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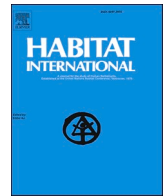
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Navigating intra-regional unevenness in China: engaging secondary cities towards coordinated mega-regionalization

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ABSTRACT

The mega-regional unevenness, namely the development gap between cores and smaller cities, has increasingly become a key obstacle for inter-city coordination in China. Scholars tend to focus more on the leading role of the cores in responding to this problem. When the smaller cities are mentioned, their endogenous characteristics and weaknesses are often highlighted, rather than being valued as important nodes embedded in the regional network and the inter-city relations. This paper conceptualizes these smaller players in mega-regional system as “secondary cities” to emphasize their interconnectedness to the cores and embeddedness in the inter-city relations. Based on this, we firstly examine the (trans)formation trends of the core-secondary relations in Chinese mega-regionalization. In this way, we focus on the role of secondary cities by exploring the functional and political positioning in the dynamic regional system. Building on such conceptualization of secondary cities, we construct an indicator system to measure changes of core-secondary unevenness from 2006 to 2023. We find that although mega-regionalization aims to rebalance inter-city relations, secondary cities are still facing challenges of polarization and peripheralization. Finally, we conduct a clustering analysis based on the differences between core and secondary cities regarding economic structure, aiming to explore the differentiated vulnerabilities of various types of secondary cities when confronted with polarization and peripheralization. This paper expands the theoretical scope of secondary cities to provide an innovative analytical perspective for understanding the mega-regional unevenness problems in China. Meanwhile, we also emphasize the potential and value of core-secondary relations in addressing the challenges of secondary cities with the expectation of more targeted policy and planning actions.

1. Introduction

Regional unevenness has always been recognized as an important obstacle to sustainable urbanization in China. Since the reform and opening up in 1978, the authorities have looked to the eastern coastal cities as national growth poles, resulting in a considerable disparity between coastal and inland areas (Fan & Sun, 2008; Ke & Feser, 2010). Subsequently, marketization, globalization, and decentralization of economic development power have stimulated cities' ambitions for rapid economic rise, leading to fierce inter-city competition (Huang & Wei, 2019). Since then, regional unevenness has been defined by two dimensions: the gap between sub-national geographic parts (i.e., inter-regional unevenness between Eastern coastal areas and Western inland areas) and inter-city disparities (Fan & Sun, 2008; Wei et al., 2020). Since the beginning of the millennium, authorities have pinned their expectations on emerging inland growth poles to cope with

unevenness, whose successful rise represents the alleviation of overall inter-regional disparities (Li, 2015; Ye et al., 2024). However, another critical problem has been overlooked: *inter-city (or intra-regional) unevenness*, since these cores are not only better endowed internally than other nearby cities but are also externally favored by growth pole policies, widening the disparities with their smaller neighbors (Du et al., 2024a).

To address this problem, the leading role of the cores in joint development is emphasized by envisioning closer partnerships between cities of different sizes to share preferential policies, markets, and resources (Wu, 2016; Ye et al., 2019). Accordingly, the concept of *mega-regions (chengshiqun in Chinese)* became the main spatial carrier of future Chinese urbanization, initiated by the authorities in 2006 (CNDRC, 2006). This new spatial unit often consists of one or two cores and several smaller cities in the same region, which are connected through planning schemes, transportation infrastructure, and open

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markets to create a coherent urban system (Li & Wu, 2020; Yeh & Chen, 2020). Despite their enormous size and significant spatial diversity, such regional systems are also widely referred to as urban agglomerations (Fu & Zhang, 2020), emphasizing the concentration of socio-economic activities within the geographies of extensive urbanization. In this research, we explore these systems from a spatial governance perspective, focusing on how various actors, including authorities and markets, promote regional development. Accordingly, we adopt the term mega-region, aligning with the terminology used in foundational studies (e.g. Harrison & Gu, 2021).

