



The Influence of Supply Chain Integration on Firm Innovation: A Meta-Analysis

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Abstract. Innovation is an essential approach to improving organizational performance. As the core element of supply chain management, supply chain integration has been widely concerned in promoting enterprise innovation. Although previous studies have examined the impact of supply chain integration on enterprise innovation, no consensus has been reached. We used meta-analyses to empirically test 15,753 samples from 52 independent studies. The conclusions are as follows: (1) Supply chain integration and its sub-dimensions have significantly positive effects on enterprise innovation; (2) Compared with foreign cultural background, under the background of Chinese culture, the integration of supply chain plays an important role in promoting innovation.

Keywords: Supply Chain Integration; Firm Innovation; Meta-analysis.

1 Introduction

As market rivalry rises, innovation is essential to maintaining a competitive edge. However, how to access more external resources to promote innovation has become a challenge for firms. Enhancing firm innovation has drawn a lot of attention to supply chain integration, a fundamental component of supply chain management. Despite the general understanding that supply chain integration and firm innovation are closely related, previous research has not come to a clear conclusion on this point. Xu et al ^[1] believed that by integrating all aspects of the supply chain, enterprises could better share information, technology and resources, thus achieving innovative cooperation across organizations. However, resource waste and opportunistic behavior may occur in enterprises in conducting supply chain integration practices ^[2], which is detrimental to innovation.

Existing literature has explored the relationship between supply chain integration and firm innovation, but no clear consensus has been achieved. Moreover, research that have already been done have not taken into account the moderator variables in the connection between supply chain integration and firm innovation. Thus, two research questions are addressed in this study: (a) Does supply chain integration have a positive impact on firm innovation? (b) Are there contingent factors that affect the relationship between supply chain integration and firm innovation? To fill these research gaps, we use meta-analysis for secondary analysis of data from existing studies. In addition, we

mined the moderator variables, using subgroup analysis to explore contingent factors on supply chain integration and firm innovation relationships. Based on the results of the meta-analysis, we propose a management strategy to promote enterprise innovation and provide practical insights for enterprises to implement supply chain integration.

2 Theory and Hypotheses

2.1 The Relationship between Supply Chain Integration and Firm Innovation

Supply Chain Integration and Firm Innovation.

According to Zhao et al. [3], we define supply chain integration as “a cooperative effort between an organization and its supply chain associates to collaboratively oversee the internal and external operations of the enterprise, to achieve efficient management of resources, information, and goods, and to deliver optimal value to clients in a prompt and economical manner.”

Most studies emphasize the positive role of supply chain integration in enterprise innovation. On the one hand, resource integration among supply chain partners is optimized through supply chain integration. Firms may enhance innovation performance and minimize expenses and losses from product innovation processes by implementing synchronous collaboration, strategic alliances, and information exchange during the integration phase [4]. On the other hand, the variety of demands from customers raises the expectation for supply chain agility. Supply chain integration facilitates access to external consumer knowledge for businesses, enabling them to promptly and accurately identify customer wants and foster service innovation [5] [6]. As a result, firms enhance core competitive capacity by supply chain integration [7]. On the basis of the above arguments, we propose that:

H1: Supply chain integration exerts a positive effect on firm innovation.

Dimensions of Supply Chain Integration and Firm Innovation.

According to Flynn et al [8], the three dimensions of supply chain integration are supplier integration, enterprise integration, and customer integration. Supplier integration describes how businesses and important suppliers can work together on strategies, actions, protocols and other areas. Supplier integration can significantly boost innovation productivity and accelerate R&D [9]. Internal integration emphasizes cross-functional operations within the enterprise and synchronization and cooperation in organizational decision-making, processes and behavior. Priority for internal integration enables enterprises to better respond to external environmental changes and gain competitive advantage by improving their flexibility [10]. Customer integration refers to accurately grasp customer needs by sharing key customer information to better serve customers. Firms may design innovative products that are marketable and nutrient-dense by involving customers in the process. Therefore, we hypothesize as follows:

H2a: Supplier integration exerts a positive effect on firm innovation.

