nguyen Thanh Hieu, 2013).

Trust should play a major role in cooperative relationships between organizations (Doney & Cannon, 1997; Zaheer et al., 1998). From an economic point of view, trust leads to efficient transactions by reducing transaction costs (Zaheer et al., 1998). From the perspective of social

Figure 1. Research model.



exchange, trust exists in the social context in which supply chain partners generate social capital and influence economic activities (Granovetter, 1985; Uzzi, 1997).

Ghosh and Fedorowicz (2008) asserted that trust as a governance mechanism plays an important role in knowledge sharing among partners in the supply chain. Liao et al. (2021) studied 208 companies in North America and China and found that trust is integral to business associations in the supply chain, and information sharing is key in enhancing the capacity of a supply chain. In most of the conclusions related to the testing of the relationship between trust and cooperation, it is confirmed that trust positively affects collaboration (Morgan & Hunt, 1994; Nguyen Thanh Hieu, 2013).

Based on the research of previous studies, the authors proposed hypotheses about the relationship between trust and collaboration:

H1: Trust positively affects collaboration in the supply chain

Commitment and trust are the central premises of collaboration according to the commitment-trust theory of relationship marketing (Morgan & Hunt, 1994). Commitment is also considered a precondition of cooperation in Force Field Theory. Nakatani (2003) also agreed that commitment is a necessary precondition for establishing cooperative relationships as both trust and commitment are developed because of interactions between two organizations leading to cooperation and collaboration in the supply chain, which in turn improves the operational performance of partners in the supply chain. Commitment has a direct impact on long-term relationship orientation (Chen et al., 2011). In a sustainable supply chain, commitment is also an important factor in promoting cooperation (Liao et al., 2021).

The proposed hypothesis about the relationship between commitment and collaboration in the supply chain is:

H2: Commitment positively affects collaboration in the supply chain.

There is a very close relationship between trust and commitment, in which trust is often considered an antecedent of commitment. Many studies have found a positive correlation between trust and commitment (Krishnan et al., 2006; Wu et al., 2004). Morgan and Hunt (1994) called trust the main determinant of commitment. It should be pointed out, however, that unless trust is translated into an actionable commitment, no measurable economic benefits from supply chain

management will be achieved. Kwon and Suh (2004) mentioned that trust promotes commitment. The proposed hypothesis is:

H3: Trust positively affects commitment

Stemming from one of the viewpoints in the theory of transaction cost, opportunism is a part of human nature and a strategic behavior of the subject of a transaction to seek personal benefits, even harm the other party of the contract by scheming, deceiving, cheating, etc. (Williamson, 1985). Opportunistic behavior is also mentioned in the Theory of Commitment—Trust in relationship marketing, especially in industrial marketing relationships between buyers and suppliers. Opportunistic behavior can lead to relationship termination (Morgan & Hunt, 1994) and limitation in firm value creation (Wathne & Heide, 2000). Knowing what drives opportunism to understand how to limit it is better than simply knowing what the consequences of opportunism are. This can also improve the quality and performance of the relationship. Supply chain management has been known as a collaborative strategy that strives to deliver values to the final customer.

Ho Que Hau (2015) also pointed out that one of the basic reasons for the limitation in cooperation between farmers and agro-processing enterprises in the agricultural sector in Vietnam is the opportunism of the parties involved in the contract. The benefits of maintaining partnerships include achieving results and adding values. However, relationships can be weakened by a “dark side,” such as in the case of conflict (Grandinetti, 2017) or opportunistic behavior (Dawson et al., 2010).

Opportunistic behavior has serious consequences for the cooperation of the parties in the transaction, such as increasing the transaction costs and weakening the collaboration between the parties (Lumineau & Quélin, 2012). The commitment-trust theory of relationship marketing by Morgan and Hunt (1994) mentioned opportunistic behavior as one of the five premises of commitment, trust, and cooperation. The proposed hypothesis:

H4: Opportunistic behavior negatively affects collaboration in the supply chain

Williamson (1985) argued that opportunism is distrustful and that organizations must view individuals as highly opportunistic and unreliable agents. Similarly, according to Morgan and Hunt (1994), opportunistic behavior reduces trust and indirectly reduces cooperation. Therefore, the proposed hypothesis:

H5: Opportunistic behavior negatively affects trust.

Many studies mentioned cooperation as an antecedent of risk reduction (Cooper et al., 1997; Tyndall et al., 1998). Ghadge et al. (2012) identified one of seven important factors for supply chain risk management is risk reduction through cooperation contracts.

