Proceedings of the 2nd International Conference on Financial Technology and Business Analysis
DOI: 10.54254/2754-1169/57/20230698

Research on the Impact of Supply Chain Concentration, and Financial Flexibility on Corporate Innovation: An Empirical Study in the New Energy Industry

Yiyang Kong[1,a,*]

[1]*Transportation College, Jilin University, 5988 Renmin St, Changchun, China*
a. kongyy1720@mails.jlu.edu.cn
**corresponding author*

Abstract: With the gradual formation of an international consensus on carbon peaking and neutrality, the new energy industry is a key focus for future development. Still, the industry also suffers from a fiercely competitive market environment. Therefore, the innovation performance of enterprises is crucial. This paper analyzes the impact of supply chain relationships and financial flexibility on corporate innovation from a resource-based viewpoint. Moreover, several variables are introduced to explore the optimal combination of innovation strategies. In the empirical part of the study, the study selects the panel data of listed companies in China's new energy industry. The fuzzy set qualitative comparative analysis approach investigates how supply chain concentration, and financial flexibility affect corporate innovation. The study shows that: corporate cash is the main internal resource for R&D, industrial clusters facilitate the acquisition of external resources, and the configuration of the two can promote corporate innovation; debt and supply chain risk inhibit corporate.

Keywords: supply chain relationship, financial flexibility, innovation, fsQCA

1. Introduction

The new energy industry ushers in a historic development opportunity under the background of the increasingly prominent carbon-neutral target. At the same time, due to the double pressure of industrial upgrading and transformation and product market competition, enterprises' financial and supply chain management are facing great challenges. Innovation is the core competitiveness of enterprises, and the development of enterprises cannot be separated from the support of innovation [1]. Research shows that supply chain relationships, financing constraints, resource dependence, knowledge learning, etc., will impact enterprise innovation [2, 3].

From the perspective of the enterprise itself, financial flexibility reflects the enterprise's financing ability. Financial flexibility can help enterprises effectively respond to negative shocks and eliminate the lack of funds. At the same time, the company's financial flexibility can be low-cost financing and restructuring. Furthermore, financial flexibility can improve the strategic emerging listed enterprises' research and development investment when the opportunity arises [4]. However, the enterprise's financial resources and innovation are complex linear relationships. For example, when the enterprise resources are limited or external risks are large, the enterprise may take a conservative development strategy, and it isn't easy to see the results of enterprise innovation; when the enterprise business

DOI: 10.54254/2754-1169/57/20230698

situation is better, the enterprise continues to maintain too high financial flexibility, which may inhibit the enterprise's innovativeness and impede the development of the enterprise [5]. Therefore, the strategy of enterprise financial flexibility needs to consider the enterprise resources fully, and the combination of strategies should be analyzed according to the enterprise conditions.

From the supply chain perspective, more and more enterprise innovations nowadays originate from the cooperative development of enterprises. In the resource base view, supply chain concentration can reflect the degree of heterogeneity of enterprise resources, and these resources will have an important impact on enterprise innovation [6]. On the other hand, partners in the supply chain can also acquire knowledge and seize innovation opportunities through cooperation [7]. The supply chain is a network chain structure composed of upstream and downstream enterprises, and the geographical distance between enterprises can directly play a role in logistics and information flow, which in turn affects the cost of knowledge acquisition and R&D investment of enterprises, and ultimately has an impact on enterprise innovation.

From the perspective of a resource-based view, this paper introduces the supply chain relationship and the enterprise's financial flexibility into the same framework. It adopts a complex causal exploration and portfolio analysis method - fuzzy set qualitative comparative analysis. For listed enterprises in the new energy industry, it explores the influence mechanisms of supply chain concentration, supply chain geographic distance, and financial flexibility on the innovation activities of enterprises. It explores the multiple paths of strategic organization of manufacturing enterprises in the supply chain to promote the sustainable development of enterprises.