H2b: Internal integration exerts a positive effect on firm innovation.

H2c: Customer integration exerts a positive effect on firm innovation.

2.2 Contextual Factors Influencing the Relationship between Supply Chain Integration and Firm Innovation

Chinese government has implemented a range of preferential and support policies to encourage businesses to implement supply chain management practices in order to foster the rapid expansion of these businesses. The government has established various supply chain research and development centers to strengthen the links, communication, and collaboration between firms and supply chain partners. In addition, the government actively conducted supply chain innovation and application pilot demonstrations to effectively help firms to actively carry out synergistic innovation. The government's promotion of an innovative culture anchored in the Chinese context appears to have had a more notable positive influence on supply chain integration and firm innovation when compared to foreign firms. Thus, we propose that:

H2: The relationship between supply chain integration and firm innovation is influenced by cultural differences.

In summary, Fig. 1 depicts the theoretical assumption model for this paper.

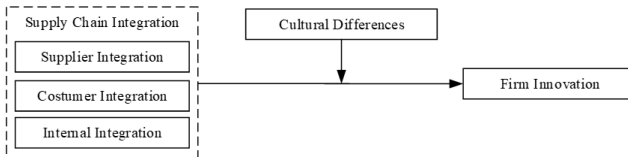


Fig. 1. Theoretical Assumption Model

3 Methodology

3.1 Sample

We used the Chinese-English expression of “supply chain integration”, “supplier integration”, “internal integration”, “customer integration” and “innovation”. The searched databases included Web of Science, Google Scholar, Elsevier Science Direct, Springer, Emerald, SAGE, Wiley Online Library and Cnki. The scope of the literature search was limited to 2024. We selected the literature under the following conditions: (1) the literature had to be empirical research; (2) the literature had to report the number of samples and the correlation coefficient, or other effect values that can be converted into correlation coefficients; (3) the literature had to use separate samples. Finally, we obtained a total of 83 effect values from 52 literature, including 15,753 separate samples.

3.2 Data Encoding

According to Lipsey and Wilson ^[10], the database literature is independently encoded by two experts in the relevant fields. The coding content is divided into basic information and effect value statistics of the documentation, the basic information of which includes the title, first author, year of publication, journal and research variable, and the effect value stats include sample quantity, related coefficients and other effect values

that can be converted into related factors. Chinese firms are coded 1, foreign firms are coded 0.

3.3 Effect Value Conversion

We used the professional software CMA3.0 for meta-analysis and the r value as the effect value. In order to reduce the decay deviation caused by measurement credibility defects [11], we use the CMA3.0 software for data processing, using the Fischer'Z conversion formula to convert the relevant coefficients to Z values, calculate the weighted average of the Fischer'Z value based on the sample volume, and then convert to the effect value that is finally used for the relevant factor [12].

4 Results

4.1 Bias Test

As shown in Fig. 2, most of the literature effect values are concentrated at the top of the funnel plot and distributed symmetrically on both sides of the effect value estimators. Therefore, we can conclude that there is no bias in the empirical literature selected for Meta-analysis. In addition, failure factor of safety indicate how many studies are needed to reverse the results of a Meta-analysis, and the larger the number, the more reliable the results are. The failure factor of safety is 10309, which is much larger than the critical value of 270. Therefore, the Meta-analysis results of the selected empirical literature are reliable.

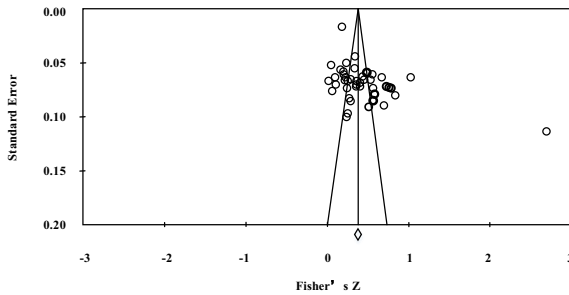


Fig. 2. Funnel Plot of Standard Error by Fisher's Z

4.2 Main Effects Analysis

Based on the results of heterogeneity test, we chose the random effects model to conduct the experiment. The results of the overall effect test are shown in Table 1. The effect value between supply chain integration and enterprise innovation is 0.404($p < 0.001$), and hypothesis H1 is validated. In addition, the effect values between supplier integration, customer integration and internal integration and enterprise innovation are 0.342($p < 0.001$), 0.357($p < 0.001$) and 0.399($p < 0.001$), respectively, indicating the hypothesis that H1a, H1b and H1c are all validated.