Referring to the influence of risk factors on supply chain collaboration, Mahesh et al. (2011) untangled the differential regulatory impact of risk and uncertainty on the collaboration. The study concluded that the presence of risks would highlight the positive effects on the quality of the relationship between buyers and suppliers. Liu (2010) and Germain et al. (2008) also agreed and argued that the higher the risk is, the more firms tend to increase cooperation. To effectively deal with demand risks or mitigate some of their negative impacts on the supply chain, there is an incentive for local businesses to establish close partnerships with partners in the supply chain. Strong relationships help enterprises become more efficient in producing and delivering better quality products and services, thereby reducing transaction costs (Walter et al., 2003).

In contrast, some studies claimed that the higher the risk, the less likely businesses are to associate with each other. Zhao et al. (2013), in the research on supply chain integration in high-tech industries in developed countries, argued that risk factors cause a crisis in supply chain collaboration. Nguyen Thanh Hieu (2016), in his study of the relationship between risk and cooperation in Vietnam's agricultural supply chain, concluded that risks from suppliers, information risks, and environmental risks have an impact on both cooperation between suppliers and customers. Meanwhile, risks from the market only affect the cooperation with customers in a negative direction. Similarly, the empirical research of Nguyen Ngoc Trung (2018) showed that the correlation between risk and linkage in Vietnam's seafood supply chain is negative. Therefore, the authors proposed the research hypothesis for the correlation between risk and supply chain collaboration:

H6: Risks negatively affect collaboration in the supply chain.

Risks in supply are one of many reasons that manufacturing enterprises are unable to satisfy customer needs in terms of quantity, quality, and time, so the trust and cooperation of customers with manufacturers will be decreased (Zsidisin, 2003). Similarly, when the risk from demand increases, partners in supply chain integration will also find it difficult to coordinate with each other. Das and Teng (2001), in one of his research projects, mentioned the relationship between trust and risk. On the one hand, risk is one of two factors that determine the level of trust. On the other hand, risk is also seen as a source of trust. The research suggested that the lower the acceptance level of risk, the higher the level of trust required in a collaboration. The proposed hypotheses are as follows:

H7: Risks negatively affect trust among entities of the supply chain.

H8: Risks negatively affect the commitment among entities of the supply.

In their study, Das and Teng (2001) referred to the term "relational risk," as it is defined as the probability of not having satisfactory cooperation. According to Khanna et al. (1998), relational risk arises from the likelihood of opportunistic behavior from both firms. Conflict arises because businesses have their own personal interests that are not necessarily aligned with the interests of their partners. In practice, many individuals or organizations will seek benefits in a relationship when having to face great risks. For example, common phenomena such as price pressure and violation of contract commitments often occur when the market is volatile, which means when risk factors increase. Therefore, the authors proposed the hypothesis for this relationship as follows:

H9: Risks positively affect opportunistic behavior.

3. Data and methodology

Data are collected by conducting a survey of entities involved in the agricultural supply chain in the North Central region including 6 provinces: Thanh Hoa, Nghe An, Ha Tinh, Quang Binh, Quang Tri, and Thua Thien-Hue. The respondents are buyers and sellers of agricultural products: enterprises purchasing agricultural products and farmers selling agricultural products. For compatibility with the research context, a convenient sampling method was selected, and a relative stratification according to provinces and localities in the North Central region was carried out. The reason for the selection of this method is due to the size of the area, population, and agricultural production structure of the provinces in the surveyed area, in which provinces with larger areas and larger populations will be taken more samples.

Data was collected in two ways online and offline. Total collected questionnaires were 416 for both forms (out of 550 sent questionnaires), in which 219 were from online survey and 197 from offline survey. This sample size is suitable (Tabachnick & Fidell, 1996). By province, the numbers of respondents are as follows: Nghe An—98 (23,6%), Thanh Hoa—92 (22,1%), Ha Tinh—74 (17,8%),

Thua Thien Hue—61 (14,7%), Quang Binh—49 (11,8%), and Quang Tri—42 (10,1%). By type of respondents, 155 respondents were enterprises buying agricultural products (accounting for 37,3%) and 261 respondents were farmers selling agricultural products (accounting for 62,7%).

The study analyzed descriptive analytics; Cronbach's alpha coefficient; exploratory factor analysis (EFA); confirmatory factor analysis (CFA); structural equation modeling (SEM), ANOVA, T-Test, and finally analysis of research results. Based on that, the authors drew conclusions that demonstrate the appropriateness of the model and the research hypotheses.

4. Research results

4.1. Descriptive statistics

In terms of location, most of the respondents are from Nghe An province (accounting for 23.6%), and the province with the lowest number of respondents is Quang Tri with 42 respondents (accounting for 10.1%).

In terms of sectors, 57.9% of the surveyed enterprises were in cultivation sectors, 32,7% of those in livestock sectors, and 9,4% of them in aquaculture sectors.

In terms of groups, there were 73 respondents who had contracts to trade agricultural products, accounting for 17,5% and 343 respondents who did not have contracts to trade agricultural products, accounting for 82,5%.

