Research on Supply Chain Integration under Service-oriented Logics and Joint Influence of Dual Innovation on Corporate Performance Path

-- Empirical Analysis of FsQCA based on Manufacturing Enterprise Data

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Abstract. The rapid development of economic globalization and the promotion of emerging technologies have spawned a Service-oriented logic that gradually dominates the contemporary industry, and the path for manufacturing companies to improve performance has become more and more complicated. Based on this background, the article uses the data of A-share listed companies in the manufacturing industry in the Yangtze River Delta and the Pearl River Delta in 2019, and uses the research method of fuzzy set qualitative comparative analysis to empirically study the core path and mechanism of multiple complex factors that affect corporate performance. The research results show that manufacturing companies can choose four paths to improve corporate performance (supply chain integration-driven based on internal control, servicing and market dual logic based on internal control-based integration-driven, relying on exploration and innovation-based integration-driven, Relying on the integration-driven type of dual innovation and balance), and found that the core role of supply chain integration and servicing level has become more prominent, becoming a key factor leading to high corporate performance. This research is helpful to identify the influence mechanism of supply chain integration, service level and other factors on corporate performance, and grasp the core of configuration, which has certain reference significance for corporate managers.

Keywords: Supply Chain Integration; Corporate Performance; FsQCA; Dual Innovation; Service Level.

1. Introduction

With the emergence of intelligent technology, the diversification and individuation of consumers' demand are amplified infinitely, and the roles of both the buyer and seller change. As a result, many industries start confronting the opportunities and challenges of digital and service transformation. Hereunder, the competition among enterprises has gradually transformed into the competition among supply chain[1].Reinforcement of supply chain management has gradually become the important strategy for enterprises to obtain competitive strength, while the supply chain integration is considered as the soul of supply chain management[2].

Nowadays, the Service-oriented logics gradually emerge. The competition dimension of manufacturing enterprises becomes diversified, gradually extends to the service innovation from previous competition in cost and quality, and attempts to achieve the diversified competition by adding service in product[3].On the occasion of transformation change, enterprises confront the scenes with great particularity. Therefore, we are necessary to concern and explain the path selection influencing corporate performance under such great change and its mechanism causes in order to help the growth and development of Chinese enterprises.

The existing research provides the solid theoretical basis and systematic analysis perspective for deep discussion of supply chain integration and corporate performance, but most of those researches are established in the traditional empirical analysis of single factor influence mechanism. The disclosure to complex causality can still be improved. Thus, the cases of manufacturing enterprises

in Yangtze River Delta and Pearl River Delta are analyzed to discuss the driving mechanism of high corporate performance from the configuration perspective.

2. Research Framework and Literature Review

2.1 Supply Chain Integration Degree and Corporate Performance

Supply chain integration refers to the efficient flow that enterprises reach strategic cooperation with supply chain partners and manage internal and external process of enterprises to reach the product flow, service flow, information flow and capital flow in order to efficiently create the maximum value for customers at low cost[4].For the manufacturing enterprises, only the supply chain integration can promote the sustainable development of the whole supply chain and achieve the value innovation. Supply chain integration strategy can boost the propaganda and sharing of knowledge, and is beneficial to enterprises obtaining new knowledge to form competitive strength and enhance corporate performance[5].Current supply chain integration refers to the integration of structure, resources and knowledge. Manufacturing enterprises shall make full use of the advantages of the current knowledge base and utilize the combination potential of old knowledge to accelerate new knowledge integration, thus shortening the internalization process of new knowledge and achieving the breakthrough and application of new technology[6][7].Effective integration of knowledge can promote the formation of organizational routines, thus reducing the organizational learning costs, improving operating efficiency and finally boosting the corporate performance.

2.2 Dual Innovation and Corporate Performance

March[8] proposed the concept of exploration and development from the organizational learning perspective the first time which effectively explained the organizational ambidexterity and was gradually extended and applied in the innovation management field, etc. later. Benner & Tushman[9] proposed and defined the concept of dual innovation (exploratory innovation and development innovation) on the basis of previous research. Lots of research has certified that the dual innovation can promote the improvement of corporate performance.

