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Internationalization of Clusters: A Qualitative Comparative Analysis (QCA) of Township Industrial Clusters

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Internationalization of Clusters: A Qualitative Comparative Analysis (QCA) of Township Industrial Clusters

Abstract

This study aims to examine the internationalization of clusters, a driving force of the rising of multinational firms from emerging markets. We explored the question from the knowledge and relational dimension of clusters. We examine how the configuration of four factors, namely, component knowledge, architecture knowledge, horizontal competition, and vertical coordination, within a cluster jointly affect the degree of cluster internationalization by utilizing the Fuzzy Set Qualitative Comparative Analysis (fsQCA) method. Using Data of 34 township clusters in Suzhou City, China, we identified three models that lead to a high cluster internationalization level.

Keywords: internationalization, cluster, horizontal competition, vertical coordination, fsQCA

Internacionalització dels clústers: una anàlisi comparativa qualitativa (QCA) dels clústers industrials municipals

Resum

Aquest estudi preten examinar la internacionalització dels clústers, un motor de l'auge de les empreses multinacionals dels mercats emergents. Hem explorat la qüestió des del coneixement i la dimensió relacional dels clústers. Examinem com la configuració de quatre factors, és a dir, el coneixement dels components, el coneixement de l'arquitectura, la competència horitzontal i la coordinació vertical, dins d'un clúster afecten conjuntament el grau d'internacionalització del clúster mitjançant l'ús del mètode d'anàlisi comparativa qualitativa de conjunts difusos (fsQCA). Utilitzant les dades de 34 clústers municipals a la ciutat de Suzhou, Xina, hem identificat tres models que condueixen a un alt nivell d'internacionalització de clústers.

Paraules clau: internacionalització, clúster, competència horitzontal, coordinació vertical, fsQCA

Internacionalización de clústers: un análisis comparativo cualitativo (QCA) de clústers industriales municipales

Resumen

Este estudio tiene como objetivo examinar la internacionalización de los clústers, una fuerza impulsora del surgimiento de empresas multinacionales en los mercados emergentes. Exploramos la cuestión desde la dimensión de conocimiento y relacional de los clústers. Examinamos cómo la configuración de cuatro factores, a saber, conocimiento de los componentes, conocimiento de la arquitectura, competencia horizontal y coordinación vertical, dentro de un clúster afectan conjuntamente el grado de internacionalización del clúster mediante la utilización del método de Análisis Comparativo Cualitativo de Conjuntos Difusos (fsQCA). Utilizando datos de 34 clústers municipales en la ciudad de Suzhou, China, identificamos tres modelos que conducen a un alto nivel de internacionalización de clusters.

Palabras clave: internacionalización, cluster, competencia horizontal, coordinación vertical, fsQCA

集群国际化：乡镇产业集群的定性比较分析

摘 要

本研究旨在考察集群国际化，这是新兴市场跨国公司崛起的驱动力。我们从集群的知识和关系两个维度来探讨这个问题。应用模糊集定性比较分析方法，我们研究了集群内部件知识、结构知识、横向竞争和纵向协调四个因素的配置如何共同影响集群国际化程度。利用中国苏州市 34 个乡镇集群的数据，我们确定了三种导致集群国际化水平较高的模式。

关键词：国际化，集群化，横向竞争，纵向协调，模糊集定性比较分析

Introduction

Past decades have witnessed the rise of multinational enterprises (MNEs) from emerging markets. One force behind this phenomenon is that emerging economies are leveraging the agglomeration effect of clusters to catch up with their global competitors (Jia et al. 2017). Studies in international business discussed clusters and MNEs mainly from the perspective of MNEs, highlighting the location advantage, such as specification, collective efficiency, and joint innovation, which are brought by clusters (Amdam et al. 2020; Maskell 2001; McCann and Folta 2008; Mesquita and Lazzarini 2008; Mudambi et al. 2018). We will shift our attention from MNEs to clusters, exploring the internationalization of clusters. We would prefer to examine why some clusters have a greater level of internationalization compared with others. Answering this question would extend the internationalization literature to the cluster level, an analysis level legitimatized by Porter (2000) and Tallman et al. (2004), but remain underexplored by existing literature. The internationalization of clusters is viewed by emerging economies as a catch-up strategy and as an engine of economic growth (Jia, Tallman and Zheng 2017). Therefore, identifying which configuration of factors would promote cluster internationalization is also of great practical relevance.

