Journal of Economic Geography, 2026, 1–22
https://doi.org/10.1093/jeg/lbag017
Original Article

OXFORD

Beyond regional economic resilience: unravelling cluster resilience in the polycrisis era

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Abstract

This study distinguishes cluster resilience from regional economic resilience, which often overlooks heterogeneous mechanisms within clusters. Drawing on a two-decade comparison of two Chinese furniture clusters, it shows how adaptive capacities are shaped by dual embeddedness in territorial contexts and wider industrial networks. One cluster, located in an underdeveloped region with a simple industrial network, relies on direct government intervention to remain resilient. The other, embedded in a diversified and advanced economy, draws resilience from market dynamics and cross-industry synergies. The study demonstrates how institutional and industrial network contexts interact to produce distinct adaptive pathways during periods of polycrisis.

Keywords: **polycrisis; cluster resilience; furniture industry; territorial and network embeddedness; China.**

JEL classifications: **L60, L68, O25, R11, R12, R58.**

1. Introduction

Research on economic resilience has gained increasing prominence in economic geography and regional studies, particularly following the 2008 global financial crisis and the COVID-19 pandemic. This growing interest has given rise to two closely related concepts: regional economic resilience (RER) and cluster resilience. Research on RER has developed into a substantial body of work examining how regions

Received: 8 August 2024. **Accepted:** 9 February 2026

absorb, adapt to, and recover from external shocks. This literature has evolved from initial debates over the definition of resilience as a "fuzzy concept" to a more structured and mature field of research (Martin 2012; Boschma 2015; Martin and Sunley 2015; Sutton et al., 2023). In contrast, the research on cluster resilience is more recent. This emerging literature has largely concentrated on how industry clusters respond to technological, competitive, regulatory, and structural disruptions and shocks (Henry et al., 2021; Li et al., 2022b; Rothgang and Lageman 2024). However, it has paid comparatively less attention to the broader dynamics of global production networks and value chains within which these clusters are embedded. In an era marked by heightened uncertainty in the global political economy and growing skepticism toward globalization (Gong et al., 2022b), it is increasingly important to examine how industry clusters can build resilience not only in relation to local conditions, but also to external shocks and transformations in the global economic system.

Following Rothgang and Lageman (2024), we argue that RER and cluster resilience share common conceptual foundations. Many insights from the RER literature, particularly regarding determinants of resilience and the role of agency, can inform research on cluster resilience, and research gaps identified in the RER literature may also remain underexplored in cluster resilience. At the same time, clusters also display distinctive characteristics that require specific analytical attention, given their sectoral specialization, territorial boundedness, and embeddedness in global production networks and value chains (Ponte and Sturgeon 2015).

This study contributes to this emerging research agenda by proposing a framework that analyzes cluster resilience through the lens of dual-embeddedness of clusters, namely within their *territorial* context and within broader *industrial networks*. This perspective allows for a more nuanced understanding of how different types of crises affect clusters and how resilience mechanisms are shaped by both territory-specific conditions and global/national industrial linkages. Empirically, this study systematically compares the resilience strategies of two Chinese furniture industry clusters in response to a range of abrupt disruptions and (adverse) developments that cumulate slowly and incrementally over long periods of time (slow-burn, Martin and Sunley 2015: 14), including platformization, tightening environmental regulations, the US–China trade war, the COVID-19 pandemic, the real estate crisis, and broader economic downturns. These challenges have had divergent impacts on the resilience performance of the two clusters.

2. Conceptual clarification on cluster resilience

RER frameworks often examine the performance of regional economies after crises at an aggregated scale, overlooking structural, network, and governance differences among clusters within a region. Yet, as clusters constitute the key productive and innovative nodes of regional economies, understanding their adaptive capacities offers a more fine-grained lens on RER. Cluster resilience thus represents a complementary analytical scale linking firm- and network-level dynamics to regional outcomes.

While cluster research has a long tradition in economic geography (Martin and Sunley 2003, 2011; Harris 2021; Chu and Hassink 2022), the term "cluster resilience" has only emerged in recent years (Henry et al., 2021; Li et al., 2022b; Rothgang and Lageman 2024). This section aims to provide a clearer understanding of what "cluster resilience" entails and to set the stage for the subsequent analytical framework. To understand cluster resilience, we first need to understand what a cluster is. The cluster concept originated from Michael Porter's discussion of national competitive advantages, where he defined clusters as geographic concentration of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (for example universities, standards agencies, and trade associations) in particular fields that compete but also co-operate (Porter 1998: 197). While this definition has been widely adopted, the cluster remains a "chaotic" concept (Martin and

Sunley 2003: 10) due to two key ambiguities: the territorial boundary of a cluster and the inter-firm relationships within it.

2.1 Clusters and regional economy

The "Geographic concentrations" of a cluster can occur either within a region, as part of the regional economy, or extend beyond regions, forming cross-regional, or even "national groups of industries and firms" (Martin and Sunley 2003: 11). Given that our subsequent empirical analysis focuses on two clusters located in two distinct jurisdictions in China, we follow the mainstream understanding and define clusters as concentrations of interconnected firms within certain administrative boundaries (Guo et al., 2020).

Debates on the relationship between clusters and regions often draw on the "Marshallian vs. Jacobian externalities" framework: the former stresses intra-industry spillovers, whereas the latter emphasizes inter-industry spillovers (Content and Frenken 2016: 2097). This has spurred work on specialization and diversification, related variety, and relatedness (Frenken et al., 2007; Boschma and Iammarino 2009) in regional development. In highly specialized and mono-structural regions, cluster resilience may closely align with regional resilience. In other contexts, for instance, when the regional economic structure is much more diversified, it may represent only one dimension of regional resilience. Therefore, it is crucial to analytically distinguish between clusters and regional economies when examining cluster resilience. Moreover, the region's industrial structure and its multi-scalar institutional environment both influence overall economic performance and, by extension, cluster resilience. Conceptually, this distinction allows us to unpack the internal heterogeneity of regional economies. Whereas RER approaches typically assess resilience at the level of aggregated regional performance, cluster resilience instead focuses on the relational and structural mechanisms, such as supply-chain linkages, knowledge networks, and governance arrangements, through which adaptive and transformative capacities unfold. This analytical distinction helps to reveal why regions that appear similarly resilient at the aggregated level may display starkly uneven resilience across their constituent clusters.

2.2 Clusters and networks: clusters as networks versus clusters in networks

Although cluster definitions often stress "interconnected companies" or "related industries," identifying such interconnectivity requires a detailed understanding of industrial networks. Suire and Vicente (2014) conceptualize clusters as localized networks of knowledge interactions, examining responses to shocks across evolutionary phases. Vicente et al. (2011) and Ter Wal (2014) also adopt network lenses (through collaboration and inventor networks) though focusing more on performance. Henry et al. (2021) highlight clusters as strategic nodes in GPNs. These approaches reveal two main ways of understanding cluster–network relationships, namely, clusters as networks versus clusters in networks.

The "clusters as networks" perspective, common in regionalist approaches, views clusters as localized networks, knowledge spillovers, and untraded interdependencies (Storper 1997; Bathelt et al., 2004; Asheim and Coenen 2005; Crespo et al., 2016), while increasingly recognizing the relevance of external linkages (Wolfe and Gertler 2004; Grashof and Brenner 2021). In contrast, the "clusters in networks" perspective, rooted in globalist approaches, stresses that industry clusters should be seen as individual nodes connected through global production networks and value chains (Henderson et al., 2002; Owen-Smith and Powell 2004; Crespo et al., 2014; Coe and Yeung 2015). This research shows how industry development has shifted from local cluster-based models to spatially dispersed, integrated value chain patterns (Ponte and Sturgeon 2015). While "clusters as networks" research often centers on endogenous innovation in developed economies, "clusters in networks" studies frequently examine production systems in developing and emerging economies.