A total of 155 respondents were enterprises purchasing agricultural products (accounting for 37,3%) and 261 respondents were farmers selling agricultural products (accounting for 62,7%).

4.2. Evaluation of the scale's reliability

The scale testing results showed that the risks in the supply chain variable (SCR) include the supply risk (RS), information risk (RI), and environmental risk (RE) and all have Corrected Item-Total Correlation being greater than 0,3 and Cronbach's Alpha coefficient of the factor being greater than 0,6. Therefore, none of the variables of the supply chain risk (SCR) variable was terminated.

The same result holds for opportunistic behavior variable (OPB), trust variable (TR), and commitment variable (COM). All of them have scale's reliability with Corrected Item-Total Correlation, all being greater than 0,3 and the Cronbach's Alpha coefficient being higher than 0,6.

Regarding the supply chain collaboration variable (SCC), the observed variables in the decision synchronization variable (DS) and the resource sharing variable (SR) have Cronbach's Alpha smaller than 0,6, so they are removed. The remaining observed variables in the SCC variables include information sharing (IS), goal consensus (CG), incentive association (IA), communication cooperation (CC), and shared knowledge construction (KC). After retesting, all of them have Corrected Item-Total Correlation greater than 0,3 and Cronbach's Alpha coefficient for SCC higher than 0,6, thus ensuring the reliability.

4.3. Exploratory Factor Analysis (EFA)

After testing the reliability of the scale, the study conducted an exploratory factor analysis (EFA) for the independent, mediating, and dependent variables.

Regarding SCR, the coefficient $KMO = 0,891$, so the factor analysis is reliable; Sig. (Bartlett's Test) = 0.000 (sig. < 0,05) shows that the observed variables of SCR are correlated with each other. Total variance extracted: Extraction Sums of Squared Loadings (Cumulative %) = 70,629% > 50%. This proves that 70,521% variation of SCR variable is explained by three component variables, namely supply risk (RS), information risk (RI), and environmental risk (RE).

OPB, TR, and COM variables have the same results as the SCR, with the coefficient $KMO = 0,911$, sig. (Bartlett's Test) = 0.000 (sig. $< 0,05$). Total variance extracted = 69,402% $> 50\%$, that is, 69402% of the variation of the data is explained by the three factors mentioned above.

Regarding SCC, the coefficient $KMO = 0,893$, so the factor analysis is reliable; Sig. (Bartlett's Test) = 0,000 (sig. $< 0,05$) shows that observed variables are correlated with each other in the SCC variable. Total variance extracted = 72,317% $> 50\%$, that is, 72317% of the variation of the data is explained by the five component variables which are information sharing (IS), goal consensus (CG), incentive linkage (IA), media collaboration (CC), and shared knowledge creation (KC).

EFA demonstrates that the loading coefficients of most of the observed variables are $> 0,5$; only the observed variable CG3 has a loading coefficient of 0,418, so it is removed. After the second testing, all observed variables have convergent significance.

4.4. Confirmatory Factor Analysis (CFA)

CFA in [Figure 2](#) shows that the Model Fit indicators are all within good levels. Specifically: $CMIN/DF = 1,129 < 3$; $GFI = 0,912 > 0,9$; $CFI = 0,981 > 0,9$; $TLI = 0,979 > 0,9$; $RMSEA = 0,023 < 0,08$; $PCLOSE = 1,000 > 0,05$. According to Hu & Bentler, the model is suitable with the data.

According to Hair et al. (2009), in [Table 1](#), CR values are both greater than 0,7 and AVE is greater than 0,5. Thus, the scales all ensure convergence. The square root of AVE is larger than the correlations between latent variables (factors) with each other, the MSV value is smaller than AVE, so the discriminant is guaranteed.

4.5. Testing of the research hypotheses

4.5.1. Structural Equation Modeling (SEM) testing

Carrying out SEM model, it is found that the all indexes were satisfactory. In [Figure 3](#), Chi-square /df = 1.231 (< 5); $GFI = 0.912 (> 0.9)$; $CFI = 0.981 (> 0.9)$ $TLI = 0.979 (> 0.9)$ and $RMSEA = 0.024 (< 0.08)$.

4.5.2. Research hypotheses testing

Estimation of the relationships of the model in [Table 2](#) shows that the research model is reliable, and all hypotheses with a significance level $P < 0.05$ are accepted.

4.6. ANOVA and T-Test

ANOVA and T-test with control variables were conducted to see if there is a difference in collaboration in the agricultural supply chain in the North Central region or not. It includes comparisons by location (six provinces), by sectors (cultivation, livestock, and aquaculture sectors), by groups (with and without contracts to trade agricultural products), and by target groups (enterprises and farmers).