We explored the question from the knowledge and relational dimension of clusters. Tallman et al. (2004) proposed a knowledge theory of clusters highlighting how knowledge stocked and flowed within clusters generates a competitive advantage for clusters in the international market. This seminal study classed knowledge into two types, component, and architectural knowledge. The relational dimension of clusters focuses on the horizontal and vertical relations within clusters. The horizontal relation mainly reflects the competitive advantages from variation and competitive response in the development and performance of clusters (Marshall 1920). However, the vertical relation represents the benefits of the collaborative and task partitioning aspects of the theory of clusters (Jia, Tallman and Zheng 2017). We aimed to examine how the configuration of knowledge types and horizontal and vertical relations within clusters jointly impact cluster internationalization by combining the two dimensions. As we focused on the configuration of knowledge and relational dimensions of clusters, we used the fsQCA method to explore which configuration of knowledge and cluster structure could foster a higher cluster internationalization level.

We examined our research question among the township industrial clusters in China. Township industrial clusters in China are a large group of firms proximately located in a specific town with a clear leading industry. The township government provides necessary infrastructure elements and favorable policies to foster cluster development (Jia, Tallman and Zheng 2017). The township clusters fulfill the definition of clusters by Porter (2000). Moreover, China has more than 5000 township clusters (Jia, Tallman and Zheng 2017), varying in the internationalization level. Therefore, the township clusters in China provide an ideal scenario to examine the internationalization of clusters. We identified three configurations that lead to high cluster internationalization level based on data from 34 township clusters.

We contributed to international business and cluster literature in two ways. First, we contribute to the international business literature by focusing on the internationalization of clusters. We examine

internationalization from the meso-level, a legitimate level of analysis that is overlooked in International Business (IB, hereafter) studies. Determining which configuration of factors promotes cluster internationalization has great practical implications. Second, we extend cluster research by moving beyond the performance heterogeneity to the strategy heterogeneity of clusters. This process will strengthen our understanding of the evolution of clusters.

Theoretical framework

Component Knowledge and cluster internationalization

Tallman et al. (2004) classified knowledge into two types, component and architecture knowledge. Cluster-level component knowledge refers to specific knowledge resources, skills, and techniques that relate to identifiable parts of an organizational system rather than the entire system (Tallman et al. 2004). It is usually associated with the technology within the industry. It is potentially transferable to informed individuals or organizations. In the context of cluster, the knowledge interaction between companies could facilitate the transfer and flow of component knowledge. We focused on two typical components of knowledge in the cluster: the number of patents within the cluster and the number of international certifications within the cluster, reflecting the technical and managerial component knowledge within the cluster.

The number of patents serves as an indicator of the technology knowledge reservoir, which encompasses the expertise and knowledge required for devising novel products, or processes that bring new technical solution. It contributes to the technical foundation within the cluster.

The technological knowledge moves among the firms quickly and freely in a township industrial cluster because of interdependencies and the shorter cognitive distance inside the cluster (Marshall 1920; Tallman et al. 2004). It flows within firms through collaboration in the supply chain and dilute to competitors within the cluster through human capital flow, or through imitation due to the weak intellectual property right protection in China. The accumulation of technological know-how within the cluster acts as a catalyst for innovation, triggering a continuous quest for fresh solutions and novel services among the member firms. It enables firms in clusters to find new solutions and provide new services to customers continuously, improve the firm's competitiveness in the international market, and thus have greater cluster internationalization level.

International standard certifications hold by firms reflect managerial component knowledge within the cluster. Firms that hold international standard certifications are required to establish a comprehensive set of managerial practices and programs. These initiatives are designed to fulfill stringent requirements and specifications, enhancing firm quality, environmental sustainability, food safety, safety protocols, and the management of work-related risks.