Although scholars increasingly recognize both endogenous and exogenous networks in regional development, studies rarely consider them in conjunction when analyzing cluster resilience. Inspired by

Henderson et al. (2002)'s and Ponte and Sturgeon's (2015) observations on value chain forms, as well as Hassink's (2021) "strategic cluster coupling," this study conceptualizes cluster–region and cluster–network relationships in terms of clusters' territorial and network embeddedness. This distinction also echoes Menzel and Fornahl's (2010) differentiation between spatial boundaries and thematic boundaries, which similarly capture the dual positioning of clusters within territorial contexts and industry-specific networks. We define cluster resilience as the capacity of cluster to absorb, adapt, and transform in response to external shocks and pressures, shaped by both place-specific assets and broader industrial linkages. By conceptualizing cluster resilience through dual-embeddedness, we move beyond region-centric accounts of resilience that emphasize territorial institutions or regional industrial compositions. This approach foregrounds how resilience emerges from the interplay between localized assets and trans-local network relations, thereby capturing a dimension of economic resilience that regional analyses alone cannot fully explain. It thus provides the foundation for systematically analyzing cluster resilience, which we develop further after identifying two key gaps in both RER and cluster resilience research.

3. Two gaps in RER and cluster resilience

Despite substantial progress in RER research over the past two decades, several important limitations remain (Lemke et al., 2023). This section addresses two gaps central to advancing RER and to deepening the study of cluster resilience.

First, amidst the evolving landscape of global challenges, a significant oversight in existing research stems from predominant focus on the impacts of isolated events or singular crises (for exceptions, see Kakderi and Tasopoulou 2017; Li et al., 2022a; Magro et al., 2022; Amdam et al., 2024; Bianchi et al., 2024) (left side of Fig. 1). This approach neglects the complexity of the contemporary "world of the polycrisis" (Tooze 2022), where crises with diverse origins can converge within the same spatial and temporal frame, significantly influencing the structure and function of regional economies (Lawrence et al., 2022). As Rothgang and Lageman (2024) state, our understanding of resilience-testing threats should encompass both sudden external shocks and gradually intensifying challenges. The reality that crises can occur simultaneously or sequentially complicates the impacts of individual crises, as their cumulative or counteractive effects often intertwine. Moreover, the nature of such polycrisis often differs, and their impacts are place- and path-dependent (Webber et al., 2018; Rocchetta et al., 2022). To capture how regional economies and clusters respond to polycrisis, a systemic approach is needed (Sutton and Arku 2022), ensuring that crises and their overall influences are analyzed and measured systematically (right side of Fig. 1). Furthermore, it is helpful to conceptually differentiate between a crisis and the shock effects it generates. A crisis can be conceptualized as an event, a significant rupture or disruption, while a shock can be understood as the *effect* that this crisis exerts on a particular system, such as the dual-embeddedness of a cluster. A single crisis may therefore lead to multiple shocks, which can vary in intensity (profound, moderate, or minor) depending on the specific part of the region or system affected. This understanding allows us to capture both the eventful nature of crises and the differentiated, multi-scalar effects they generate.

Second, as Sutton et al. (2023) emphasize, the shock effects of crises are not uniformly distributed across regions; rather, variations in impact often stem from both the specific nature of the shock and distinct resources, capabilities, and structural conditions of each region. The relative importance of structural versus agential forces and the diversified vs specialized industrial structure in influencing RER has long been debated (Tan et al., 2020; Hu et al., 2022; Li et al., 2022a). Proponents of the structural perspective argue that regions endowed with certain structural characteristics, such as diverse industrial bases, are inherently more resilient (Balland et al., 2015; Boschma 2015; Martin and Sunley 2020). Conversely, scholars from a political-economy perspective argue that adaptability is significantly shaped by state agency, especially in structurally weak regions (Pike et al., 2010; Bristow and Healy 2014; Tan et al.,

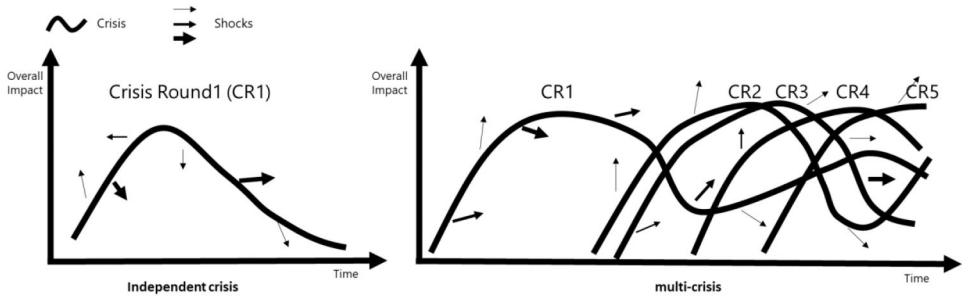


Figure 1. Independent crisis versus multi-crisis.

2020). Yet such agency should not be assumed to exist collectively or effectively in all clusters, as governance capacities vary greatly across contexts. The nature of shocks encompasses their types, intensity, and duration (Gong et al., 2020). While the conventional view associates shocks with negative outcomes for regional economies, there is growing recognition that under certain conditions, shocks may catalyze positive transformation (Bănică et al., 2020; Martin and Sunley 2020). While existing research acknowledges the pivotal role of both structural and agential factors in shaping RER (Bristow and Healy 2014; Li et al., 2022a), it has yet to clarify how these two sets of factors interact, and under what conditions one may outweigh the other. This lack of clarity complicates the formulation of policy recommendations, leading to overly generalized policy recommendations that treat both structural and agency-driven factors as equally important, yet fail to provide nuanced, context-specific strategies.

4. Cluster resilience: an analytical framework

To address the research gaps identified in Section 3, this study develops a dual-embeddedness analytical framework to conceptualize cluster resilience. Building on the theoretical discussion in Section 2, the framework incorporates territorial and network embeddedness as two interrelated dimensions that jointly shape a cluster's capacity to absorb, adapt to and recover from crises (see Fig. 2).

4.1 Network embeddedness: input and output markets

While cluster networks involve multiple relational dimensions, this study treats institutional and cognitive linkages as part of territorial embeddedness. Network embeddedness here primarily captures value-chain and production-network connections, with a focus on input and output markets. Cluster resilience is often shaped by these markets: input markets refer to sources of raw materials from various regions, while output markets include different consumer regions, tiers, segments, and channels. Firms connect these markets through forward and backward linkages (Kitsos et al., 2023: 4). In clusters, backward linkages involve suppliers of inputs, services, and components, while forward linkages refer to downstream manufacturers, assemblers, or end markets—domestic and/or international. Importantly, due to differing locations and developmental histories, clusters within the same sector can have distinct input and output markets. This means that the same crisis may impact clusters differently. Moreover, as Martin and Sunley (2020) argue, such differences in resilience across regions can contribute to interregional patterns of long-run growth. Following Fingleton et al. (2012), they highlight that differential resilience may trigger resource flows from regions or clusters more severely hit by crises toward those more resistant, potentially exerting downward hysteretic pressure on the growth paths of the former while reinforcing the trajectories of the latter. In this sense, variation in clusters' input–output configurations and resilience capacities not only shape their individual recovery trajectories but can also influence broader spatial dynamics of uneven development. Another element of the framework is industry-level competition (Fig. 2).