Table 1. Main Effect Analysis Results

Variable	N	95%CI			Z	Q	Heterogeneity Test			Model
		Effect Estimates	LL	UL			df	p	I ² (%)	
Supply chain integration	52	0.404	0.339	0.465	11.138***	1123.123	51	0.000	95.459	Random
Supplier integration	37	0.342	0.270	0.410	8.816***	564.488	36	0.000	93.623	Random
Customer integration	26	0.357	0.286	0.424	9.242***	253.958	25	0.000	90.156	Random
Internal integration	17	0.399	0.312	0.479	8.312***	168.471	16	0.000	90.503	Random

4.3 Moderator Effect Analysis

The Moderating Effect of Cultural Differences.

The results of moderating effect analysis are shown in Table 2. The Q values of supplier integration, customer integration and internal integration were 3.122($p < 0.1$), 5.787($p < 0.05$) and 5.306($p < 0.05$), respectively. H2 is validated. In the dimension of supplier integration, the sample effect value of domestic culture background (0.369) is larger than that of foreign culture background (0.262). In the dimension of customer integration, the sample effect value of domestic culture background (0.393) is larger than that of foreign culture background (0.211). In addition, the sample effect value of domestic culture background (0.443) is larger than that of foreign culture background (0.281). On the whole, the supply chain integration under the background of Chinese culture has a more obvious effect on enterprise innovation.

Table 2. Moderator Effect Analysis Results

Moderator	Independent Variable	Group	K	95%CI			Two-Tailed Test		Total between Overall					
				Effect Estimates	LL	UL	Z	P	Q	df	p			
cultural differences	SI→FI	China	29	0.369	0.281	0.451	7.709	0.000	3.122	1	0.077			
		foreign	7	0.262	0.178	0.342	5.959	0.000						
	CI→FI	China	21	0.393	0.318	0.464	9.389	0.000				5.787	1	0.016
		foreign	4	0.211	0.075	0.340	3.012	0.003						
	II→FI	China	13	0.443	0.350	0.528	8.398	0.000	5.306	1	0.021			
		foreign	3	0.281	0.172	0.383	4.939	0.000						

5 Conclusions

Based on the literatures collected and coded, we have obtained 52 empirical literatures on the impact of supply chain integration on firm innovation, and conducted a meta-analysis. The main conclusions are as follows: (1) Supply chain integration has a significant positive impact on firm innovation, which shows that supply chain integration is an important driving force of supply chain operation. Firms can optimize production process, improve customer relationship and achieve the goal of improving innovation performance by supply chain integration. (2) Compared with the foreign cultural background, the role of supply chain integration in promoting innovation is more obvious in China. The Chinese collectivism culture is more conducive to supply chain integration. Companies with a collectivism culture tend to collaborate more and focus on building their own integration capabilities, which makes them comfortable in the process of supply chain integration.

The limitations of this paper are as follows: (1) In the process of literature collection, we select the literature with strict standards and high quality to ensure the reliability of the experimental data. This has led to the failure of some relevant literature to be included in the meta-analysis. Therefore, in future research, we should use more sufficient literature sample with more uniform data distribution to reduce the error risk of second-order sampling. (2) We only considered one potential moderators in this paper, and the mining is not detailed enough. Therefore, it is necessary to supplement and perfect the potential moderating variables in the future study.

Acknowledgment

This research was supported by 2024 the basic scientific research ability of young and middle-aged teachers in Guangxi universities # 2024KY0738.

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