The adoption of international standard certifications can yield significant benefits for firm production processes, which may lead to heightened efficiency, reduced material waste, shorter production timelines, and decreased inventory costs (David and Greenstein 1990). The managerial knowledge could also spillover within the clusters. Firms would encourage their suppliers in the supply chain change their management system align with the certification to ensures the quality and timely delivery of components and parts, thereby elevating the

overall managerial of firms within the cluster. The spillover of managerial knowledge related to international standards results in the establishment of an effective and standardized production network, thus fostering compatibility and stability among the participating firm (David and Greenstein 1990). This collective effort effectively reduces the production costs within the cluster, granting the cluster a distinctive cost competitive advantage in the international market.

International standard certification also signals firm quality to international customers (Leland 1976). Products certified by international standards are more likely to gain the trust and recognition of customers in the international market, where information asymmetry is more pronounced. Additionally, globally recognized standards such as the ISO 14000 environmental management system standards can facilitate companies in overcoming non-tariff barriers, including environmentally focused restrictions, facilitating their entry into the international market.

Architectural knowledge and cluster internationalization

The second type of knowledge in clustering, architectural knowledge, refers to the understanding developed at the regional cluster level through the routinization of the network of interactions, interdependencies, and common interests among the members (Tallman et al. 2004). Architectural knowledge concerns the structure and systems of an organization and is generated and developed endogenously as an integral and part of the organization, rather than as knowledge that exists independently of the organization. Compared with component knowledge, architectural knowledge is not easily transferable, but it also has an impact on knowledge flow.

We viewed the establishment of research and development (R&D) centers as architectural knowledge within cluster. With the establishment of the R&D center, a technology-oriented identity and convention could be created in a cluster, which constitutes an important part of cluster-level architecture knowledge that helps boost innovativeness and internationalization (Tallman et al. 2004; Jia, Tallman and Zheng 2017).

Research and development (R&D) centers serve as an innovation platform integrating enterprises within the cluster, scientific research institutions within and outside the cluster, and colleges, universities, and intermediaries to provide enterprises within the cluster with a technology innovation service. It optimizes the configuration and management of research and development resources in the industrial cluster and provides technical innovation and cooperation platform for all members of the industrial cluster. R&D centers translate global innovation into exploitative knowledge that allows the local firms to utilize their productive capacity in some township clusters (Jia, Tallman and Zheng 2017).

R&D centers cultivate the creation of cluster architectural knowledge. The presence of these centers acts as a catalyst for collaboration, catalyzing knowledge spillover and fueling increased investments in research and development endeavors within clusters. The existence of R&D centers cultivates a technology-centric identity and conventions within a cluster (Maskell 2001; Jia, Tallman and Zheng 2017). It elevates the overall reputation of the cluster—an integral facet of cluster-level architectural knowledge that bolsters its innovativeness (Tallman et al. 2004). The cluster consequently becomes a magnet for new enterprises, both domestic and multinational,

enriching the innovation landscape with fresh ideas and expertise (Lamin and Livanis 2013). The greater innovativeness within cluster enables firms provide novel product and service and improve production process to improve efficiency. It would make firms in clusters have greater competitiveness in the international market, thereby improving cluster internationalization level.

Horizontal competition, vertical coordination, and cluster internationalization

Porter (1998) proposed that a cluster is a collection of interconnected firms in a specific field that compete with each other but also cooperate with each other. Cooperation and competition exist in all fields and levels of the cluster, and the more enterprises in the cluster, the more intense the cooperation and competition to win and retain customers. We would like to examine how the horizontal competition and coordination within the cluster influence cluster internationalization.

Vertical coordination and cluster internationalization

In most developing countries, firms are striving to go global to reduce their dependence on the domestic market and reduce the impact of market fluctuations. Compared to their counterpart from developed countries, firms from developing countries usually lacks of competitive advantage or even could not gain access to the international market due to weak institutional infrastructure in their home country. Studies show that joint action among small and medium enterprises (SMEs) in developing countries can break down scale disadvantages and infrastructure constraints.