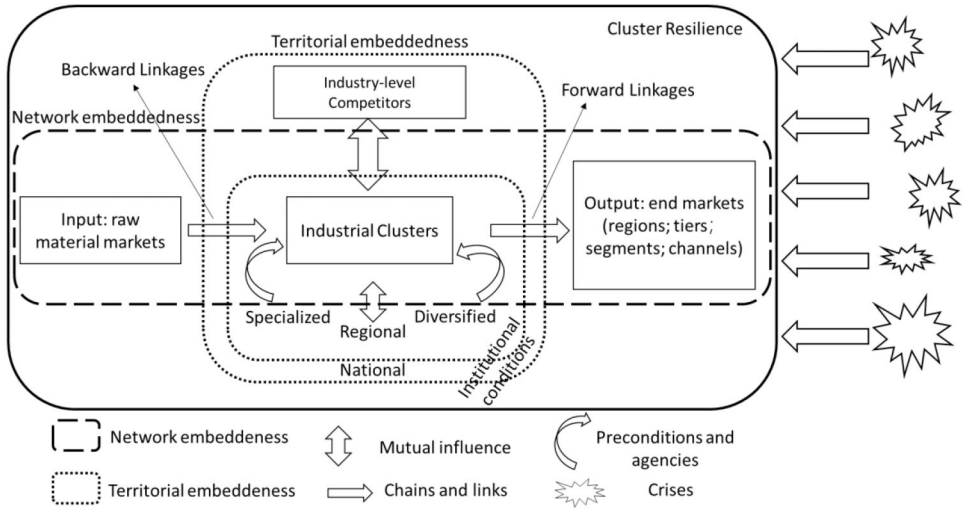


Figure 2. Theoretical framework on cluster resilience.

Although industry-level competition is inherently relational and thus part of network embeddedness, in our empirical setting—which focuses exclusively on two Chinese clusters rather than on cross-national cluster networks—its dynamics are predominantly shaped by territorial conditions, including shared national institutions, regional industrial structures, and domestic market configurations. For this reason, we position domestic competitors within the territorial embeddedness dimension of our framework, while recognizing that such competitive relations simultaneously constitute an element of clusters' broader network embeddedness.

4.2 Territorial embeddedness: pre-existing regional industrial structures and multi-scalar institutional conditions

Cluster resilience is also shaped by the territorial context in which it is embedded. This study emphasizes a cluster's embeddedness in a multi-scalar territorial context, highlighting the regional and national scales. In this regard, the impact of regional industrial and institutional structures on cluster resilience warrants special focus. Existing research has discussed the impact of different industrial structures on RER yet largely overlooks the effects of these structures on specific clusters (Liang 2017; Xiao et al., 2018; Cainelli et al., 2019; Delgado and Porter 2021; Lazzeretti et al., 2022; Li 2024). This is a gap we aim to fill. As discussed above, domestic competitive dynamics—while relational in nature—also form part of territorial embeddedness in our context, since they are conditioned by shared national institutions and domestic market environments. Variations in industrial and institutional structures—both within and beyond a cluster's immediate environment—can lead to differentiated exposure to shocks during crises.

Recent studies stress that regional economies are dually embedded in territorial and industrial contexts (Gong et al., 2022a; Chlebna et al., 2023). For cluster resilience, however, as Suire and Vicente (2014: 145) argue, this duality also entails a "paradox of embeddedness": while the production of complex technologies requires a high level of connectivity in knowledge networks, maintaining resilience and avoiding negative lock-in requires openness and modularity. Excessive connectivity, reflected in rigidity and high assortativity, may hinder adaptation and lead to lock-ins that weaken long-term resilience. Indeed, the embeddedness literature has recognized both positive and negative effects. Dense social capital, strong local institutions, and vibrant industrial connections can enhance resilience (Boschma 2015; Wei 2015). However, over-embeddedness—both in the territorial and industrial networks—can result in

cognitive myopia, institutional inertia, and vulnerability to cascading shocks (Granovetter 1985; Parr et al., 2002; Kitsos et al., 2023). Empirical evidence further shows inverted U-shaped relationships between embeddedness and resilience, underscoring the delicate balance between integration and flexibility (Kitsos et al., 2019). This pattern echoes the broader 'paradox of embeddedness' articulated by Uzzi (1997) and Suire and Vicente (2014).

5. Responses to polycrisis in different contexts: evidence from the two case studies

We have chosen the furniture industry in China as our empirical focus, which has in the last decade gained significant attention in the literature (Gregson et al., 2012; Yang and Fu 2017; Yang et al., 2017; Dyba et al., 2020). As a typical export-oriented sector in China, the industry is deeply embedded in both local industrial ecosystems and global furniture production networks. In recent years, it has undergone a series of institutional reforms, industrial upgrading, and structural adjustments, and has also experienced a polycrisis ranging from trade tensions and environmental regulation to digital transformation and domestic economic downturn. This makes it an appropriate case for addressing the research questions of this study, especially for examining how industrial clusters navigate complex, multi-scalar crisis dynamics within the Chinese institutional context.

5.1 Background and research design

This study compares two major Chinese furniture clusters: Shunde, the most established and diversified, and Nankang, a rapidly emerging cluster. Shunde has a diversified industrial base as part of the broader "big home"（大家居, *Dajiaju*）sector, while Nankang is more specialized in furniture manufacturing (see Fig. 3). The two are embedded in distinct sub-models of Chinese capitalism (Zhang and Peck 2016). Guangdong Province, where Shunde is located, has long been a pioneer of reform and opening-up policies, marked by institutional flexibility and export-oriented growth. Since the reform era, it has benefited from investment from Hong Kong and Macao, fostering a diversified industrial base. Over nearly fifty years, it has developed two main furniture hubs: the Longjiang Manufacturing Base, producing a wide range of high-quality furniture for middle and upper markets, and the Lecong Professional Market, the largest furniture distribution center in China with 180 furniture trade complexes. Despite its strength, the furniture sector has not been a policy priority during crises.

In contrast, Jiangxi Province, home to Nankang, is often seen as more peripheral but has a governance style shaped by stronger party-state-led development strategies (Pearson et al., 2023). Since the 1990s, it has received substantial government support, benefiting from industrial relocations from coastal regions like Shunde (Yan 2017). After nearly 30 years of development, Nankang has built a complete furniture industrial chain focused on middle- and low-end wooden and panel furniture. In recent years, there has been growing emphasis on developing more advanced upholstered furniture for the domestic and international markets. This contrast offers a valuable lens to examine how different institutional environments within the same national system shape cluster resilience in times of polycrisis.

Table 1 provides a basic statistical comparison between Nankang and Shunde. Although differences in statistical classification across jurisdictions mean exact comparisons are difficult, notable differences are still observable: Shunde's industrial structure is highly diversified, while Nankang remains more specialized.