Considering the location, the Sig Levene's Test result in [Table 3](#) is $0.340 > 0.05$. The authors used the results of the F-test sig in the ANOVA table. Sig F-test equals $0.182 > 0.05$ (in [Table 4](#)), so it can be concluded that there is no difference in collaboration among members in the agricultural supply chain in different provinces in the North Central region.

In terms of sectors, there are three groups in this variable that need to be examined, namely the relationship between enterprises and suppliers in cultivation, livestock, and aquaculture sectors.

In [Table 5](#) Sig Levene's Test is $0.173 > 0.05$, and it can be concluded that there is no difference in the variance between groups, and it is eligible for Anova analysis.

In [Table 6](#), Sig F-test is $0,001 < 0,05$. Thus, there is a difference in the collaboration among the cultivation, livestock, and aquaculture sectors in the agricultural supply chain of the North Central

Figure 2. Confirmatory factor analysis (CFA).

Source: Extracted from AMOS.

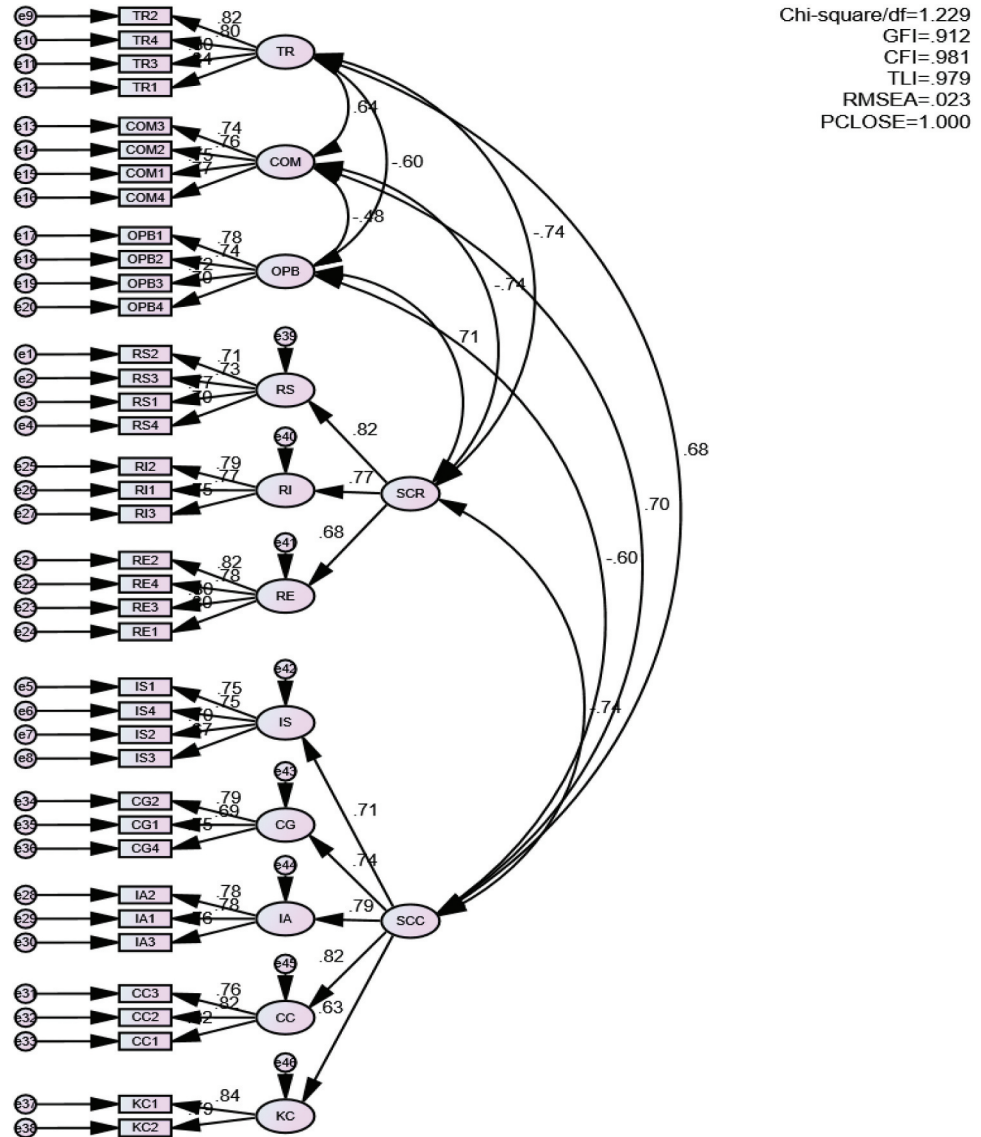


Table 1. Validity and reliability

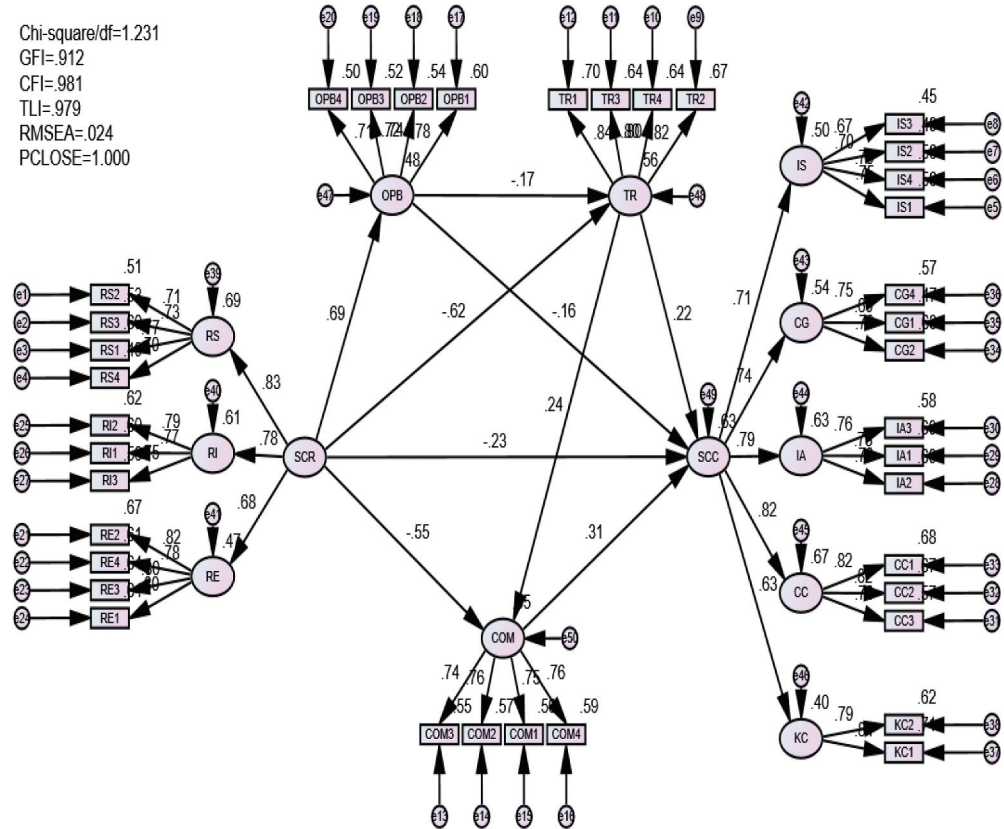
	CR	AVE	MSV	TR	COM	OPB	SCR	SCC
TR	0.887	0.663	0.548	0.814				
COM	0.840	0.568	0.545	0.641***	0.753			
OPB	0.824	0.540	0.502	-0.598***	-0.476***	0.735		
SCR	0.804	0.579	0.548	-0.740***	-0.738***	0.709***	0.761	
SCC	0.858	0.548	0.541	0.683***	0.695***	-0.601***	-0.735***	0.740

Note: statistically significant at *10%, **5% and ***1% Source: Extracted from AMOS

region. The average statistics in Table 7 show that collaboration is higher in the aquaculture sectors (Mean = 3.0923), being lowest in cultivation sectors (Mean = 2.7231). This result shows that the development level of the aquaculture sector is higher than that of cultivation and livestock sectors, which is also consistent with the fact that the livestock sector and especially the cultivation in the North Central region are mainly fragmented, small, and short of cooperation.