Vertical coordination increases production efficiency and cooperative innovation rate. By aligning the efforts of upstream and downstream entities, production activities can be synchronized to achieve swifter inventory turnover and punctual deliveries (Boyer et al. 1997). This cooperative synergy yields production efficiencies that confer cost-based competitive advantages upon upstream and downstream enterprises in the global arena. The coordination of upstream and downstream enterprises improves the efficiency of joint innovation and enhances the ability to fulfill the needs of different international customers (Jia, Tallman and Zheng 2017; Mesquita and Lazzarini 2008). Therefore, vertical coordination in the clusters could improve productivities efficiency and innovativeness within the cluster, making the cluster become more competitive in the global market (Canina, Enz and Harrison 2005; Tallman et al. 2004; Tendler and Amorim 1996), thereby increasing internationalization levels (Schmitz 1995).

Horizontal competition and cluster internationalization

The agglomeration effect of clusters, such as the specification of labor, input, and knowledge spillover, leads to greater efficiency and production. Fierce competition within the cluster will prompt all companies to improve efficiency and productivity, increase output quality and quantity, reduce production costs, and gain sufficient competitive advantages in the international market. The gathering of a large number of firms from the same industry could reduce the customers' search costs. The horizontal competition within the cluster prompts firms to offer a diverse array of products spanning various categories and price points. This abundance enables customers to evaluate a wide spectrum of offerings within the cluster, thereby enhancing the cluster's competitive stance in the global market (McCann and Folta 2008).

Furthermore, the magnitude of horizontal competition escalates with the growth of the

cluster's size. Studies in developed economies showed that the agglomerate effect may decline as the cluster becomes overcrowded and the competition intensifies (Folta, Cooper and Baik 2006). However, studies in emerging markets show that increasing the cluster size is unlikely to result in diseconomies of scale (Alcácer and Zhao 2012; Jia, Tallman and Zheng 2017). Instead, horizontal competition will lead to a high possibility of variation and a greater degree of the division of labor in a cluster, which will foster the overall competitiveness of a cluster in the global market (Jia, Tallman and Zheng 2017).

Research method

Fuzzy-set QCA analysis

In order to rigorously examine the necessary and sufficient causal relationships, we employed the method of Fuzzy-set Qualitative Comparative Analysis (fsQCA), recognized as a suitable approach for investigating asymmetric and configurational arguments (Ragin 2008). Diverging from the conventional regression analysis that tests the "net effects" of contextual factors, fsQCA represents a case-based, asymmetric methodology that accentuates intricate causal relationships between contextual factor configurations, thereby unveiling complexities inherent in social phenomena (Fiss 2011; Ragin 2008).

This methodology offers several analytical prospects. Firstly, fsQCA enables the determination of whether the achievement of outcomes requires a singular condition. Secondly, fsQCA acknowledges the asymmetry of relationships and is adept at revealing relationships in minority cases (Douglas, Shepherd and Prentice 2020). Thirdly, fsQCA facilitates the exploration of the sufficiency of relationships among all antecedent conditions, thereby identifying multiple equivalent pathways.

Sample

Our initial sample is composed of 59 townships (streets/parks) within the Jiangsu Province of China. In each cluster, we first identified one or two leading firms and then randomly pick eight or nine companies to make sure a research subset of 10 enterprises was extracted from each cluster (streets/park). The questionnaire at the cluster level was completed by the local government officials responsible for economic affairs, while the questionnaire at the firm level was completed separately by either the CEO or Deputy CEO of the respective enterprises. Through a meticulous data screening process, this paper undertook the removal of entries marked by deficiencies in the number of companies within clusters, as well as those displaying incomplete values for internationalization levels. Subsequently, the resultant dataset encompasses data from 34 distinct clusters.

Measures and calibrations for set membership

Prior to engaging in configurational analysis, a preliminary calibration process is requisite, involving the allocation of set memberships to cases (Schneider and Wagemann 2012). The calibration of variables into sets necessitates the establishment of three threshold values, namely full out, crossover point, and full in, with converted set member values ranging between 0 (full out) and 1 (full in) based on theoretical and practical external directives or standards. Given the composite nature of the study data, comprising objective data and survey responses, three distinct approaches to variable calibration have been adopted.