Mega-regionalization has long been entrusted with addressing intra-regional unevenness. Cores are required to support the development of neighboring cities towards a cooperative rather than competitive polycentric regional system (Wu, 2016), meaning that all cities can gain important functional positions and benefit from connecting with other cities (Ji & Yuan, 2023). However, previous studies remain overly focused on either the overall mega-regional governance process or the functional role of the cores in tackling unevenness, for example, through the transfer of redundant heavy industries to the periphery, and leading planning implementation (Luo & Shen, 2009; Xu & Yeh, 2013). The role and value of other smaller cities in this system, conceptualized here as *secondary cities*, are neglected.

Secondary cities and their potential to contribute to a more balanced regional system have been widely recognized in Western literature, which examined their innovation capacity, social vitality, and functional complementarity (Johnson, 2021; Mayer et al., 2021). The opportunity for these smaller cities to develop through spatial, functional, or institutional integration with nearby large cities is now widely regarded as the standard answer to the problem of intra-regional unevenness (Hauswirth et al., 2003; Nelles, 2013). In China, by contrast, secondary cities are widely recognized as facing inherent challenges, including urban shrinkage, industrial decline, and a loss of social vitality (Hu et al., 2021; Yang & Pan, 2020).

However, by analyzing the conditions of singular secondary cities, these studies miss the significant impacts of the network of relations within mega-regions as the fundamental context. Importantly, inter-city relations (especially between core and secondary cities) can explain the origins of regional unevenness: it is difficult for secondary cities to gain from mega-regionalization because of the considerable resource concentration gap compared with the mega-regional cores. As a result, supportive and balanced core-secondary relations are crucial for these smaller players to survive in such a system.

To summarize the research gap, Chinese mega-regionalization is considered a promising approach to address unevenness as a crucial national policy through encouraging cooperative industrial projects or joint governance towards regional common risks between cores and smaller cities (Li et al., 2022; Su et al., 2017a, 2017b). However, the overemphasis on regional cores has left the smaller cities neglected. Based on this, we argue for (re)positioning these smaller players within the regional network rather than viewing their developmental challenges in isolation, emphasizing their relational position to core cities, through which they are conceptualized as secondary cities. In this way, we foreground *core-secondary relations* as a fundamental analytical lens. This is because, first, the concept of secondary cities is inherently relational, highlighting their subordinate position to core cities within a regional system. Second, inter-city relations constitute a fundamental component of mega-regional formations, with scholars extensively discussing multidimensional interactions between cities across social, economic, and spatial aspects (Meijers & Burger, 2017). Finally, reflecting on intra-regional unevenness essentially underscores the developmental disparities between core and secondary cities, thus, focusing on core-secondary relations offers a more direct and effective lens for reflecting on the unevenness problem.

We first aim to answer the question: *How have the relations between core and secondary cities been (re)shaped and transformed throughout the process of Chinese mega-regionalization?* Building on this, we

examine the unevenness challenges embedded in the mega-regional system, and explore the diverse roles and the context-dependent vulnerabilities of secondary cities within this uneven system.

The first research question aims to verify whether the concept of secondary cities is applicable in the Chinese context. If the process of mega-regionalization in China has been accompanied by the formation, strengthening, or optimization of inter-city relations, alongside increasing development disparities among cities, the emergence of “secondary cities” can be understood as a new standpoint through which to reflect on intra-regional unevenness. We emphasize that mega-regionalization is a *process*, a concept that was officially endorsed by the authorities in 2006 as sub-national spatial units, recognized in the 11th Five-Year Plan as key spatial carriers for guiding future urban development (CNDRC, 2006). Geographically, this process refers to the gradual emergence of integrated interaction systems between one or several major cores and a broad periphery of urban entities (Yeh & Chen, 2020). In fact 2006 did not mark the beginning of this process but much earlier on the basis of various socio-economic activities, shaping different spatial patterns (Li & Wu, 2012). As our point of departure, we trace the evolution of this spatial unit from the early stages of state formation in 1949, with particular attention to the transformation of core-secondary city relations over time. We expect such an investigation can yield a more concrete identification of secondary cities. This, in turn, guides us toward the further exploration: to understand more in-depth the unevenness challenges and the roles of secondary cities in the process of mega-regionalization.