2.3 Servitization Degree and Corporate Performance

Globalization and technological change make market environment become opener and opener, and rich information flow makes every kind of subject perceive the change faster and respond. Nowadays, consumers mostly occur in the commercial environment as producers, marketing communicators and investors. The appearance of community and self-organization phenomenon, social contact of acquaintances, and crowd funding mode of investment links can also enlighten manufacturing enterprises which shall also attach importance to the demand side and supply side of supply chain and consider high value increment of both sides to provide enterprises with the vision premium and sustainability energy. The high value increment is determined by the service level provided by the manufacturing enterprises in the face of suppliers and customers. The high service degree can promote the enterprises to understand thoroughly and focus on long-tail demands and explore the subconscious demands of consumers. In case of breakthrough, the corporate performance has qualitative improvement. The manufacturing enterprises' service degree significantly enhancing the corporate performance fails to reach a consensus in the academic circle. Many scholars think: due to "service paradox", manufacturing enterprises can boost the corporate performance only when the service degree matches with its ability.

2.4 Internal Control and Corporate Performance

The research on the relationship between internal control and corporate performance has been relatively mature. The internal control is deemed as the core explaining variable or moderating variable, whose promotion action to corporate performance mostly presents prominent positive effect

in research. Favorable internal control can improve performance appraisal of employees, and motivate internal innovation incubation. The "makerspace" of Tencent emerges in this way. The internal control can't do without the construction of system, and favorable system and rational procedure are conducive to constructing the unblocked information communication mechanism and rapid response mechanism in the face of risk, thus promoting the implementation of innovation project and boosting the overall performance of enterprises.

3. Study Design

3.1 Research Methods

The qualitative comparative analysis of fuzzy sets is based on the research methods of Boolean algebra and set theory. It was first proposed by Ragin (2000) to try to reveal the combination of various working conditions that lead to a specific result [10] [11]. Based on this, this paper selects the fuzzy set qualitative comparative analysis method for analysis.

3.2 Samples and Data

The manufacturing industry A-share listed companies in two typical industrial economic belts: Yangtze River Delta and Pearl River Delta Region in 2019 are selected as the original samples to successively eliminate the following companies: (1) Companies lacking dual innovation activities; (2) Companies without disclosure of internal control information; (3)*ST, S*ST, SST and ST companies; (4) Companies lacking other research data. Finally, 59 effective research cases are obtained. The financial data of listed companies are from Shenzhen GTA database. DIB internal control indicators are from internal control and risk management database of DIB.

3.3 Measurement of Variables

1. Corporate performance (ROA).The outcome variable in the research is the corporate performance. For convenience, the practices [12] of He Yubing and Ding Jiamin are referred and the return on total assets (ROA) is selected to balance the corporate performance.

2. Supply chain integration degree (VAS) People often adopt the added value index method to measure the supply chain integration degree[13].The specific reference practice of Buzzell[14] adopts the following VAS calculation formula:

$$\mathrm{VAS} = \frac{\text{Operating revenue} - \text{operating cost} - \text{after} - \text{tax net profit} + \text{net asset} * \text{average annual yield rate}}{\text{Operating revenue} - \text{after} - \text{tax net profit} + \text{net asset} * \text{average annual yield rate}}$$

3. Dual innovation, exploratory innovation (R) and development innovation (D). For the measurement of exploratory innovation and development innovation, the practice of Bi Xiaofang, et al.[15] is referred to measure the dual innovation, in which the fee expenditure of research and development activities is used as the measurement indicator of exploratory innovation, and the capitalization expenditure of research and development activities is used as the measurement indicator of development innovation (D).

4. Internal control (IC). DIB internal control indicators are adopted to measure the internal control level.

5. Manufacturing industry servitization level (SER). The SER is selected as the antecedent variable, and can comprehensively reflect the service level of manufacturing enterprises as the financial output indicator of service. By reference of the research of Xiao Ting[16], the "net non-operating income and expenditure /total profits (%)" (SER) in enterprises' financial data is adopted to quantitatively measure the service degree of manufacturing enterprises.

6. Enterprise size (SIZE). The size also generates a significant influence on performance. In order to make configuration richer and more completely, the enterprise size is also included in configuration

for analysis. By reference of the research of Wu Shaoyu[17], the quantity of enterprise employees is used to measure the enterprise size.

7. Market environment (ME). By reference of the practice of Tang Jianrong, et al.[18], the per capita GDP is adopted to measure the market environment.