Firstly, we employed the substantively anchored connotations of pre-validated scale

anchors to correspond to the three thresholds. This technique, characterized by calibration grounded in both theoretical and substantive meanings, is widely regarded as yielding optimal results (Du and Kim 2021; Ragin 2008). This technique was applied to calibrate the "vertical coordination" variable. Secondly, thresholds were established using minimum, midpoint, and maximum values, affording partial substantive insight into scale anchors (Fiss 2011; Misangyi and Acharya 2014; Ordanini and Maglio 2009). This calibration approach was employed for "cluster level internationalization", "international standard certification" and "architecture knowledge" variables. Lastly, due to the highly skewed data distribution of "patents" and "horizontal competition", and in order to mitigate the potential influence of outliers on the analysis, a quartile calibration method was applied to these two variables. Specifically, the 25th percentile (full out), 50th percentile (crossover point), and 75th percentile (full in) were utilized as thresholds.

In accordance with established practice, a small constant (0.001) was introduced into causal conditions with calibration scores below 1 to circumvent the use of precise 0.5 membership scores (Fiss 2011) and mitigate the impact of extreme values on the analysis. Table 1 summarizes the variables for each fuzzy set, their calibration anchors, and descriptive statistical data.

TABLE 1. SETS, CALIBRATIONS AND DESCRIPTIVE STATISTICS

	Fuzzy set calibrations			Descriptive statistics			
Sets	Fully out	Crossover	Fully in	Mean	SD	Min	Max
Cluster level internationalization (CI)	2.86	23.14	70.71	28.90	21.41	2.86	70.71
International standard certification (ISC)	0.33	1.40	3.00	1.43	0.63	0.33	3.00
Patents (Pat)	9.58	15.35	38.10	28.70	34.48	2.88	180.30
Architecture knowledge (AK)	0.00	4.18	12.76	4.40	2.93	0.00	12.76
Vertical coordination (VC)	2	4	6	5.08	1.42	1.67	7
Horizontal competition (HC)	62.25	142.00	298.50	311.71	491.06	25	2580

Sources: Based on survey from 59 township clusters in Jiangsu Province, China.

Cluster level internationalization. Following Mesquita and Lazzarini (2008), we used export ratio to capture the internationalization level of clusters. We randomly select 10 companies from each cluster, and used the average number of foreign sales to represent the cluster level international ratio. We assigned the scale anchors to maximum, midpoint, and minimum as the thresholds for fully in, crossover points, and fully out.

Component knowledge. We used two proxies to capture component knowledge, one is the average patent number, the other is the average number of international standard certifications within the cluster to capture element knowledge. We randomly select 10 companies from each cluster, and used of the 10 companies to represent cluster level component knowledge. For the patent number, we assigned the scale anchor to the values of 75th, 50th, and 25th quantiles as the thresholds for fully in, crossover point, and fully out to reduce the impact of extreme values on the analysis.

We also used the average number of international standard certifications within the cluster to capture component knowledge. We focused on six representative international certifications in the cluster, ISO9000, ISO14000, OHSMS18000, QS, CE EU Standard and HACCP.

This paper uses maximum, midpoint, and minimum to set the fully in, crossover, and full out threshold.

Architectural knowledge. We used the number of research and development centers within the cluster to capture architectural knowledge. This paper uses maximum, midpoint, and minimum to set the fully in, crossover, and full out threshold.

Vertically integration. We measured vertical integration using a scale developed by Kaufmann and Stern (1988) and Palay (1984). The scale assesses the cooperation between company and their upstream and downstream enterprises in three aspects, mutual information sharing, mutual helping, and fairly sharing the benefit generated by cooperation. Vertical integration within the cluster. The respondents evaluated the vertical cooperation level on the seven-point scale, with 1 referring to "strongly disagree" and 7 to "strongly agree" (α=0.98). The questionnaire, administered by local government officials overseeing economic matters, was responsible for soliciting these responses. We calibrated the second smallest observed value (=2) for fully out, and the second largest observed value (=6) for fully in. The crossover point was 4.

Horizontal competition. Following McCann and Folta (2008), we used cluster size, the number of enterprises in a cluster, to measure horizontal competition within clusters. It reflects the degree of agglomeration of the cluster. Considering that the distribution of cluster size is extremely uneven, from 25 to 2,580, this paper assigned the scale anchor to the values of 75th, 50th, and 25th quantiles as the thresholds for fully in, crossover point, and fully out.