This paper makes two significant contributions. First, the conceptualization of secondary cities expands the global-related regional studies literature to the Chinese context. It helps scholars and policymakers explore the similarities and differences between Chinese and Western mega-regional systems for more meaningful discussions. Second, at the practical level, we develop a new perspective for reflecting on Chinese mega-regional unevenness by understanding the challenges that secondary cities suffer from in this system, and to inspire more targeted policy and planning actions. The following section provides an overview of current theoretical studies on conceptualizing secondary cities towards a conceptual framework. Section 3 outlines the research design. We firstly draw on historical analysis of policy documents to trace the development trajectory of mega-regionalization and clarify the evolution of core-secondary relations (Section 4). Building on this, we employ cluster analysis to classify the differentiated roles of secondary cities within these relations (Section 5). In parallel, we apply the Theil index and the Dagum Gini coefficient to measure the degree of unevenness between core and secondary cities, to identify the specific challenges they currently face (Section 6). The paper concludes with a discussion and summary in Sections 7.

2. Theoretical underpinning

2.1. Secondary cities: a concept based on inter-city spatial relations

Scholars increasingly focus on secondary cities to denote a variety of associated concepts. For example, Manchester and Philadelphia have been studied as national secondary cities in relation to London and New York, respectively by developing independent agency and specific strengths to integrate and benefit from globalization (Hodos, 2011). There is a growing interest in defining “second-tier cities” based on their performance in various functional dimensions (GaWC, 2022). The emergence of these concepts implies that the classification of city levels is not only based on size but also on inter-city socio-economic networks (Cardoso, 2023; Sluka et al., 2019). Size-related functional capacities and political roles have also become noteworthy factors in differentiating city levels (Dattagupta, 2017; Hodos, 2007; Kaufmann et al., 2016).

Turning to the regional scale, research suggests that the interaction between cities and the associated restructuring of their spatial

configurations progressively strengthens inter-city socio-economic relations through infrastructural linkages, industrial transfers, and population mobility. This is often considered a trigger of “city-regionalization” as the core city upgrades its functional role to form a regional system by relocating redundant or strategic functions to the smaller neighbors, thus providing them more development resources (Scott, 2001; Vogel et al., 2010). In alternative to this core-periphery redistribution model, secondary cities (or secondary city alliances) can also generate new functional roles that do not depend on the core city agenda. This is more visible in city-regions where a dominant core is absent or where political agreements have allowed a more balanced system of functional autonomy (Cardoso & Meijers, 2016; 2017).

In this process, and compared to large and functionally heterogeneous core cities, secondary cities can be roughly regarded as smaller in size, and either more specialized or more vulnerable in terms of functional and political roles. Intuitively, they can be described in the vague but well-understood sense of “other cities, the less recognized, less celebrated cities, and located next to the famous cities that gather all the attention” (Pendras & Williams, 2021). In the context of Chinese mega-regionalization, we use the term “secondary” to emphasize the interaction and dependence of these cities on the cores in the regional network, rather than just on their ranking in particular indicators.

According to Pendras and Williams (2021), “secondness” is mainly reflected at the intra-regional scale. That is, cities are “secondary” to their associated cores, spatially and functionally closely related to these dominant players but they usually retain independent cultural and symbolic identities. Functionally, competition largely shapes these inter-city relations, especially in attracting investment, and cores tend to have a better chance of capturing these resources and becoming winners in the regionalization game (Jonas, 2012). A functional hierarchy therefore emerges in which, for example, accommodating low-end industries evacuated from the cores reflects one of the dimensions of being a (regional) secondary city (Aguilar, 2002). As political and economic interests gravitate towards each other, this hierarchy tends to be reflected at the institutional level, and core city policy agendas tend to have a greater voice than secondary city priorities in political decision-making (Li & Jonas, 2023).