Figure 3. SEM model structure.

Source: Extract from AMOS.



To check whether there is a difference in collaboration between two groups with and without contracts to trade agricultural products, the authors used an Independent T-Test instead of ANOVA.

In Table 8, Sig Levene’s Test is 0,327 > 0,05. The author used the sig test result of the T-Test of equal variances assumed. Sig test T-Test is 0.000 < 0.05. The conclusion is that there is a difference in collaboration between groups with and without contracts. The statistics in Table 9 show that collaboration is higher in the contract group (Mean = 3.0447) than in the without contract group (Mean = 2.7572). This proves that the role of legality is important to regulate cooperative behavior.

Regarding the survey subjects, the Independent T-Test produces the following results:

In Table 10, Sig Levene’s Test is 0.859 > 0.05. The authors used the sig testing results T-Test of the Equal variances assumed. Sig tests T-Test is 0.338 > 0.05. Therefore, there is no difference in the collaboration between enterprises and farmers in the agricultural supply chain in the North Central region.

5. Discussion

Hypothesis H1 is accepted with $P = 0.005$, respectively, less than 5% significance level; The regression weight is 0.145, respectively, which means that trust has a positive influence on cooperation in the supply chain in the North Central region.

Hypothesis H2 is accepted with $P = 0.000$ less than 5% significance level. The regression weight 0.229 reflects that the commitment positively affects the supply chain collaboration in the North Central region.