Results

Employing the fsQCA, we conducted both necessary ("no X without Y") and sufficient ("if X, then Y") causal relationship analyses. Through this two-step analytical sequence, we were able to ascertain the necessity and/or sufficiency of any strategy for achieving high cluster internationalization under intricate operational circumstances.

Necessary conditions analysis

We initially subjected the necessary conditions to fuzzy set analysis using a consistency threshold of 0.90 (refer to Table 2). Notably, we did not identify a pathway solely defined by

TABLE 2. ANALYSIS OF NECESSARY CONDITIONS FOR HIGH CLUSTER INTERNATIONALIZATION IN FSQCA

Sets of conditions	Consistency	Coverage
International standard certification	0.716	0.711
~ International standard certification	0.584	0.526
Patents	0.661	0.631
~Patents	0.501	0.469
Architecture knowledge	0.661	0.697
~Architecture knowledge	0.653	0.559
Vertical coordination	0.796	0.519
~Vertical coordination	0.460	0.787
Horizontal competition	0.534	0.512
~Horizontal competition	0.638	0.594

Note: ~means the absence of. For example: ~Architecture knowledge = absence of high architecture knowledge
Sources: Based on survey from 59 township clusters in Jiangsu Province, China.

possessing component knowledge, architectural knowledge, horizontal competition, and vertical integration as the means to attain high cluster internationalization.

Sufficiency analysis for performance

We conducted the sufficiency analysis using a frequency benchmark ≥ 1, raw consistency benchmark ≥ 0.8, and a proportional reduction in inconsistency (PRI) ≥ 0.60 (Greckhamer et al. 2018). We report two sets of results: the configurations for the presence of high cluster level internationalization, followed by the results for the absence of high cluster level internationalization.

Configurations for high cluster level internationalization

We present the results of the three first-order configuration solutions in Table 3, each of which is sufficient to attain high cluster-level internationalization. These solutions exhibit robust solution consistency and coverage, with values of 0.81 and 0.59, respectively, meeting the requisite criteria for each solution. Solution 1 (H1) shows a knowledge-driven strategy. When in the early stage of cluster wherein size is small and horizontal competition is absence, component knowledge (CK), which featured by a greater number of patent and international standard certifications in the cluster, is sufficient for high cluster internationalization. Notably, in the absence of horizontal competition (HC), a synergy between high component knowledge and elevated vertical coordination is adequate to achieve high cluster-level internationalization. H1`s consistency (0.85) exceeds the accepted threshold of 0.80. As shown by its raw coverage

TABLE 3. CONFIGURATIONS FOR ACHIEVING HIGH CLUSTER LEVEL INTERNATIONALIZATION

Configurations	H1 : Knowledge Strategy	H2a : Innovation Network Strategy (network+Pat)	H2b : Innovation Network Strategy (network+ISC)	H3 : Survival Strategy
Component knowledge (CN)				
International standard certifications (ISC)	●	⊗	●	●
Patents (Pat)	●	●	⊗	⊗
Architecture knowledge (AK)		●	●	⊗
Vertical coordination (VC)	●	●	●	⊗
Horizontal competition (HC)	⊗	●	●	●
Raw coverage	0.37	0.24	0.21	0.19
Unique coverage	0.22	0.07	0.03	0.03
Consistency	0.85	0.88	0.87	0.97
Solution coverage	0.59			
Solution consistency	0.81			

This paper uses ● to indicate the existence of conditional variables and uses ⊗ to indicate the absence of conditional variables. For both of these icons, the bigger circle indicates the core condition, and the smaller circle indicates the peripheral condition. Blank spaces indicate that the condition variable is irrelevant (it may or may not appear).
Sources: Based on survey from 59 township clusters in Jiangsu Province, China.

(0.37), H1 occupies a substantial proportion within the outcomes of high cluster-level internationalization.