2.2. Clarifying core-secondary relations

2.2.1. Defining the “relations”

Simply put, “inter-city spatial relations” can be understood as the interactions among functionally interrelated cities in a region arising from socio-economic activities such as spatial agglomeration, industrial relocation, and population migration. Burger et al. (2014a) identify the transformation of these relations as key to overcoming the challenges of an unevenly polarized region, namely from a “hierarchical system” in which the dominance of the core city is consolidated to a “network system” in which polycentricity fosters positive interactions among cities. Following this, we summarize such relations into two aspects.

The first is the **spatial structure**, which refers to how the regional spatial configuration is shaped by core-secondary relations regarding their morphological structure (uni-nodal or multi-nodal), orientation of functional flows (uni-directional or multi-directional), and overall spatial arrangement (monocentric or polycentric). The second aspect involves the **functional ties** between cities. This encompasses aspects such as economic specialization and economic externalities among cities. They may engage in competition fighting for local interests or cooperation towards regional complementarity of various functional roles. In a hierarchical system, the distribution of economic functions is often determined by the dominance of the core city, with high-end economic sectors concentrated and limited positive interactions with surrounding smaller cities. Consequently, positive economic externalities tend to be limited to the cores. In a network system, cities play similarly significant but differentiated functional roles, relying on their positions within the network and a division of labor. As a result,

economic externalities are more widely distributed.

2.2.2. The transformation of the “relations”

We argue that core-secondary spatial relations are both the culprit of unevenness and the key factor for addressing this issue. Dealing with uneven relations and fostering beneficial interactions have become crucial approaches for building a balanced and efficient regional system. Scholars have summarized two dimensions driving these relations (Hodos, 2007; Kaufmann et al., 2016; Scott, 2001). The first is **political positioning**. We interpret this as privileging certain cities with greater development potential through preferential policies. Regarding the spatial structure, this is reflected in the attempt to control city size, to form one primary core and/or define the hierarchy of the polycentric system; Regarding economic ties, it involves assigning specific economic dominance to certain cities (Xu & Yeh, 2005). This is usually a political choice that goes beyond marketization and often aims to empower the cores as growth machines to maintain the competitiveness of the region as a whole (Crouch & Le Galès, 2012).

A second dimension entails **functional positioning**. Functional differences consolidate the position of cores in the regional system by perpetuating their roles as financial centers, transportation hubs, innovation gateways, and investment attraction engines (Hanssens et al., 2014). Secondary cities are in a weaker position; while they have the possibility of taking advantage of the larger market of the cores in a closely integrated regional network, persistent functional weaknesses make them lose their competitiveness. This is well explained by the comparative concepts of borrowed size and agglomeration shadow, which suggests that enhancing the functional position of secondary cities is an effective approach for building a polycentric regional system. This is primarily reflected in guiding spatial flows and leveraging beneficial economic externalities (Meijers & Burger, 2017).

2.3. Secondary cities in Chinese mega-regional system

2.3.1. Mega-regionalization in China

In the Chinese context, mega-regions are often composed of one or two core cities and several ordinary prefecture-level cities located beyond its administrative boundaries (Yeh & Chen, 2020), which we define as mega-regional secondary cities. More precisely, we focus on secondary cities at the scale of mega-regions, not metropolitan areas (for example, the satellite towns surrounding the metropolitan core in Greater Beijing), or national-scale “second-tier cities” based on the ranking of their economic attractiveness of cities, such as Wuhan (Yicai, 2024). Accordingly, we define mega-regional unevenness as the inter-city disparities that emerge at this spatial scale.

Mega-regions are often regarded as urban-regional spatial configurations composed of multiple interrelated urban systems (Harrison & Hoyler, 2015). This reflects the complexity of mega-regional systems, based on in the morphological structures shaped by rapid urbanization and vast functional entities supporting economic interactions and flows driven by specialization and competition in the global market (Florida et al., 2008; Schafraan, 2014). Both dimensions are fundamentally built upon inter-city relations carried by spatial structures and economic interactions as their carriers. This highlights that mega-regions embody a dual nature of “space” and “process” (Harrison & Hoyler, 2015): a spatial assemblage of socio-economic functions and activities based on a system of multiple urban systems (which we interpret as a spatial network grounded in inter-city relations), and a process of spatial functional restructuring and governance aimed at enhancing the overall functioning of the system (understood here as reshaping and transforming patterns of inter-city relations).