Table 2. Testing results of the research hypotheses

Hypothesis	Relationship	Weight	S.E.	C.R.	P	Weigh
H1	SCC ←—TR	.145	.051	2.838	.005	Accepted
H2	SCC←—COM	.229	.060	3.845	***	Accepted
H3	COM←—TR	.211	.075	2.823	.005	Accepted
H4	SCC ←—OPB	-.132	.061	-2.167	.030	Accepted
H5	TR ←—OPB	-.212	.097	-2.189	.029	Accepted
H6	SCC ←— SCR	-.235	.118	-1.996	.046	Accepted
H7	TR ←—SCR	-.945	.141	-6.687	***	Accepted
H8	COM←—SCR	-.749	.133	-5.628	***	Accepted
H9	OPB ←—SCR	.832	.090	9.286	***	Accepted

Note: Statistically significant at *10%, **5% and ***1% Source: Extracted from AMOS.

The accepted hypotheses H1 and H2 suggest that both trust and commitment are fundamental elements of any collaboration process despite the context. This demonstrates the trust and commitment that underlie many partnerships. The positive influence of the two factors is supported by most studies in both theory and practice of supply chain. This study has shown that supply chain’s entities have ensured trust and commitment to enhance collaboration (Morgan & Hunt, 1994; Kwon & Suh, 2004; Nguyen Thanh Hieu, 2013; Wu et al., 2004).

Hypothesis H3 is accepted with the significance level $P = 0.005 < 0.05$, and the regression weight is 0.11. This illustrates that trust and commitment in the agricultural supply chain in the North Central region has a positive correlation. This result is similar to many previous studies (Krishnan et al., 2006; Kwon & Suh, 2004; Morgan & Hunt, 1994; Wu et al., 2004). Regarding this relationship, Ho Que Hau (2015) confirmed that the higher the trust between enterprises and farmers is, the higher the commitment level when performing the sales contract and the commitment to repay the investment capital of farmers is more secure for the company. Although in this study, the impact is only considered in the direction of trust having on commitment, but according to the author’s prediction, the opposite direction of commitment and trust in the supply chain likely to have a positive correlation as well.

Hypothesis H4 is accepted with $P = 0.029 < 0,05$, and regression weight is -0.132 . Opportunistic behavior negatively affects supply chain collaboration in the North Central region. The opportunistic behavior reducing collaboration in the supply chain is consistent not only with the conclusions of Dawson et al. (2010) and Lumineau and Quélin (2012) but also with some recent studies of Grandinetti (2017). This observation shows that there are opportunistic behaviors that really exist in the relationship of the agricultural supply chain in the North Central region, and this has adversely affected the agriculture between partners as stated in some conclusions drawn from the context of Vietnam (Ho Que Hau, 2015).

Hypothesis H5 is accepted with a significant weight of $P = 0.030 < 0.05$, and a regression weight of -0.212 , which means that opportunistic behavior negatively affects trust in agricultural supply chain in North Central. This hypothesis is consistent with the view of the relationship marketing by Morgan and Hunt (1994).

The influence of opportunistic behavior on collaboration, commitment, or trust is consistent with many of the underlying theoretical perspectives. These relationships are both supported by the commitment-trust theory and the force field theory. The phenomenon of market manipulation by domestic and foreign traders for many agricultural products in Vietnam for a long time has caused heavy damage and reduced the confidence of farmers is a practical example. The cause of these

Table 3. Table of test of homogeneity of variances by province

Test of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
f_SCC	Based on Mean	1.137	5	410	.340
	Based on Median	1.101	5	410	.359
	Based on Median and with adjusted df	1.101	5	397.127	.359
	Based on trimmed mean	1.138	5	410	.340

Source: Extracted results from SPSS.

Table 4. ANOVA results by province

ANOVA					
f_SCC					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.045	5	.609	1.520	.182
Within Groups	164.255	410	.401		
Total	167.300	415			

Source: Extracted results from SPSS.

Table 5. Test of Homogeneity of variances by sectors

Test of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
f_SCC	Based on Mean	1.761	2	413	.173
	Based on Median	1.625	2	413	.198
	Based on Median and with adjusted df	1.625	2	407.891	.198
	Based on trimmed mean	1.714	2	413	.181

Source: Extracted results from SPSS.

phenomena, according to the authors, comes from the imbalance of information and power in the relationship between farmers and enterprises, in which the disadvantaged is often farmers.