2. Literature Review

2.1. Supply Chain Relationship and Innovation

In many studies on the relationship between supply chain and enterprise innovation, scholars have concluded that the supply chain is an important source of external resources for enterprises. The enterprise's own unique and unrepeatable resources maintain the sustained competitiveness of the enterprise. Schildt and others believe that the concentration and integration of supply chains are conducive to promoting enterprise cooperation [8]. Enterprise cooperation can enable upstream and downstream enterprises to learn bilaterally, mutual understanding, and thus promote innovation [9]. The geographical proximity of firms can further accelerate the information flow rate and improve innovation efficiency. Therefore, knowledge learning is a way for supply chain relationships to promote enterprise innovation. At the same time, the concentration of supply chain geographic location will also bring the effect of industrial clusters, which promotes enterprise innovation from economic policies, coordination effects and other aspects [10].

However, supply chain concentration may also generate resource dependence. Although the concentration of firms' customers and suppliers can increase firms' bargaining power, improve profitability, and increase R&D investment to obtain sustained competitiveness. However, Lonsdale points out supply chain concentration can create asymmetric power structures [11]. This can lead to multiple risks, such as deterioration of the partnership, holding additional inventory and lower future sales [12]. Firms are in a dilemma, and the concentration of supply chain relationships also means they lose their diversified customer base, which can affect their innovation activities.

2.2. Financial Flexibility and Innovation

Research by Cassiman and Veugelers has shown that internal R&D research and external knowledge acquisition are complementary aspects of a firm. Still, the degree of complementarity is sensitive to the strategic environment external to the firm [13]. Therefore, it is necessary to analyze financial flexibility and supply chain relationships in a group context. Kale and Shahrur studied the relationship

DOI: 10.54254/2754-1169/57/20230698

between financial leverage and proprietary investment in supplier-customer relationships [14]. When firms are in a better financial position and have lower debt leverage, suppliers will have a keen sense of and will increase proprietary investment, which can attenuate the negative impact of supplier concentration on R&D investment.

Financial flexibility, itself as a measure of the firm's financing ability and cash holdings an indicator, firms can use their financial flexibility to improve R & D investment. Le and Brien showed that firms setting a reasonable amount of financing for R&D could force firms to accomplish innovation better [15]. However, a high debt ratio can also produce a higher profit burden, which forces firms to abandon the development work of new projects. Meanwhile, on the other side of financial flexibility, i.e., the cash flexibility perspective. Brown's study shows a strong positive correlation between R&D and cash flow [16]. The study of Matthew et al. also supports the view that financial flexibility, especially cash flow, is crucial for R&D investment in growing firms [17]. Therefore, in this paper, the variable of financial flexibility is selected to measure new energy, a high-growth industry (As shown in Figure 1).

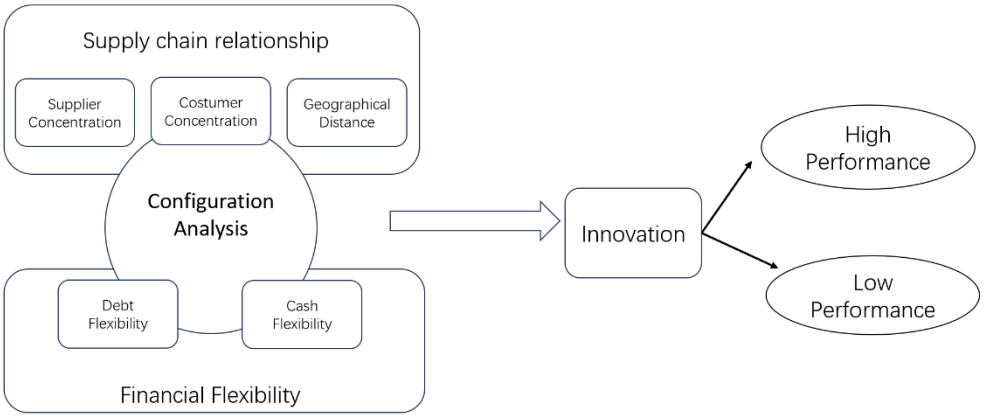

Figure 1: Modelling of mechanisms influencing market competitiveness. (Photo/Picture credit: Original).