Robustness checks

We conducted three additional robustness tests to ensure the reliability of our findings. First, we reran our analysis with a higher proportional reduction in inconsistency of PRI ≥ 0.70 (compared to the PRI ≥ 0.60 used in our primary model) (Misangyi and Acharya 2014). This yielded support for a subset of H1 (ISC * Pat * AK * VC *~ HC) and H3 configurations, reinforcing our initial results. Second, while keeping other parameters constant, we raised the frequency benchmark to 2. This adjustment yielded similar solutions, highlighting the H1 and H2b configurations. Lastly, we harmonized the calibration of objective indicators, setting the thresholds for fully in, crossover point, and fully out to correspond to the values of the 75th, 50th, and 25th quantiles. Additionally, the calibration points for Vertical Coordination were adjusted to 7, 4, and 1. Remarkably, these modifications also supported our established findings. These robustness tests collectively underscore the validity and stability of our results.

Conclusion and Discussion

Conclusion

The fsQCA method effectively identified four paths of cluster internationalization, indicating that cluster internationalization is a complicated process influenced by multiple factors. According to the core conditions of the existence of the four paths in the results, this paper summarizes the cluster internationalization path into three models: knowledge driven internationalization, innovation network driven internationalization, and survival driven internationalization.

Knowledge-driven internationalization

Knowledge-driven internationalization strategy mainly apply to clusters in the early stage,

TABLE 4. CONFIGURATIONS FOR ABSENCE OF HIGH CLUSTER LEVEL INTERNATIONALIZATION

Configurations	NH1	NH2	NH3	NH4
Component knowledge (CN)				
International standard certifications (ISC)	⊗			⊗
Patents (Pat)	⊗	⊗	⊗	
Architecture knowledge (AK)		●	⊗	⊗
Vertical coordination (VC)	●	●	●	●
Horizontal competition (HC)		⊗	●	●
Raw coverage	0.47	0.20	0.33	0.41
Unique coverage	0.10	0.03	0.04	0.11
consistency	0.88	0.95	0.89	0.90
Solution coverage	0.65			
Solution consistency	0.86			

This paper uses ● to indicate the existence of conditional variables and uses ⊗ to indicate the absence of conditional variables. For both of these icons, the bigger circle indicates the core condition, and the smaller circle indicates the peripheral condition. Blank spaces indicate that the condition variable is irrelevant (it may or may not appear).
Sources: Based on survey from 59 township clusters in Jiangsu Province, China.

where the cluster size is small and the horizontal competition is absent. Adequate component knowledge under this condition, such as with high patent numbers and firms with international certificate, are sufficient for cluster internationalization. High patent numbers represent that firms in the clusters have great innovativeness. They are able to provide new services and solutions to meet international market demands and compete in the global market. The international certificates also signal firm quality and reduce the information asymmetry in the international market. Although the relatively small size of the cluster makes firms lack of agglomeration benefits, the vertical coordination in supply chain could elevate production efficiency and foster collaborative innovation. Production activities can be synchronized to achieve swifter inventory turnover and punctual deliveries by aligning the efforts of upstream and downstream entities (Boyer et al. 1997). It helps to overcome the disadvantage of small cluster size. Therefore, we propose the following proposition:

Proposition 1: When the cluster size is small, clusters have greater internationalization level when firms in the cluster have more component knowledge and have strong vertical collaboration

Cluster internationalization driven by innovation network

Innovation network internationalization strategy shows that clusters could achieve high internationalization level by establishing R&D centers, encouraging vertical collaboration, horizontal competition, and accumulating either type of component knowledge, patents, or internationalization standard certification. R&D centers, high vertical collaboration, and horizontal competition constitute innovative network in clusters. Either type of component knowledge (CK), high patent number (H2a) and high international standard certification (H2b), refers to the knowledge and resources that flow in the innovative network. In the innovative network, firms within the cluster, R&D centers, scientific research institutions outside clusters, intermediates, and government agencies constitute nodes. The nodes in the innovation network share their knowledge, resources, and information. Fundings, facilities, and equipment could be shared within the innovation network, enabling participants to leverage one another's strengths. By connecting different nodes of expertise and knowledge, innovation networks accelerate the pace of innovation, allowing participants in the cluster to access and adopt innovation faster.