5.2 Data and methods

Given this study's focus on the complex mechanisms through which polycrisis affects clusters, we adopt a qualitative approach to reveal nuanced processes that statistical models often overlook (Evenhuis 2020). To understand how clusters experienced and responded to multiple crises, we employed a

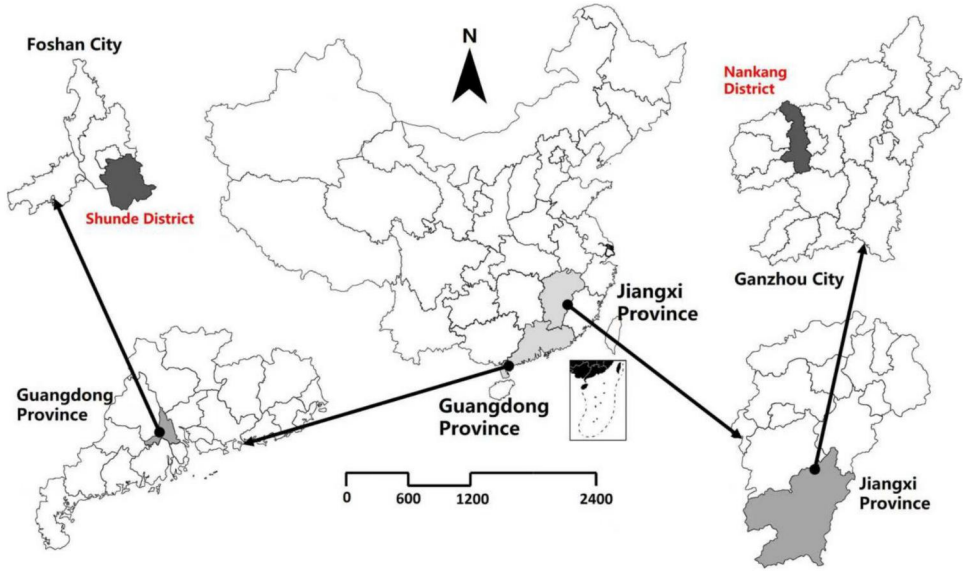


Figure 3. Locations of the Shunde and Nankang furniture clusters.

longitudinal backward- and forward-tracking approach (Grillitsch and Asheim 2024). This longitudinal method enables researchers to trace both historical developments leading up to a given point in time (backward tracking) and ongoing changes that unfold thereafter (forward tracking). In practice, we first reconstructed the key turning points and shocks that had shaped each cluster prior to 2022, such as the 2008 global financial crisis, the real estate downturn, and the rise of digital platforms, while simultaneously following how more recent crises, including COVID-19 and the US–China trade war, were unfolding and being governed as fieldwork progressed. Moreover, the first author conducted fieldwork in both clusters during August–December 2022 and after the pandemic (January–February 2024). The first round reconstructed the clusters' developmental trajectories, examining industrial preconditions, institutional support, governance structures, and the role of digital platforms in disrupting or empowering local industries. Conducted during China's COVID-19 lockdown, this phase also captured differentiated pandemic impacts on cluster adaptation. The second round involved follow-up interviews exploring the nature of shocks and the resilience responses developed, revealing evolving threats, coping strategies, and the interplay between structure and agency.

The study included 29 formal interviews in Shunde and 36 in Nankang (Supplementary Appendix 1), each lasting 2 h or more with government officials, company leaders, employees, associations, platforms, and academics, selected via purposive and snowball sampling. When citing quotes or information from these groups in the study, we use a capital letter indicating the group and a number (e.g. "G1" for Government official 1; "E5" for Employee 5). All interviews and field notes were transcribed and analyzed in Chinese using MAXQDA, with findings translated into English only at the final writing stage to minimize the risk of misinterpretation.

We used an abductive coding approach guided by our framework, identifying crisis types (A–F), preconditions, affected domains (shock position), impact intensity (shock magnitude), and actor responses (agency). We also allowed new themes to emerge inductively, such as the role of industry-level competitors and the complex interactions between shocks from different crises, which could offset or amplify each other—adding further depth to our understanding of cluster resilience mechanisms.

Table 1. Basic comparison of the Shunde and Nankang.

	Shunde District (end of 2022)	Nankang District (end of 2022)
Administrative level	District under the jurisdiction of a city	District under the jurisdiction of a city
Population (in million)	Total resident population: 3.21 Registered population: 1.62	Total resident population: 0.83 Registered population: 0.78
GDP (in million yuan)	416,639	44,390
Per capita GDP (in yuan)	128,517	53,547
Sectoral composition of GDP	Primary industry: 1.71% Secondary industry: 59.49% Tertiary industry: 38.80%	Primary industry: 6.35% Secondary industry: 43.52% Tertiary industry: 50.14%
Leading industries and their output value (in million yuan)	Electrical machinery and equipment manufacturing industry: 565,342	Mineral products industry: 27,300
	Metal products industry: 69,528	Furniture manufacturing industry: 25,409 (dominant sector)
	Rubber and plastic products industry: 46,731	Electronics industry: 4,505
	General equipment manufacturing industry: 42,884	—(no other major sectors comparable)
	(Other major industries)	—(no other major sectors comparable)
	Furniture manufacturing industry: 27,309 (ranked lower among industries)	—(no other major sectors comparable)
Enterprises above designated size (number of enterprises)	In total: 3082 In furniture manufacturing industry: 299 (9.70%)	In total: 600 In furniture manufacturing industry: 527 (87.83%)
The beginning of furniture development:	1970s	1990s

Source: Nankang District People's Government (2007–2022); Nankang Local Chronicles Office (2007–2022); Shunde District People's Government (2007–2022); Shunde Yearbook Compilation Committee (2007–2022).

5.3 Research results

Drawing on the theoretical framework of cluster resilience and our empirical findings, Fig. 4 presents a synthesis of the key results of the study. It illustrates how different crises have produced divergent impacts on the territorial and network embeddedness of the two clusters. Section 5.1 examines the multiple crises facing the Chinese furniture industry since 2010 and their effects on the clusters' embedded structures. Section 5.2 then highlights the variation in the intensity of shocks experienced by the two clusters and the distinct response strategies and forms of agency mobilized in each case.

5.3.1 Polycrisis, different shock positions

We conceptualize crisis as an event and shock as the specific impact that such an event exerts on a particular system. Crucially, a single crisis can generate shocks of varying intensities across different parts of an economic system. The propagation and amplification of these shocks are not static processes; rather, they are jointly shaped by combinations of structural conditions and actor agency. This perspective enables us to capture the heterogeneous and multi-scalar nature of contemporary disruptions. In the following section, we empirically illustrate how different types of crises—produce differentiated shock patterns across spatial and institutional contexts, using our proposed analytical framework.

Drawing on multiple rounds of inquiry and cross-validation with interview partners, we identify six major crises that have affected China's furniture industry since 2008. These crises include global exogenous events (e.g. the COVID-19 pandemic), structural and technological transitions (e.g. digital platform