In China, the concept of the mega-region was not officially recognized by authorities as the main carrier for future urbanization until 2006. However, this does not mean that mega-regions appeared in China only after this point: scholars had already extensively discussed their emergence since the 1980s, especially in the Pearl River Delta, driven by

global trade and industrial development and relocation (Yeh & Chen, 2020). As the concept becomes more widely adopted in top-level spatial policies, mega-regions are often viewed as ‘spatial imaginaries’ aligned with the national political goal of achieving regional coordination and integration, but not always reflected in geographical reality, either in terms of spatial arrangements or functional interaction (Harrison & Gu, 2021). Indeed, Chinese mega-regions are assumed to possess both “space” and “process” attributes: beyond the spatial boundaries and structures explicitly defined in planning policies, the increasingly intensive inter-city relations are seen as concrete manifestations of mega-regionalization taking shape. Therefore, in this research, we focus on how inter-city relations at this scale (the space) have been progressively shaped, strengthened, and optimized (the process), with particular attention to the challenges of core-secondary imbalances within mega-regions.

2.3.2. The fundamental features of Chinese secondary cities

Mega-regional secondary cities are smaller urban entities outside the core in a predominantly monocentric system, which are expected to play a more significant role in building a polycentric network through processes of coordinated mega-regional governance (Su et al., 2017a, 2017b). However, core cities still dominate the mega-regional functional system, with knowledge-intensive and innovative industries more likely agglomerating there (Xu et al., 2022), while secondary cities play a subordinate economic role, often characterized by low-end, labor-intensive, and low profit activities (Zhang, 2015). This duality triggers core-secondary relations that are characterized by differences in functional positioning in almost all Chinese mega-regions. This is mirrored by a similarly uneven political positioning, as the role of cores as leading actors is reinforced by various regional policies (especially in some inland provinces) that aim to cultivate provincial champion cities to ensure their competitiveness in the national economic system (Zhou & Yang, 2024).

Nevertheless, this system is dynamic: regional development policies at different stages influence the cities’ political and functional positioning and further reshape core-secondary spatial relations. Since the 2000s, under state-driven regionalism, recentralized regional governance aimed at inter-city coordination has become the main approach to address problems of excessive competition and unevenness (Wu, 2016). It seeks to promote the development of secondary cities by leveraging the positive externalities of the cores. Functionally, joint industrial projects are planned and both core and secondary cities are expected to be engaged. Politically, there is a new approach of limiting the over-concentration of resources in cores and encouraging the rise of smaller cities through direct support of the cores (CNDRC, 2021, 2022). While the value of secondary cities grounded in inter-city relations is increasingly valued by Chinese authorities, the problem of mega-regional unevenness remains unresolved and entails disparities beyond demographic size and economic power. The disadvantaged position of secondary cities is visible in development gaps in social vitality, innovation capacity, industrial structure, regional embeddedness, and quality of green development, among other features of high-quality development.

3. Research design

Step 1: Understanding mega-regionalization process from secondary cities’ perspective

We begin by tracing the trajectory of mega-regionalization in China. This serves, on one hand, to examine how core-secondary relations have been formed, intensified, and optimized, thereby assessing the applicability of the concept of secondary cities. Also, we pay particular attention to how shifts in political and functional positioning throughout this process have shaped the specific roles of secondary cities. Policy analysis is employed as the main method. The Five-Year Plans, as the

arrangement and guidance of national socio-economic development by the authorities, determines the direction of mega-regionalization and thus serves as the basic institutional contextual reference for scholars discussing the various regionalism issues in China (Fang, 2015). We use official policy documents from the 1st Five-Year Plan (1953–1958) to the 14th Five-Year Plan (2021–2025) as main research materials.