Hypothesis H6 with significance level $P=0.046 < 0.05$ and regression weight is -0.235 is accepted. This means risks negatively affect collaboration in the agricultural supply chain in the North Central region. The accepted hypothesis H6 contradicts statements in many studies that the higher the risk, the more cooperative firms in the supply chain will be (Germain et al., 2008, 1995; Liu, 2010; Walter et al., 2003). However, this result is similar to some previous studies (Mahesh et al., 2011; Zhao et al., 2013), and also suitable with the context of Vietnam's agricultural industry researched by Nguyen Thanh Hieu (2016) on Vietnam's agricultural supply chain and Nguyen Ngoc Trung (2018) on the supply chain of Ben Tre seafood industry. It is also consistent with the reality

Table 6. ANOVA results by sector

ANOVA					
f _{SCC}					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.518	2	2.759	7.043	.001
Within Groups	161.782	413	.392		
Total	167.300	415			

Source: Extracted results from SPSS.

Table 7. Average statistics of collaboration by sectors

Descriptives								
f _{SCC}								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Livestock	136	2.8760	.62186	.05332	2.7705	2.9814	1.40	4.60
Cultivation	241	2.7231	.64227	.04137	2.6416	2.8046	1.20	4.60
Aqua culture	39	3.0923	.52752	.08447	2.9213	3.2633	1.67	4.07
Total	416	2.8077	.63493	.03113	2.7465	2.8689	1.20	4.60

Source: Extracted results from SPSS.

of the agricultural supply chain in the North Central region as it was concluded that risk is one of the factors hindering collaboration.

The H7 and H8 hypotheses with significance $P < 0.05$ and the regression weights -0.945 and -0.749 are accepted. This means risk has a negative correlation with both trust and commitment. For H7 hypothesis, the risk is inversely proportional to trust, and this is compatible with most studies on collaboration or relationships in many fields (Das & Teng, 2001). For H8 hypothesis, similar to the relationship between risk and trust, risk and commitment also have an opposite correlation. The correlation between risk and commitment in the supply chain, although very little or has not been discussed in previous studies, but the reality shows that the more risks there are, the more lacking commitment will be in the supply chain.

The hypothesis H9 is accepted with a weight of 0.832 and the significance $p < 0.05$. Risk and opportunistic behavior have a positive correlation, the greater the risk is, the more opportunistic behaviors in the supply chain will be. This hypothesis was supported by Khanna et al. (1998), Das and Teng (2001) or Nasirzadeh et al. (2014). It is also consistent with the judgment that the lack of policy mechanisms and strictness in the binding business relations reduces the effectiveness of commitment and increases opportunistic behaviors as stated in the current situation of supply chain collaboration in agriculture in the North Central region. It shows that opportunistic behavior in the relationship between businesses and farmers is often not fair in the division of benefits, as all parties want to transfer risks to partners, press prices or break the contract.

According to the analysis results, the effect of risks on opportunistic behavior is the strongest compared to other correlations in the research model with the absolute value of the standard

Table 8. Independent T-Test for groups with and without contracts to trade agricultural products

Independent Samples Test

		Levene's Test for Equality of Variances		T-Test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
f_SCC	Equal variances assumed	.962	.327	3.562	414	.000	.28751	.08071	.12886	.44616
	Equal variances not assumed			3.603	106.138	.000	.28751	.07981	.12929	.44573

Source: Extracted from SPSS.

Table 9. Average statistics of cooperation by group with and without contracts to trade agricultural products

Descriptives								
f_SCC								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
With contracts	73	3.0447	.61725	.07224	2.9007	3.1888	1.20	4.27
Without contracts	343	2.7572	.62803	.03391	2.6905	2.8239	1.20	4.60
Total	416	2.8077	.63493	.03113	2.7465	2.8689	1.20	4.60

Source: Extracted results from SPSS.

regression coefficient being 0.691. This reflects the fact that there may be many cooperative entities that are taking advantage of the lack of the complete supply chain of the agricultural sector. Theoretically, it is necessary to clarify and research the relationship between risk and opportunistic behavior in many different contexts to limit opportunistic behavior in collaboration.

Among the factors affecting collaboration in the supply chain, commitment is the factor with the greatest impact, with the standard regression coefficient being 0.310, followed by risk and trust, and finally opportunistic behavior, with the standardized regression coefficient being 0.232, 0.219, and 0.157. In addition to the commitment factor, the relatively strong influence of risk on collaboration in the supply chain is a relatively surprising finding from this study.

Anova analysis and T-Test for control variables show that the level of uneven cooperation between various sectors in the agricultural supply chain of the North Central region is still high. The cultivation sector still has more limitations in collaboration compared to the livestock sector, and especially the aquaculture sector has achieved improvements in building supply chain collaboration. Also, it is necessary to enhance collaboration in the agricultural supply chain by using contracts.

6. Policy implications

Based on the research results to enhance supply chain collaboration in agriculture in the North Central region in the future, it is recommended to carry out the following solutions:

6.1. Maintain trust and enhance commitment between partners in the supply chain

Agricultural supply chain in Vietnam in general and the North Central region in particular still lack trust and commitment. This is one of the causes that hinders collaboration.