3. Research Design

3.1. Research Method

fsQCA, i.e., fuzzy set qualitative comparative analysis method, is a case-orientated research method based on set theory ideas and group state thinking, effectively linking qualitative and quantitative analysis. Unlike the ordinary weights and measures perspective, where the histogram perspective is more complex, fsQCA takes a holistic perspective, analyzing the relationship between the elemental histograms and the outcome variables, emphasizing the complexity of the causal relationship. Further, histogram analysis assumes that independent variables interact and that multiple elements constitute the occurrence of the outcome [18]. In Fiss's model, the analysis of the two paths of high-performance occurrence and high-performance absence allows for the distinction of the histogram configuration of high-performance generation, distinguishing between core and peripheral conditions [19].

3.2. Sample Data

This paper selects the data of 50 new energy sector-related enterprises in A-shares of Shanghai and Shenzhen for the study, and the case enterprises involve upstream and downstream industries such as

DOI: 10.54254/2754-1169/57/20230698

the metal processing industry, electronic equipment manufacturing and automobile manufacturing. The following 2 types of samples are excluded: ST, *ST enterprises; enterprises with incomplete data for each variable. The specific data sources are: supply chain concentration, financial flexibility and enterprise innovation data from Cathay Pacific CSMAR financial and economic research database, and weighted geographic distance data are mainly collected by hand for collation.

3.3. Variable Measurement

3.3.1. Supply Chain Relationship

Existing studies mainly study supply chain relationships from supply chain concentration and network. In this paper, we refer to the study of Jiang to measure supply chain concentration in terms of supplier and customer concentration [20]. Supplier concentration (SC) refers to the proportion of the top five suppliers' purchases to the total purchases; customer concentration (CC) refers to the proportion of the top five customers' sales to the total sales.

Referring to Ayers, this paper uses the top five suppliers as the firm's supply chain weighted geographical distance (DIS) as a proxy variable for supply chain geographical distance [21]. The supply chain weighted geographic distance is calculated as the logarithm of the product of the geographic distance between corporate headquarters and the percentage of purchases.

3.3.2. Financial Flexibility

In this paper, financial flexibility is divided into cash flexibility and liability flexibility. The calculation formula is as follows: Cash Flexibility (CFF)=Corporate Cash Holding Ratio-Industry Average Cash Holding Ratio, Liability Flexibility (LFF)=MAX (0, Industry Average Gearing Ratio-Corporate Gearing Ratio)

3.3.3. Corporate Innovation

This paper, R&D investment is used as a proxy variable for corporate innovation performance. The specific measurement for R&D investment is selected from the R&D expenditure data disclosed by listed companies to exclude the influence of scale effects among different enterprises, referring to the study of Brown [22], R&D investment is measured using R&D expenditures divided by total assets (RD), and the robustness test is measured by the ratio of R&D expenditures divided by operating revenues (RD1).

4. Result

4.1. Analysis of Necessary Conditions

This paper uses fuzzy set qualitative comparative analysis research through fsQCA3.0. Necessity analysis calculates the consistency and coverage of the single variables to assess whether the single variables are necessary for firms to invest more in innovation, as detailed in Table 1. In the test of the four conditional variables on firms' innovation (RD), each single variable's necessity level does not exceed the standard threshold for determining a single variable's necessity level (0.8). This indicates that more than any single variable is required to lead to high innovation in the firm.

DOI: 10.54254/2754-1169/57/20230698

Table 1: Necessity test for the positive effect of variables on firm performance.

Variable	Consistency	Coverage	Variable	Consistency	Coverage
SC	0.503	0.516	CFF	0.574	0.654
~SC	0.588	0.588	~CFF	0.575	0.523
CC	0.422	0.438	LFF	0.788	0.601
~CC	0.690	0.682	~LFF	0.396	0.451
DIS	0.506	0.513	~DIS	0.592	0.596

4.2. Configuration Analysis

Based on the corresponding arithmetic rules and sample size of the fsQCA method, the frequency threshold and consistency threshold are set to 2 and 0.8 for causal sufficiency assessment, respectively. Taking innovation performance as the outcome variable, complex solution, intermediate solution, and parsimonious solution are obtained through fuzzy set qualitative comparative analysis, and then core conditions and edge conditions are distinguished according to the parsimonious solution and intermediate solution. Consistency is the degree of correspondence between the outcome and the set theory relationship of the variable combination constructs; unique coverage is the proportion of cases in which a particular construct can only explain the outcome.