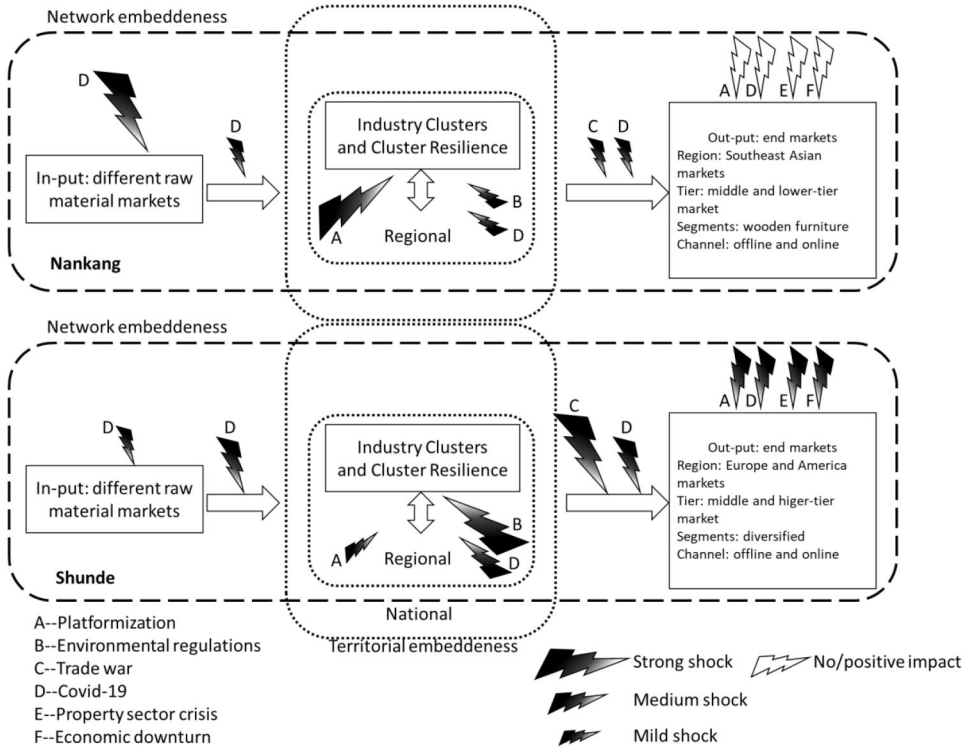


Figure 4. Polycrisis and their effects on two clusters' dual-embeddedness.

penetration, tightening environmental regulations), geopolitical tensions (US-China trade war), and cyclical market downturns. Using the dual-embeddedness framework, we analyze how these crises generated shocks across different cluster positions (Fig. 4).

Crisis A—Platformization (2006–2010; 2019–2021): Technological change, automation, and digitization have transformed production processes, distribution channels, and consumer behavior. Between 2010 and 2014, the rapid expansion of Chinese e-commerce platforms led to the closure of offline stores and trade complexes unable to adapt to digital marketing, which in turn affected furniture manufacturers supplying these outlets. Since 2019, the rise of cross-border e-commerce platforms has reshaped export channels, largely empowering rather than disrupting output markets. Overall, Crisis A primarily impacted the internal production coordination, sales organization, and output-markets linkages in both clusters (interviews: A1, P1, C6, C26, E10, C32, G3).

Crisis B—Environmental regulations (2010–2015): In 2008, Guangdong Province launched the *"Empty the Cage for New Birds" (腾笼换鸟Teng Long Huan Niao)* policy, aimed at phasing out polluting, low-end industries and promoting industrial upgrading. From 2010 onward, increasingly stringent environmental regulations led to the closure of numerous furniture manufacturers. Crisis B therefore generated shocks mainly within the internal production domain of clusters (interviews: C22, C29, C30, C32).

Crisis C—US–China Trade war (2018–2020): Trade wars resulted in the erection of trade barriers (e.g. tariffs) by governments, exacerbated geopolitical tensions, and disrupted the supply of raw materials, components, and intermediate products. Since 2018, the United States has imposed tariffs on Chinese imports, escalating trade disputes. For furniture industry clusters, the trade war primarily affected their output-market connections through increased tariffs (interviews: A1, P1, A3, C12, C18, C26, E10, C29, E7, C32, G3).

Crisis D—COVID-19 (2019–2023): The COVID-19 pandemic disrupted production, supply chains, and consumer behavior globally, affecting all parts of the furniture production and consumption networks and influencing both the territorial and network embeddedness of the two clusters (interviews: A1, A2, A5, P1, A3, C8, C14, C26, E10, C29, C30, C32, G3, G5, G6).

Crisis E—Real estate industry crisis (2016–2023): Although exemplified by the collapse of Evergrande Group in 2021, the decline of China's real-estate market began much earlier. Since around 2016, in order to curb the rapid rise in housing prices and speculative activities, the Chinese government has implemented a series of stringent regulatory policies, such as purchase restrictions, credit limits, and sales restrictions. As an upstream sector linked to furniture production, the real estate crisis directly reduced demand for furniture (i.e., in the output market), especially in the domestic market (interviews: A2, A3, C13, C18, E7, G3, G5, G6).

Crisis F—Economic downturn (2016-): Since 2016, China's GDP growth has fluctuated around 5%.[1] More critically, the cumulative effects of several major crises—such as structural economic shifts (e.g. the decline of the real estate sector), trade tensions and tariffs, COVID-19, population ageing and declining birth rate, have been particularly evident in recent years, leading to a sharper decline in consumer demand, reduced investment, and a shrinking export market. In China's furniture industry, crisis F significantly affected the domestic output market (interviews: A2, C14, C26, E10, C29, G1, G3, G5, G6).

5.3.2 Same shocks, different magnitudes, and responses

While the crises identified above affected the Chinese furniture industry broadly, their magnitudes differed sharply between the two clusters, reflecting distinct territorial and network contexts. We categorize the shocks generated by these crises as mild, medium, strong, and no/positive impact across the two case contexts (see Fig. 4). The following sub-sections specify the concrete shock effects of each crisis and the mitigation measures adopted by firms, local governments, and other actors within the two clusters, through the lens of the dual-embeddedness perspective introduced earlier. These two dimensions are summarized in Tables 2 and 3, respectively.

5.3.2.1 Variegated shock effects: a territorial embeddedness perspective

At the territorial level, Shunde is situated in the Pearl River Delta, one of China's most dynamic and economically promising regions, characterized by strong market power and a highly diversified industrial structure. The region offers a rich pool of assets that can be mobilized to enhance innovation, entrepreneurship, and adaptability. Consequently, in response to Crisis A (platformization), Shunde was able to quickly attract talent with expertise in e-commerce operation and management from nearby cities such as Guangzhou, thereby mitigating the disruptive effects of the crisis. As one interviewee explained: "At that time, we spent a lot of money to poach a brand director from Guangzhou and then established the brand department. We gradually built and strengthened our team from graphic design to e-commerce operation and now have three new media groups for Douyin, Xiaohongshu, and WeChat video" (C6).

Moreover, Shunde's diversified industrial structure means that its economy is not solely dependent on the furniture industry. Compared to greener and higher value-added sectors, the furniture industry has received limited policy support from provincial and local governments. In fact, recent tightening of environmental regulations by the Guangdong government has led local authorities to increasingly discourage furniture production. The following quote illustrates the significant impact of Crisis B (environmental regulations) on Shunde's furniture cluster. "In recent years, the government's strict requirements on safety, environmental protection, and fire protection for traditional manufacturing enterprises have posed severe challenges and unprecedented impacts on the survival and development of local furniture

1. Although this growth rate is not considered low by the standards of many developed countries, Chinese entrepreneurs have clearly felt the pressures, challenges, and constraints associated with an economic downturn. This observation is also explicitly noted in the 2019 Lecong Furniture Economic Development Report (Yang 2019).

Table 2. Crises and their shock effects through territorial embeddedness lens.

	Shunde	Nankang
Crisis A: Platformization	Precondition: Strong regional economy with easy access to talent and diverse industries Agency: Attracted talent from Guangzhou; built digital teams for Douyin, Xiaohongshu, WeChat Shock effect: Mild	Precondition: Dominant furniture industry; limited appeal; lack of digital talent Agency: Government provided infrastructure, training, subsidies to build local e-commerce capacity Shocks effect: Strong
Crisis B: Environmental regulation	Precondition: The furniture industry has received limited policy support due to diversified regional industrial structure. Recent tightening of environmental regulations has led authorities to increasingly discourage furniture production. Agency: Firms upgraded technology, adopted environmental standards, relocated production Shocks effect: Strong	Precondition: Strong desire and demand to develop the furniture industry with a relatively lenient approach to environmental regulation Agency: Low enforcement of environmental policies Shocks effect: Mild
Crisis D: COVID-19	Precondition: Presence of international furniture malls; more exposed to global market disruptions Agency: Firms adopted online procurement, livestreaming via WeChat to shift their focus to the domestic market, Shocks effect: Medium	Precondition: Primarily a production base with small-scale mall exposure; Smaller competition pressure Agency: Crisis perceived as an opportunity Shocks effect: Mild

enterprises in Lecong" (Yang 2019: 3). While crisis B presented a substantial threat to the Shunde furniture cluster, it also forced firms to upgrade production techniques, adopt more stringent environmental standards, and relocate production facilities—particularly to domestic furniture clusters such as Nankang, as well as to Southeast Asia, most notably Vietnam, leading to an overall environmental upgrading in Shunde.