3.4 Data Calibration

The direct calibration method is adopted to set up the threshold value for the transformation of membership grades of fuzzy set. Based on the research of Fiss[19], 3 anchor points of antecedent variable and outcome variable are set as 75%, 50% and 25% of the sample data, respectively. Non-high corporate performance is calibrated through the disaggregation of high corporate performance. The FsQCA3.0 software is used for the fuzzy set's calibration of the sample research data by virtue of "calibrate" function according to the above standards. Table 1 summarizes the calibration information of each condition and result in this paper.

Table 1. Calibration Anchor of Each Variable

Variable		Complete membership	Intermediate point	Complete non-membership
Result variable	Corporate performance (ROA)	0.0523	0.0292	0.0149
Antecedent variables	Supply chain integration degree (VAS)	0.4155	0.2006	0.1496
	Exploratory innovation (R)	467358174	177301671	67952700
	Development innovation (D)	79862935	19028762	7821084
	Internal control (IC)	722.09	681.35	636.33
	Service degree (SER)	0.0261	0.0007	-0.0096
	Enterprise size (SIZE)	9818	3765	1795
	Market environment (ME)	134982	98643	86412

4. Research Results

4.1 Analysis of Necessity of Single Condition

Table 2. Necessity Test Results of Single Antecedent Condition

Antecedent variables	High corporate performance		Non-high corporate performance	
	Consistency	Coverage ratio	Consistency	Coverage ratio
VAS	0.63	0.65	0.43	0.44
~VAS	0.46	0.45	0.66	0.64
R	0.54	0.55	0.54	0.54
~R	0.54	0.54	0.55	0.54
D	0.48	0.50	0.56	0.57
~D	0.59	0.57	0.51	0.49
IC	0.67	0.70	0.40	0.41
~IC	0.43	0.42	0.70	0.68
SER	0.51	0.52	0.57	0.57
~SER	0.58	0.58	0.53	0.52
SIZE	0.55	0.56	0.51	0.51
~SIZE	0.52	0.52	0.56	0.55
ME	0.60	0.55	0.61	0.55
~ME	0.51	0.57	0.50	0.56

After calibration, the necessity analysis must be conducted to the single variable. It is generally recognized that such condition is necessary or almost necessary when the consistency level is more than 0.9[10]. While the case with membership degree of just 0.5 would be deleted in the analysis. The practice of Campbell [20] will be adopted to amend the membership degree from 0.5 to 0.501, and the necessary condition inspection between high corporate performance and non-high corporate performance is conducted. The Table 2 shows that the consistency rate between each antecedent condition and corporate performance doesn't exceed the judgment standard (0.9), so they can't constitute the necessary condition of high corporate performance and non-high corporate performance, and the qualitative comparative analysis is needed.

4.2 Sufficiency Analysis of Condition Configuration

Table 3. High/non-high Corporate Performance Configuration

Antecedent condition	High corporate performance				Non-high corporate performance					
	H1	H2	H3	H4	NH1	NH2	NH3	NH4	NH5	NH6
VAS	●	●	●	●	⊗	⊗	⊗	⊗	⊗	⊗
R	⊗	⊗	●	●		⊗	•	•	•	⊗
D	⊗	⊗	⊗	•	●		•	●	⊗	•
IC	•	●	●	⊗	⊗	⊗	⊗	⊗	⊗	⊗
SER	⊗	●	●	●	•	•	⊗	⊗	⊗	⊗
SIZE	●	⊗	•	•	⊗	⊗	•	⊗	●	•
ME	⊗	●	⊗	●	⊗	•	⊗	•	•	•
Consistency	0.9050	0.9454	0.9539	0.9054	0.9525	0.9134	0.8698	0.9005	0.8985	0.8701
Original coverage degree	0.0609	0.0933	0.0627	0.0741	0.1095	0.1403	0.0935	0.0680	0.0604	0.0457
Unique coverage degree	0.0306	0.0640	0.0226	0.0512	0.0396	0.0772	0.0450	0.0208	0.0218	0.0058
Consistency of solution	0.9382				0.9283					
Coverage degree of solution	0.2095				0.3092					

Note: ● indicates the existence of core condition, ⊗ indicates the absence of core condition, • indicates the existence of edge condition, ⊗ indicates the missing of edge condition, and "blank" indicates the condition can exist or miss.