As can be seen through Table 2, in both high and low innovation solutions, the consistency level of either solution and the overall solution is higher than the minimum acceptable level of group consistency of 0.8, which implies that all four configurations can adequately explain the existence of the variables and that both solution sets have a certain level of coverage, which can be regarded as a sufficiently necessary condition for influencing the innovation of the firms.

Table 2: Configuration analysis results.

Condition	High-performance			Underperformance	
	Configuration			Configuration	
Result	1	2	3	1	2
Suppler Concentration		⬩	●	●	♦
Customer Concentration	⬩		♦		•
Distance	♦	♦			●
Liability Flexibility		⬩		⬩	●
Cash Flexibility	●	●	♦	♦	
Raw Converage	0.31502	0.18419	0.14380	0.14089	0.12308
Unique Coverage	0.15020	0.03162	0.08656	0.10931	0.09150
Solution Coverage	0.43320			0.23289	
Solution Consistency	0.91869			0.87902	

Notes: ● indicate the presence of a condition, and rhombuses ♦ indicate its absence. Large motifs indicate core conditions; small ones, peripheral conditions.

DOI: 10.54254/2754-1169/57/20230698

4.2.1. Influence Mechanism of High Innovation Performance

Among the grouped configurations of the variables in this paper, there are three that can positively influence corporate innovation. From the first and second constructs, the high cash flexibility of the firm and closer geographic distance to the supply chain are the core conditions. This shows that firms' cash flow is still the main source of firms' R&D investment. Secondly, geographic distance becomes the core condition, suggesting that industrial clusters are crucial for innovation in China's new energy industry. The third construct presents a different result. Firms in the configuration are mainly small and medium enterprises. Their main characteristics are a concentration of suppliers and a dispersion of customers. Even though firms are not rich in cash holdings, they still need to invest in R&D to adapt to market changes.

4.2.2. Influence Mechanism of Low Innovation Performance

In the ~RD solution set, two configurations influence firm innovation. The first is a firm with high debt and tight cash flexibility, while the firm has a high concentration of suppliers and customers. Such a firm is risky to operate if it further increases its investment in innovation. In the second configuration, the firm's suppliers are distant and dispersed, while the firm's debt is high. This is a situation where the firm needs help managing its supply chain well, acquiring knowledge and resources from external sources, and has internal business risks. This type of firm is less innovative.

4.3. Robustness Test

In fsQCA analysis, the robustness test is a crucial analytical step, which can be done by adjusting the calibration threshold. Due to the practice of the calibration process, it is very easy to have a fuzzy set affiliation score of 0.5. Therefore, this study adopts adjusting the calibration criterion between -25% and 25% to test the robustness, referring to the practice of Fiss [19], who corrected the value of concentration calibrated to be exactly 0.5 from 0.499 to 0.501 and re-processed the data. The results show very little difference in the state of the set relationship between the different groups of states, realizing bipartite improvisation and the fitting parameters of the different groups of states, so the results of the present study can be considered robust.

5. Conclusion

Based on the original research, this paper explores the multiple factors and their combination paths affecting enterprise innovation from a resource-based viewpoint. Regarding the presented constructs, cash flow is critical for growth firms (industry), while few firms support innovation through loans. Companies with dispersed customers have a greater incentive to innovate because firms need to offer diverse products. But concentrated suppliers, and concentrated geographical distribution facilitate firms' supply chain management, which accelerates inter-firm cooperation and knowledge learning. The role of industrial clusters in developing China's new energy industry should also be considered. In the low-innovation cases, the impact of business risks within firms on innovation is prominent, with bargaining power over the upstream and their indebtedness determining whether firms can be bold enough to make changes.