The last crisis that significantly affected Shunde from a territorial perspective is Crisis D (COVID-19). Although the pandemic had enormous economic effects nationwide, within our two case study locations the direct territorial impact was relatively minor, as neither experienced full lockdowns. However, the impact was relatively greater in Shunde the cluster hosts international furniture trade complexes. As one interviewee described: "As you saw this morning, the malls are almost empty. If you had come before the pandemic, it would have been bustling" (A1, where "the malls" refers to the international furniture trade complexes). Local firms attempted to mitigate the crisis by adopting online procurement methods, such as establishing WeChat groups and utilizing enterprise WeChat live streaming functions. As an interviewee noted: "Before the pandemic, agents came over to place orders themselves. But now they can't come, so you have to find ways to retain them or contact them" (C8).

In stark contrast to Shunde, Nankang's economy is relatively underdeveloped, with per capita income less than half that of Shunde (Table 1). Its industrial structure is highly specialized, with the furniture industry overwhelmingly dominating the local economy. In addition, Nankang's mountainous geography offers little locational advantage, limiting opportunities for industrial diversification. However, benefiting from policies supporting less-developed regions and its historical role as a revolutionary base of the

Table 3. Crises and their shock effects through network embeddedness lens.

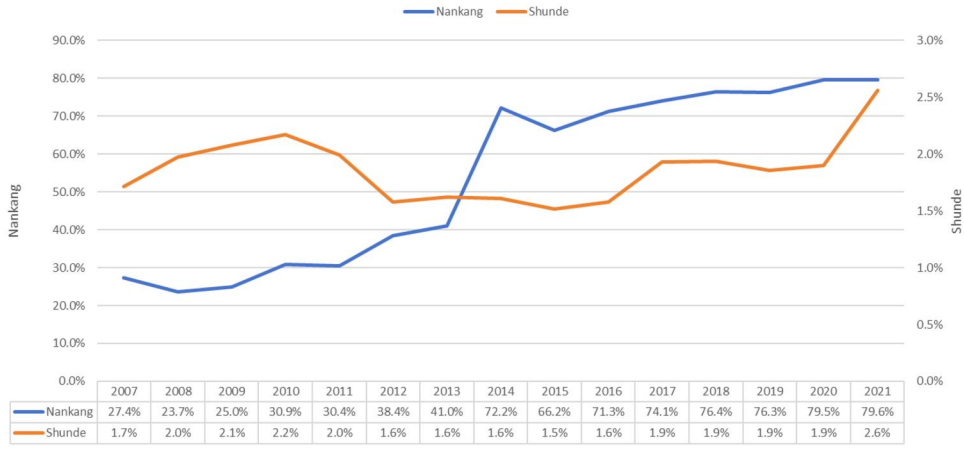
Cluster	Shunde	Nankang
Crisis A: Platformization	Shock position: Output market Agency: Strong online adaptation; e-commerce and cross-border platforms helped offset offline sales losses Shock effect: Medium	Shock position: Output market Agency: Benefited from consumer downgrading; aligned with low-cost online market demand Shock effect: No/positive impact
Crisis C: US–China trade war	Shock position: Forward linkages Agency: rerouted exports via third countries Shock effect: Strong	Shock position: Forward linkages Agency: Less impacted due to limited international reach; sensitive to raw material shocks Shock effect: Mild
Crisis D: COVID-19	Shock position: Input market/Backward linkages/Forward linkages/Output market Agency: Impact absorbed due to diversified inputs and regional diversified industrial base; Platformization empowering subsequent adjustment Shock effect: Mild/Medium/Medium/Medium	Shock position: Input market/Backward linkages/Forward linkages/Output market Agency: Simplified backward linkage; vulnerable to single-material disruptions Shock effect: Strong/Mild/Mild/No/positive impact
Crisis E: Real estate crisis	Shock position: Output market Agency: Suffering from consumption downgrading due to its focus on the high-end market Shock effect: Medium	Shock position: Output market Agency: Benefiting from consumption downgrading due to its focus on the low-end market Shock effect: No/positive impact
Crisis F: Economic downturn	Shock position: Output market Agency: Platformization enabling subsequent adjustment; suffering from consumption downgrading Shock effect: Medium	Shock position: Output market Agency: Benefiting from consumption downgrading; new sales markets exploration Shock effect: No/positive impact

Communist Party of China, Nankang's furniture industry has received substantial attention and support from both central and local governments.

In 2005, the Nankang municipal government established a specialized department dedicated to the furniture industry, marking the first of its kind in China. In 2012, the State Council issued *Several Opinions on Supporting the Revitalization and Development of Original Central Soviet Areas such as Southern Jiangxi*, which included the objective of "accelerating the construction of Ganzhou Port" (State Council of the People's Republic of China 2012). Subsequently, this port became the only inland port in China for imported timber, providing a strong boost to Nankang's furniture industry. As shown in Fig. 5, the share of Nankang's total furniture output value to the total industrial output value has grown rapidly since 2012.

Nankang's locational disadvantage limited its access to digital talent during Crisis A (platformization), intensifying the shock relative to Shunde. In response, local authorities provided subsidies and training the cluster was later designated a "National E-Commerce Demonstration Base" in 2015. However, as digital platforms continue to evolve rapidly, Nankang still struggles to attract new generations of skilled digital professionals due to its limited locational appeal.

Compared with Shunde, Crises B (environmental regulation) and D (COVID-19) had a relatively smaller impact on the territorial embeddedness of Nankang's furniture industry cluster. On the one hand, driven by the local government's strong commitment to developing the furniture industry, the enforcement of environmental regulations in Nankang was relatively lenient. As one interviewee noted, "The



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Nankang	27.4%	23.7%	25.0%	30.9%	30.4%	38.4%	41.0%	72.2%	66.2%	71.3%	74.1%	76.4%	76.3%	79.5%	79.6%
Shunde	1.7%	2.0%	2.1%	2.2%	2.0%	1.6%	1.6%	1.6%	1.5%	1.6%	1.9%	1.9%	1.9%	1.9%	2.6%

Figure 5. The proportions of furniture output to total industrial output. (The original data come from annual regional statistical yearbooks and local government work reports for Shunde District and Nankang District from 2007 to 2021. We use proportions rather than absolute values because the statistical definitions and measurement units changed after 2016. However, within each individual year, the data for "total industrial output" and "furniture output" remain comparable. Moreover, this indicator effectively highlights the dominant role of the furniture industry in Nankang's local economy, especially after 2012.) *Source*: Nankang District People's Government (2007–2022); Nankang Local Chronicles Office (2007–2022); Shunde District People's Government (2007–2022); Shunde Yearbook Compilation Committee (2007–2022).

implementation of environmental regulations is relatively lax; some large factories may upgrade certain processes to reduce pollution, while smaller factories tend to turn a blind eye" (C22). On the other hand, as Nankang primarily functions as a furniture production base with a much smaller retail space compared to Shunde, the impact of COVID-19 on its local economy was also more limited.