We employ the conceptual framework developed in Section 2 as an analytical tool (Fig. 1), with a focus on how policy orientations of regional development in each Five-Year Plan period have shaped the cities’ political and functional positioning. Our analysis centers on the evolving spatial structures and economic ties between core and secondary cities with specific focuses on, firstly, the institutional continuity reinforced by positive feedback benefits, that is, path dependency. Also, some major shifts as critical junctures have come into focus, referring to “the moments when new sets of institutional arrangements are established, ..., when the rules of the game are changed” (Capoccia & Kelemen, 2007; Sorensen, 2015). Building on this, we conduct a more detailed exploration on the process of each stage through the lens of core-secondary relations, and the evolving roles of secondary cities.

Step 2: Identifying the current challenges of secondary cities

Based on investigating the process of Chinese mega-regionalization, we further explore to what extent the unevenness has improved or worsened in this process, and thus discuss the current challenges faced by secondary cities. On the basis of conceptual framework in section 2, we construct an indicator system that comprehensively considers the two dimensions of core-secondary relations, spatial structure and economic ties, and the two triggers of political positioning and functional positioning, to represent and measure mega-regional unevenness. The specific indicators and the rationale for their selection are provided in the Supplementary Materials.

The measurement of mega-regional unevenness focuses specifically on the period from 2006 to 2023 (the 11th to the 14th Five-Year Plan). This is because, on one hand, starting in 2006, mega-regions were promoted by the authorities across the national territory as the main carrier for urbanization. Prior to this, although some core-secondary relations had been shaped in specific regions, they lacked the comprehensive and sustained basis for systematic analysis. On the other hand, our analysis of the historical process of mega-regionalization also reveals that prior to 2006, the state primarily endorsed the growth pole strategy to address inter-regional unevenness. However, this approach inadvertently exacerbated core-secondary unevenness. It was only after the mega-region concept was formally embraced by the authorities that intra-regional unevenness began to be systematically considered.

When calculating, we divide the cores and secondary cities within each mega-region into two groups and focus on the disparities between these groups to capture the core-secondary unevenness. The *Theil index* and *Dagum Gini coefficient* are recognized as mature and reliable methods for calculating inter-group development gaps (Dagum, 1997; Theil, 1973). We use these techniques for measurement, and the results obtained from both approaches corroborate each other, demonstrating the robustness of the findings.

Step 3: Rethinking the roles of secondary cities in uneven mega-regionalization

Our analysis of the historical process of mega-regionalization also enables us to identify the (potential) roles played by secondary cities. Building on this, we further reflect on the roles these cities are currently assuming amid the ongoing trend of uneven mega-regionalization, and how these roles shape their positioning within the regional system. We use data from *the Seventh National Population Census* (2020), focusing on the proportion of employment across different economic sectors in each city. Guided by the theoretically expected roles of secondary cities, we select relevant economic sectors and compare them with those of