References

[1] *Porter, M. E. (1992) Capital disadvantage: America's failing capital investment system. Harvard business review, 70(5), 65-82.*

DOI: 10.54254/2754-1169/57/20230698

[2] Bellamy, M. A., Ghosh, S., & Hora, M. (2014) The influence of supply network structure on firm innovation. Journal of Operations Management, 32(6), 357-373.
[3] Campello, M., Graham, J. R., & Harvey, C. R. (2010) The real effects of financial constraints: Evidence from a financial crisis. Journal of financial Economics, 97(3), 470-487.
[4] Gamba, A., & Triantis, A. (2008). The value of financial flexibility. The journal of finance, 63(5), 2263-2296.
[5] Cheng, J. L., & Kesner, I. F. (1997). Organizational slack and response to environmental shifts: The impact of resource allocation patterns. Journal of management, 23(1), 1-18.
[6] Cuervo-Cazurra, A., & Annique Un, C. (2010). Why some firms never invest in formal R&D. Strategic Management Journal, 31(7), 759-779.
[7] Basole, R. C., Bellamy, M. A., & Park, H. (2017). Visualization of innovation in global supply chain networks. Decision Sciences, 48(2), 288-306.
[8] Schildt, H., Keil, T., & Maula, M. (2012). The temporal effects of relative and firm-level absorptive capacity on interorganizational learning. Strategic management journal, 33(10), 1154-1173.
[9] Hammervoll, T. (2009). Value-creation logic in supply chain relationships. Journal of Business-to-Business Marketing, 16(3), 220-241.
[10] Boschma, R. A., & Lambooy, J. G. (2002). Knowledge, market structure, and economic coordination: dynamics of industrial districts. Growth and change, 33(3), 291-311.
[11] Lonsdale, C. (2001). Locked-in to supplier dominance: on the dangers of asset specificity for the outsourcing decision. Journal of Supply Chain Management, 37(2), 22.
[12] Dhaliwal, D., Judd, J. S., Serfling, M., & Shaikh, S. (2016). Customer concentration risk and the cost of equity capital. Journal of Accounting and Economics, 61(1), 23-48.
[13] Cassiman, B., & Veugelers, R. (2006). In search of complementarity in innovation strategy: Internal R&D and external knowledge acquisition. Management science, 52(1), 68-82.
[14] Kale, J. R., & Shahrur, H. (2008). Corporate leverage and specialized investments by customers and suppliers. Journal of Applied Corporate Finance, 20(4), 98-104.
[15] Le, T. V., & O'Brien, J. P. (2010). Can two wrongs make a right? State ownership and debt in a transition economy. Journal of Management Studies, 47(7), 1297-1316.
[16] Brown, J. R., Fazzari, S. M., & Petersen, B. C. (2009). Financing innovation and growth: Cash flow, external equity, and the 1990s R&D boom. The Journal of Finance, 64(1), 151-185.
[17] Billett, M. T., King, T. H. D., & Mauer, D. C. (2007). Growth opportunities and the choice of leverage, debt maturity, and covenants. the Journal of Finance, 62(2), 697-730.
[18] Zschoch, M. A. (2011). Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques, Benoit Rihoux and Charles Ragin, eds., Thousand Oaks CA: Sage Publications, 2009, pp. xxv, 209. Canadian Journal of Political Science/Revue canadienne de science politique, 44(3), 743-746.
[19] Fiss, P. C. (2011). Building better causal theories: A fuzzy set approach to typologies in organization research. Academy of management journal, 54(2), 393-420.
[20] Jiang, S., Yeung, A. C., Han, Z., & Huo, B. (2023). The effect of customer and supplier concentrations on firm resilience during the COVID-19 pandemic: resource dependence and power balancing. Journal of Operations Management, 69(3), 497-518.
[21] Ayers, B. C., Ramalingegowda, S., & Yeung, P. E. (2011). Hometown advantage: The effects of monitoring institution location on financial reporting discretion. Journal of Accounting and Economics, 52(1), 41-61.
[22] Brown, J. R., Martinsson, G., & Petersen, B. C. (2013). Law, stock markets, and innovation. The Journal of Finance, 68(4), 1517-1549.