Finally, at the national level, territorial embeddedness also encompasses their interactions as industry-level competitors, as outlined in our analytical framework (Fig. 2). While they compete for the same domestic market and national policy support, certain shocks can create asymmetric effects, where the negative impact on one cluster may benefit the other. As one Nankang interviewee observed, "The pandemic basically had no negative effect on us; rather, it was more of an opportunity. At that time, the lockdowns in Shunde were much stricter, so many of Shunde's long-standing dealers turned to Nankang to place their orders" (A5).

5.3.2.2 Variegated shock effects: a network embeddedness perspective

After analyzing how the polycrisis influenced the two clusters from a territorial embeddedness perspective, this subsection examines how differences in their network embeddedness shaped their variegated shock effects and resilience strategies across input/output market and forward/backward linkages within the furniture industry.

Owing to its diversified product portfolio, both the input and output markets of Shunde's furniture industry are relatively broad. This diversity, however, also meant that Crises C (trade war) and D (COVID-19) had a more pronounced impact on both forward and backward linkages—with the thickness of the linkage indicating the severity of disruption (Kitsos et al., 2023). As Grabher (1993) argues in his seminal work, while strong ties are instrumental in the early development of industrial clusters, they may also lead to regional lock-in, constraining the adaptability to changing external environments. The US–China trade war particularly affected forward linkages, disrupting Shunde's access to international sales markets. While local firms adopted various strategies to mitigate these effects, the associated costs remained high. As one interviewee explained, "The demand in the US market still exists, but because the tariffs are

too high, we may not directly ship goods from Chinese customs to the US, but instead send them to neighboring countries such as Thailand and Vietnam first, and then to the US" (C12). In terms of input markets, Shunde's raw material needs—including wood, fabrics, leather, aluminum, and rattan—are diverse but generally not scarce. As a result, even when certain supply sources were disrupted during the pandemic, alternative suppliers were available, helping to sustain furniture production and mitigate the overall impact on the cluster.

Regarding the output market, while Crisis A (platformization) has negatively affected offline sales channels in several Chinese furniture clusters, its impact on Shunde was relatively limited. Although the offline sales market in Shunde experienced some disruption during the early 2010s, local actors quickly adapted to the emerging demand generated by online sales channels. This early adaptation not only mitigated the effects of platformization but also enhanced the cluster's resilience to subsequent crises, including Crisis D (COVID-19) and Crisis F (economic downturn). Platformization has diversified consumer purchasing channels—enabling online shopping during the pandemic–and expanded Shunde's market reach both domestically and internationally. This has provided important buffer zones and alternative markets during periods of crisis. Yang et al. (2017) similarly argue that following the 2008 global financial crisis, the rapid growth of domestic e-commerce in China (2012–2015) prompted many furniture exporters to shift their focus from overseas to the domestic online market, thereby alleviating the shock of declining foreign demand. More recently, since the onset of the pandemic in 2019 and the slowdown of the domestic market, some Shunde manufacturers have again turned to overseas markets through cross-border e-commerce platforms. This dynamic adaptation partially explains the notable increase in Shunde's furniture output shown in Fig. 5 since 2019.

When it comes to the other crises affecting output market of Shunde, the impact can generally be considered medium, as crises D (COVID-19), E (Real estate industry crisis), and F (Economic recession) have all led to a decrease in consumer purchasing power in the output markets. This had negative consequences for the sale of furniture products from Shunde, as it is primarily targeting medium- to high-end markets. However, embedded in a rich and diversified industrial base in Foshan, cross-industry collaborations within the region have alleviated some of the crises affecting the Shunde cluster's output market. Foshan has nurtured a range of home industries, including furniture, electronics, ceramics, sanitary ware, building materials, hardware, and textiles, forming one of the most comprehensive home furnishing supply chains in China. *In recent years, Shunde has collaborated with other local industries such as kitchen and bathroom products and home appliances to jointly create the regional brand of* "If there is a home, there is Foshan-made." Associations from various home furnishing sectors have jointly formed the "Foshan Home Industry Federation"[2] to strengthen cross-industry cooperation and brand promotion" (A2). "The benefits of cross-industry collaboration lie in avoiding competitive pressure among peers and preventing monopolization. Instead, it fosters mutually beneficial market networks, enhancing brand value collectively" (C13). In addition to marketing efforts, Shunde has devoted considerable efforts to product design and innovation to meet the increasingly advanced demands of the output market. "Nowadays, some companies are innovating their production lines through 3D printing technology and automated production techniques. Some companies are also beginning to embed smart devices and functionalities into furniture products. Since market downturn is inevitable, we [need to] embrace change and actively evolve" (G1). Due to the innovation and proactive adapting strategies by enterprises and industry associations, and the support of abundant co-located, related industrial assets, the negative impacts exerted by the aforementioned crises on the output market have been greatly alleviated. These forms of coordinated responses operate at what Menzel and Fornahl (2010) describe as the systemic level

2. On February 25, 2023, the Foshan Home Furnishing Industry Federation was officially established. Its member units cover 25 sub-sectors of the home furnishing industry, including home appliances (particularly kitchen appliances), furniture, ceramics, and sanitary ware. For more details, see: https://news.cctv.com/2023/02/28/ARTIiulfA2lUmlXRcomMfB7D230228.shtml

of cluster dynamics, where collective action, institutional coordination, and network-wide adjustments shape resilience beyond firm-level strategies.

For Nankang, due to its relatively simple industrial network, the shock effects on both forward and backward linkages are much smaller. However, because its product portfolio is simple, and focusing mainly on wooden furniture, any disruption to the wood supply market caused by the pandemic (Crisis D)—especially given that much of Nankang's timber is imported from overseas—would have a disproportionately significant impact on Nankang's furniture cluster. Additionally, unlike Shunde, key actors in the Nankang cluster, particularly the local government, view the consumer downgrading resulting from Crises A (platformization), D (COVID-19), E (real estate industry crisis), and F (economic recession) as an opportunity for its cluster development because it is targeting the mid-to-low market segments, aligning well with the demand in the online market for cheap, low-quality products, featuring the overall consumption downgrading trend. "… the online market emphasizes cost-effectiveness, and Nankang's products offer excellent value for money. Similarly, other crises have led to consumption downgrading, and Nankang's products align well with the current consumer demand" (G4). Despite this, some enterprises in Nankang also strive to develop new products and explore sales markets under the guidance of the local government. For example, "We invite delegations from the Malaysian Furniture Association to visit our local area to develop the Southeast Asian market. Last year, we also went to Milan to attract design talent to enhance our furniture R&D capabilities" (G7). However, given the relatively underdeveloped industrial environment in Nankang, apart from a few leading firms that recognize the importance of innovation, most companies rely on copying designs and engaging in "race-to-the-bottom" price competition to respond to declining consumer demand. While this strategy may appear to boost the cluster's short-term post-crisis performance, it risks creating negative lock-ins over the long term. The same concern applies to the Nankang government's previously lenient approach to environmental regulations, which, although easing short-term pressures, ultimately undermines the cluster's prospects for sustained development.

6. Discussion and conclusion

This study advances a dual-embeddedness framework of cluster resilience, integrating territorial and network dimensions. First, we clarified the conceptual distinction between cluster resilience and RER, emphasizing the specific relational positioning of clusters within both local territories and broader industrial networks. Second, building on insights from RER research and addressing the complexity of polycrisis, we developed an analytical framework to capture the differentiated impacts of multiple, overlapping crises on cluster resilience. Third, we applied this framework in a comparative case study of two Chinese furniture clusters—Nankang and Shunde—examining their responses to a series of disruptions including platformization, tightening environmental regulations, the US–China trade war, the COVID-19 pandemic, the real estate crisis, and broader economic downturns.