In the research, the threshold value (0.8) is set for the number (default value is 1) of combination matching case in truth table and consistency. The threshold values of PRI in high corporate performance configuration and in non-high corporate performance configuration are set as 0.85 and 0.75, respectively in order to screen the aggregation with stronger explanation degree. The algorithm based on Boolean algebra is used to logically decrease the truth table to simplified combination, then the conditional combination conforming to the requirements is further analyzed to work out complex solution and simple solution. The counterfactual analysis based on theory shall be conducted for the

generation of the intermediate solution. The "existence/non-existence is ok" option is selected in the step where the intermediate solution is generated, and the intermediate solution is reported, matched with simple solution. Details are as shown in Table 3.

Based on high corporate performance, for four kinds of configurations represented in Table, the consistency level of both single solution and overall solution is higher than the acceptable minimum standard (0.75), in which the consistency of overall solution reaches 0.9381, highly consistent. The coverage degree of overall solution is 0.21, which basically conforms to the QCA research in the relevant field. Four kinds of configurations can be deemed as the sufficient condition combination to improve corporate performance of manufacturing enterprises in the Yangtze River Delta and Pearl River Delta. In the non-high corporate performance, six kinds of configurations are represented. The consistency level of both single solution and overall solution is higher than the minimum standard (0.75), in which the consistency and coverage degree of overall solution are 0.9283 and 0.31, respectively.

4.3 Robustness Test

Upon the robustness testing, the consistency threshold values of original samples of high corporate performance configuration and non-high corporate performance configuration are increased to 0.9, and 0.85, respectively. Then the configuration is analyzed. The configuration changes slightly maybe because the improvement of result accuracy on account of the change of consistency threshold value. The consistency of overall solution increases to 0.9571 and 0.9564, respectively, and the coverage degree of overall solution decreases to 0.1276 and 0.1949, respectively. But the configuration is basically the same, and the core path doesn't contradict the above conclusion, which indicates the above results are robust.

5. Research Conclusions and Enlightenment

5.1 Research Conclusions

(1) Manufacturing corporate performance owns concurrency of many causes. Any single factor isn't the essential condition and sufficient condition of high corporate performance. After analysis, it is not difficult to find that the influence factor of high performance of manufacturing enterprises can't play a role independently, but constitute resultance force in configuration form to jointly boost the corporate performance. This conclusion can promote the transformation of research on corporate performance influence factors toward the holistic perspective to some extent.

(2) As the service logics gradually occupy the leading role at present, four kinds of core paths to boost corporate performance of manufacturing industry are refined, namely the supply chain integration driving type based on internal control, the conformity driving type based on internal control in the dual logics of service and market, the conformity driving type based on exploratory innovation in Service-oriented logics, and the conformity driving type based on dual innovation balance in the dual logics of service and market. Absolutely different configuration is corresponding to different paths, and manufacturing enterprises suitable for different development statuses select the corresponding adaptation factors, thus making the strategic adjustment and transformation change.

(3) The key role of supply chain integration degree and service level increasingly highlights. The results show that 4 configurations of high corporate performance contain the supply chain integration degree, and it can be found that there are 3 configurations for high corporate performance with the enterprise service level as core variable, which reflects the leading role of service logic in post-industrial age and the importance and necessity of supply chain integration management. Nowadays and in the future, the manufacturing enterprises will tend to deem customer demands as the top design. In respect of supply chain integration and relationship management, the value pulling is the effective means for internal optimization and external connection.

5.2 Management Enlightenment

The research conclusion of this paper is conducive to reinforcing the recognition improvement and correct selection of corporate performance path by enterprises. Firstly, it is necessary to pay attention to the Service-oriented logics and construct the effective supply chain integration mechanism. With the integration of internet technology and the development of platform ecology, the "decentralization" gradually creates the heterogeneity demand of users, and enterprise managers shall construct the benign interaction between enterprises and external market. The supply chain integration of manufacturing enterprises shall not only focus on basic process and organizational structure, but also develop toward knowledge management and pay attention to the effective integration of information flow and knowledge flow. Secondly, the market environment and innovation consciousness also can't be ignored. Favorable market environment is deemed as the important condition to drive enterprises to conduct the exploration innovation and balance dual innovation, and the insight into the policy environment will concern the adjustment and change of enterprise strategy. Thirdly, enterprises shall pay attention to pushing the organic balance between dual innovation, and weigh their respective investment according to the actual development condition of enterprises. Generally speaking, exploratory innovation can directly improve the corporate performance, and can build the core competitiveness with certain barrier and pioneer advantages. So it is the long-term goal of enterprises. While the development innovation focuses on current situation more. In the face of restriction of scale or resources, enterprises shall not be overly ambitious, and their proper improvement of product efficacy can also boost corporate performance to some extent.