R&D centers play a central role in the cluster innovation network. It serves as a focal point for concentrated R&D effort. Resources and information from innovative network pooled in the R&D center to generate technologies and solutions, which are shared with the network for further refinement and adoption. Vertical collaboration and horizontal competition also facilitate the development of innovation network. The vertical collaboration facilitates the knowledge and information spillover in the cluster. On the one hand, vertical collaboration in the supply chain enables rapid prototyping and testing of new ideas in the R&D centers, accelerating the development of novel products and processes. On the other hand, the R&D center's innovations can spill over to various stages of the supply chain and improve the overall innovativeness and efficiency of supply chain. The greater size the cluster, the more firms leverage diverse perspectives to find innovative solutions. The combination of R&D centers, vertical collaboration, and horizontal competition may help toward building an innovative network within and beyond clusters, which would increase cluster innovativeness,

reduce overall cost, and improve customer satisfaction. It would improve the cluster's competitiveness in the international market and increase cluster internationalization level. Therefore, we propose the following proposition:

Proposition 2: Clusters have high internationalization level when clusters have R&D centers, high vertical collaboration and horizontal competitions, and component knowledge, such as patent and international standard certificate.

Survival driven cluster internationalization

Survival driven cluster internationalization apply to clusters which lack of vertical collaboration, and innovation related knowledge, such as patent and R&D center. These clusters usually are in labor-intensive industries. Under this condition, fierce horizontal competition within cluster is sufficient for clusters to attain high internationalization level. On the one hand, the horizontal competition leads to specification of labor, input, and knowledge spillover, leads to greater efficiency and production. Fierce competition within the cluster will prompt all companies to improve efficiency and productivity, increase output quality and quantity, reduce production costs, and gain sufficient competitive advantages in the international market. On the other hand, fierce competition in the cluster may motivate firms go global to survival. The presence of international certifications also signal quality in the international market and reduce the entry barrier to the international market. Therefore, we propose the following proposition:

Proposition 3: Clusters have greater internationalization level with fierce horizontal competition and more international standard certification in cluster.

Theoretical Implications

First, we contribute to internationalization studies by shifting attention from company level analysis to cluster level analysis. Previous studies mainly focused on the internationalization of multinational companies, or examining cluster's effect on firm's internationalization. The internationalization at the cluster level is rarely examined. We identified three strategies clusters could adopt to improve their internationalization level by using internationalization of township clusters in China, thus advancing our understanding of internationalization.

Second, this study used a configurational analysis to explain the multiple ways to improve cluster internationalization level. Previous studies tend to focus on the net effect of contextual factors that impact internationalization. However, internationalization is a complex strategy that comprises interplay of different forces. We identified three second-order equifinal configurations sufficient for high cluster internationalization in China. Necessity analysis shows that cluster internationalization is not the result of a single tool; each effective path contains two or more tools. Multiple factors jointly lead to the outcomes, and a single condition is insufficient to explain internationalization.

The conclusion of this study is also of great practical implications. We identified three combinations revealed by our configurational approach help explore the strategies cluster adopt to improve their internationalization level. The strategies apply to different types of types. For instance, when the cluster size is small, clusters could improve internationalization through accumulate component knowledge, such as patent and

international certificate, as well as fostering vertical collaboration in the cluster.

For clusters that lack patents, R&D centers, and vertical collaboration, while the horizontal competitions could promote the cluster internationalization, acquiring international certificate would assist firms in the clusters to go global. We highlighted the importance of establishing innovative network, such as building R&D center, promoting horizontal competition, and vertical competition, in internationalization. Our findings also showed that high internationalization is caused by a configuration of different contextual factors. Firms or government agencies should select strategies based on the specific condition and feature of the cluster. Improving the internationalization level requires multiple contextual factors in play.

Limitation and future direction

Our study does contain limitations. First, we acknowledge that the fsQCA method's strength is to extend theory based on necessary and sufficiency causality (Douglas, Shepherd and Prentice 2020). Future research could extend the conclusion by conducting in-depth interviews or combining QCA with methods such as regression analysis. Second, the conditions contained in fsQCA studies are limited by observed cases. Future studies could comprise further cases. Possible configurations may increase to examine more complex settings involving additional cases, strategies, and operating conditions.

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