Resilience emerges from diverse, context-specific mechanisms rather than predetermined trajectories. Echoing the expression "all roads lead to Rome," our study suggests that within industry clusters, different roads may also lead to resilience, though not through the same mechanisms or by the same means. The two clusters examined demonstrate that resilience can emerge from very distinct pathways, shaped not only by varying configurations of territorial and network embeddedness, but also by their institutional environments, which condition the resources, coordination mechanisms, and policy instruments available for coping with shocks. One contribution of this study lies in its within-country comparative design. By examining two clusters embedded in distinct regional sub-models of Chinese capitalism (Huang 2012; Zhang and Peck 2016; Hung and Chen 2018), the study moves beyond firm- or industry-level explanations to show how broader institutional environments shape resilience pathways. In Shunde, market-oriented institutions and decentralized governance fostered firm-level experimentation, cross-industry linkages, and adaptive learning. In contrast, Nankang's more state-led institutional setting

channeled resilience through coordinated government interventions, targeted support measures, and state-mediated resource mobilization (Pearson et al., 2023). Crises affected different aspects of the clusters' structures and relationships, prompting varied adaptive responses and shaping their development trajectories. These institutional differences therefore defined the distinct "roads to resilience" followed by each cluster, highlighting the importance of viewing cluster resilience as a multi-faceted, context-dependent process, requiring flexible, tailored strategies to support clusters facing increasingly complex and overlapping crises. This contrast provides valuable analytical leverage for theory development, demonstrating how the same set of crises can produce divergent outcomes for clusters operating within the same national framework but embedded in different subnational institutional environments. The comparative design thus contributes to a more institutionally grounded theorization of cluster resilience.

From an industrial network point of view, our findings highlight the need to treat cluster resilience as a distinct object of study, rather than subsuming it within broader RER frameworks. Clusters are embedded not only within their local territories but also within domestic and global industrial networks. In Shunde, diversified network connections, encompassing both horizontal (cross-industry) and vertical (supply chain) linkages, have enabled enterprises and industry associations to flexibly restructure supply chains, reroute exports, and tap into new online and international markets. In contrast, Nankang's relatively narrow and domestically based on the single product structure focused network embeddedness constrains the cluster's adaptability. As a result, their crisis responses have largely relied on cost-based competition and selective state-led upgrading. These contrasts demonstrate that network embeddedness is not merely a matter of having external connections, but also of how such connections are strategically positioned and institutionally supported.

This dual-embeddedness perspective thus provides analytical clarity in identifying both vulnerabilities and sources of resilience that may be obscured in region-focused analyses. Moreover, our attention to inter-cluster dynamics—particularly the role of *industry-level competitors*—offers new insights into how disruptions in one cluster can create opportunities or pressures for others. In this sense, our findings resonate with Martin and Sunley's (2020) argument that differential resilience can generate wider spatial effects, as crises may redistribute resources and growth potential across regions. Extending this logic to the industrial field, we show that asymmetric resilience across clusters within the same industry can likewise reshape competitive hierarchies and longer-term development trajectories within and beyond national boundaries. More broadly, RER captures the aggregate adaptive capacity of an entire regional economy, often emphasizing institutional frameworks, industrial diversity, and path dependence. In contrast, cluster resilience centers on the intersection between territorial and network embeddedness. While RER is useful for understanding aggregated regional-level recovery patterns, the cluster perspective reveals the relational mechanisms through which resilience is enacted, transferred, or constrained within and between industries. Recognizing this distinction not only refines existing theories of RER but also opens new avenues for examining the uneven geographies of adaptation and transformation.

The study addresses two main research gaps. First, regarding the *multiplicity of crises*, our systemic approach demonstrates how overlapping crises generate complex and sometimes counteractive effects. For instance, platformization—while disruptive to offline sales—created adaptive capacities in Shunde that helped mitigate the impacts of subsequent crises such as COVID-19 and the domestic economic downturn. This highlights the need for future research to systematically explore how crises interact, rather than treating them as isolated events.

Second, this study advances the identification of causal mechanisms underpinning cluster resilience by highlighting how structural conditions and agential responses interact in context-specific configurations. In Nankang, where industrial networks are thin and territorial embeddedness is weak, cluster resilience relies heavily on multi-level government support. This reflects a broader pattern: in regions with highly specialized and monolithic industrial structures, dominant clusters tend to receive concentrated policy attention during times of crises, as local efforts are channeled into protecting the core industry. In contrast, Shunde furniture cluster's resilience is primarily driven by market forces, cross-industry synergies, and the absorptive capacity afforded by its diversified regional industrial structure. In more

diversified regional economies, such as metropolitan areas, a specific cluster may receive less targeted government support, as it constitutes only one part of a broader industrial landscape. However, such structural diversity can offer alternative sources of cluster resilience, including greater flexibility, knowledge spillovers, and access to varied input and output markets. These contrasting cases underscore the importance of aligning cluster resilience strategies to underlying regional conditions.

Our study also has limitations that suggest directions for further research. First, while our findings draw on rich, triangulated qualitative data, the case study approach is inherently exploratory and context-specific. The evidence reflects a single industry in two relatively mature clusters within one national setting, limiting broader generalizability. Future research would benefit from comparative studies across countries, sectors, and institutional settings, ideally complemented by quantitative analyses where data permit.

Second, while our dual-embeddedness framework captures key aspects of manufacturing cluster resilience, accelerating digitalization calls for further reflection. Digitally mediated clusters may face different forms of embeddedness and vulnerabilities than those anchored in physical production networks (Foster and Graham 2017; Verfürth and Helwing-Hentschel 2025). Future work should explore how digitalization reshapes cluster structures and resilience dynamics, including the potential decoupling from traditional territorial constraints.

Finally, and closely related to the second point, the clusters studied here are manufacturing-based, rooted in traditional industries with strong material production and supply-chain linkages. Factors shaping resilience in such contexts may differ significantly from those influencing knowledge-intensive or high-tech clusters, where intangible assets, financial networks, innovation capabilities, and global knowledge flows play a larger role. Future research should extend the analysis to these kinds of clusters to assess whether the mechanisms identified here apply across different sectors and organizational contexts. Such comparative work would strengthen the generalizability of cluster resilience frameworks and support a more comprehensive understanding of resilience across diverse industrial landscapes.

Acknowledgements

We are sincerely grateful to all interviewees who generously shared their time and insights during the fieldwork. We also thank Chanman Xie and Xingci Wang from Guangdong University of Technology for their invaluable assistance in collecting and organizing secondary statistical data. A preliminary version of this article was presented at the DFG Project (458455447) Workshop in Beijing University, China, May 2024 and the 2025 Global Conference on Economic Geography, Worcester, USA, June 2025, and The authors thank all those who contributed to this work, in particular Robert Hassink for his valuable and constructive comments.

Supplementary material

Supplementary material is available at *Journal of Economic Geography* online.

Conflicts of interest. None declared.

Funding

This research was supported by the project “Die Auswirkungen von COVID-19 auf die regionale Resilienz und Disparitäten in Deutschland und China” (Exploring the impact of COVID-19 on regional resilience and disparities in Germany and China), funded by the Deutsche Forschungsgemeinschaft (DFG), project number 458455447.

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Journal of Economic Geography, 2026, 00, 1–22
https://doi.org/10.1093/jeg/lbag017
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