References

[1] Ma Shihua, Lin Yong and Chen Zhixiang. Supply Chain Management [M]. Beijing: China Machine Press, 2000.

[2] Horvath L. Collaboration: The key to value creation in supply chain management[J]. Supply Chain Management, 2001, 6 (5): 205-207.

[3] Li Huashan. Influence of Manufacturing Enterprise Service on Corporate Performance and Empirical Research of Situational Factors [D]. Harbin Institute of Technology, 2019.

[4] Flynn B B, Huo B, Zhao X. The impact of supply chain integration on performance: A contingency and configuration approach[J]. Journal of Operations Management, 2010, 28(1): 58-71.

[5] Grant RM. Prospering in dynamically-competitive environments: organizational knowledge as knowledge integration[J]. Organization Science,1996,7(4): 375-387.

[6] Yu Fei, Hu Zemin, Dong Liang, Et Al. Research on Influencing Mechanism of Enterprise breakthrough Innovation by Knowledge Coupling [J]. Studies in Science of Science, 2018, 36(12): 2292-2304.

[7] Yu Fei, Liu Mingxia, Wang Lingfeng, et al. Influence Mechanism of Green Innovation of Manufacturing Enterprise by Knowledge Coupling-- Adjusting Role of Redundant Resources [J]. Nankai Business Review, 2019, 22(3): 54-65.

[8] March J G. Exploration and exploitation in organizational learning [J]. Organization Science, 1991, 2(1): 97-118.

[9] Benner M J, Tushman M L. Exploitation, exploration, and process management: The productivity dilemma revisited [J]. The Academy of Management Review, 2003, 28(2): 238-256.

[10] RAGIN, set relations in social research: Evaluating their consistency and coverage. Political Analysis, 2006 (14(3)): p. 291-310.

[11] Li Yongfa. Qualitative Comparative Analysis: Configuration Comparison Method Integrating Quantitative and Qualitative Thinking. Journal of Guangxi Normal University (Philosophy & Social Science Edition), 2020. 56(03): 89-110.

[12] He Yubing and Ding Jiamin. Internal Association of Enterprise Diversification Strategy and Its Influence on Performance-- Empirical Evidence from Listed Companies in China's Manufacturing Industry [J]. Studies in Science of Science, 2015,33(11):1715-1726.

[13] Huang Jiegen, Ji Xiangxi and Li Yuanxu. Influence of Enterprise Innovation Strategy on Business Performance -- Taking the Supply Chain Integration Strategy of Manufacturing Enterprises as an Example [J]. Scientific Management Research, 2021,39(01):111-115.

[14] Buzzell R D, Gale B T. Strategy and Performance:PIMS Principle [M]. Huaxia Press, 1999.

[15] Bi Xiaofang, Zhai Shuping and Jiang Baoqiang. Influence of Government Subsidies and Financial Redundancy on Dual Innovation of High-tech Enterprises [J]. Accounting Research, 2017(1): 46-52, 95.

[16] Xiao Ting, Nie Qunhua and Liu Hua. Research on Influence of Manufacturing Industry Servitization on Corporate Performance-- Empirical Evidence Based on China's Manufacturing Enterprise [J]. Science of Science and Management of S.&T, 2014, 4 (35): 151-159.

[17] Wu Shaoyu, Wang Bo, Li Xiaoyan and Wang Dong. Research of Influence of Dual Social Network Embedment on Technological Innovation Performance of Returnees Entrepreneurial Companies [J]. Science of Science and Management of S.&T., 2016(10).

[18] Tang Jianrong and Wu Minghua. Research on Returnee Executives and Enterprise Innovation Capability -- Empirical Analysis based on FsQCA [J]. Management Modernization, 2019,39(02):98-101.

[19] Fiss, P.C., Building Better Causal Theories: A Fuzzy Set Approach to Typologies in Organization Research. Academy of Management Journal, 2011. 54(2): 393-420.

[20] Campbell J T, Sirmon D G, Schijven M. Fuzzy Logic and the Market: A Configurational Approach to Investor Perceptions of Acquisition Announcements[J]. Academy of Management Journal, 2016, 59 (1): 163-187.