To maintain trust among partners in the supply chain, it is significant to provide enough reliable information resources by sharing information, sharing risks and benefits, and increasing official communication. Then, ensuring honesty and integrity in the implementation of collaboration, highly valuing the credibility in business and the interests of the parties is essential.

To enhance commitment, the partners in collaboration in the agricultural supply chain should follow some core commitment contents which are implemented including the quality standards of agricultural products, prices, and allocating benefits and risks in the long term and sustainable cooperation. Additionally, it is necessary to strengthen the commitment by legal, namely increasing the rate and encouraging agricultural trading transactions through economic contracts.

Table 10. Independent T-Test by survey subjects Independent Samples Test

	Levene's Test for Equality of Variances		T-Test for Equality of Means							
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
								Lower	Upper	
f_SCC	.032	.859	.959	414	.338	.06178	.06439	-.06480	.18835	
			.962	326.797	.337	.06178	.06419	-.06450	.18805	

Source: Extracted results from SPSS.

6.2. Reduce risks for the agricultural supply chain

The research also confirms that risk is a factor that negatively influences collaboration in the supply chain. To reduce the risk for the supply chain, it is necessary to:

Improve the scale, quality, and efficiency of the supply of agricultural products, develop towards large production according to the models of farms and co-operatives; strengthen production in the direction of specialized and intensive farming, form concentrated agricultural production areas. It is also recommended that the government improve quality, reduce costs, and increase the efficiency of upstream factors in the supply chain of agricultural products, ensure good logistics conditions such as collection, storage, and transportation to improve the quality and value of agricultural products.

Local authorities of provinces in the North Central region should support supply facilities on planning of agricultural production areas, provide technical support and logistics activities, offer forecasting of market information and research to limit supply risks, improve the policy environment, establish a legal framework to enhance trust and commitment between partners in the supply chain, limit opportunistic behavior, and strengthen the collaboration

6.3. Minimize opportunistic behaviors

This study confirmed that opportunistic behavior damages supply chain collaboration, so it is necessary to take measures to limit its effects. Appropriate distribution of benefits between partners in the supply chain is the most effective measure. Many studies pointed out that in the partnership of the agricultural supply chain, disadvantages are always on the side of the supplier of agricultural products. They not only encounter issues from the natural environment but also have risks of price pressure, higher quality standards, and big businesses, they never master the game. Therefore, the role of limiting opportunistic behavior from enterprises during buying, processing, and consuming agricultural products is extremely important. In addition, agricultural suppliers also need to improve their competitiveness and position in the partnership in the supply chain to balance the power in this relationship, the agricultural supply facilities must improve their own competitiveness, and integrate deeply into closed supply chains.

6.4. Attract large enterprises to invest in agriculture

A significant factor that promotes supply chain collaboration in agriculture in the North Central region is the participation of large enterprises in the field of agricultural production. To attract large businesses to invest in agriculture, the role of local government is vital. The government should improve the investment environment, develop a breakthrough mechanism and policies, complete infrastructure, develop planning in order to motivate agricultural production and rural development as they play the nuclear role in the link chain of large-scale agricultural production of large-scale commodities.

6.5. Diversify forms of production connection and collaboration in agriculture

Strengthen regional connection and cooperation between provinces in the region; between the North Central region and other regions throughout the country; expand connection within international production in agricultural production, strengthen the connection under the “4 houses” model: farmers, enterprises, state, and scientists, in which the State plays the main role of making strategic-and-environmental-orientated policies for agricultural development; scientists support knowledge in science and technology; enterprises and farmers cooperate to share benefits.

7. Research limitations and future research directions

Despite efforts made to perfect the research, there are still some limitations in this study:

The context of the study was limited to the North Central region, so it did not build up the most suitable model to fully assess the factors affecting the supply chain collaboration.

The study was limited to the relationship between enterprises that buy, process, and consume with agricultural product suppliers. To have an adequate insight of cooperation, it is essential to add more relationships between partners in the supply chain such as the relationship between purchasing enterprises and processing businesses, between processing enterprises with retailers, etc.

The study did not have the conditions to compare the level of collaboration in the agricultural supply chain and other manufacturing industries in the national economy or compare the collaboration in the agricultural supply chain in the North Central region with other regions across the country.

The risk factor's impact was not reflected according to its specific type, so there is no specific view to have solutions to limit any type of risk that influences supply chain collaboration in agriculture in the North Central region.

These limitations suggest more directions for future research. Specifically, future studies can expand the scope of research with many different partners in the supply chain to fully understand the collaboration throughout the supply chain. It is possible to specify the impact of each type of risk on collaboration, and approach the research model of collaboration in the supply chain by adding new theories that have not been mentioned in previous studies...

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