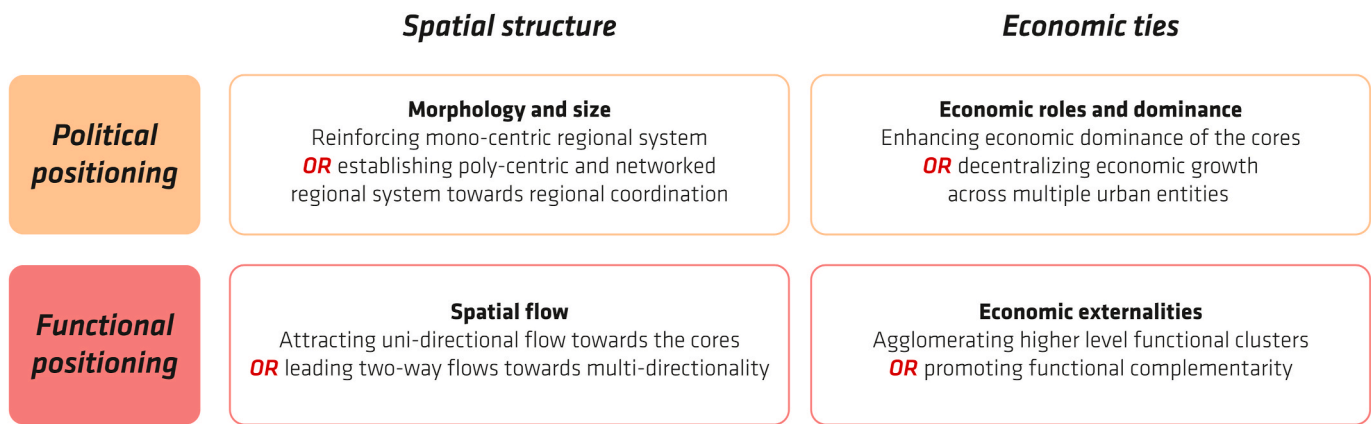


Fig. 1. The different core-secondary relations and triggers of transformation.

core cities, thereby constructing a role profile for each secondary city. We then apply *K-means clustering analysis* to group these cities, enabling further exploration of the characteristics and patterns associated with different types of secondary cities. This is a machine learning method that maximizes inter-group differences while minimizing intra-group variation based on multiple urban attributes. Due to its simplicity and robust performance, it has been increasingly applied in the field of urban studies (Cardoso, 2023). To ensure the coherence of the narrative in this study, the specific mega-regions and list of cities for further analysis are identified following the historical analysis, see Section 5.1 for details. Considering the length of this paper, we omit the detailed calculation steps, the relevant Python code for data processing and calculating are available upon request.

4. Periodical trends of core-secondary relations

Drawing on the historical analysis of Chinese mega-regionalization, we divide the process of shaping and transforming core-secondary relations into four stages marked by three distinct critical junctures, which still exhibit a path dependency based on the problems left by the previous stages (Fig. 2). We apply the conceptual understanding constructed from the two perspectives of core-secondary spatial relations—spatial structure and functional ties—and the triggers for the transformation of these relations—political and functional positioning—as the analytical tool to explore this historical process and the roles of secondary cities in each stage.

4.1. Stage I: yet-to-be-formed core-secondary spatial relations in a planned economy

The first stage, from the 1st (1953–1957) to the 4th Five-Year Plan (1971–1975), can be characterized by two sub-stages. In the beginning, with the assistance of the Soviet Union, 472 heavy industrial projects were laid out in the inland areas, and 222 were distributed in the coastal areas. This was an attempt to balance development between sub-national parts and promote urbanization across the national territory. At this stage, the mega-region as a spatial scale had not yet taken shape, and inter-city cooperation relied on the control of the authorities, appearing in a limited scope based on industrial production chains such as raw material supply or logistic infrastructure. The second sub-stage began with the 3rd Five-Year Plan (1966–1970). Considering national security, the authorities decided to relocate heavy industries further inland, looking for substitutes for Anshan (national heavy industrial basis) and Shanghai (national industrial and commercial basis) and establishing military industries in these areas. This was known historically as the “Three Line Project”, meaning that important development resources were relocated from the coastal areas (first line) to the safer inland areas (third line). However, this stage witnessed multiple

turbulences and pressures from international relations, lagging production systems, and natural conditions. Coupled with the political struggles in the 1970s (McFarlane, 1983), regionalization ended with socio-economic backwardness and decline.

Although the mega-region scale had not yet materialized during this period, certain economic ties began to emerge. Cities that accommodated key national industries were, to some extent, regarded as “cores”, while the surrounding inland areas were explicitly designated as “agricultural supply zones”. This agricultural supply partnership can be interpreted as an early form of core-secondary relations but not situated within a mega-regional framework. In the present context, smaller neighboring cities around mega-regional cores are often tasked with similar functions: ensuring agricultural security and supplying food to the cores (DNR Hebei, 2021).

4.2. Stage II: growing core-secondary spatial relations in emerging coastal mega-regions

The second stage began with the 6th Five-Year Plan (1981–1985) (the 5th Five-Year Plan is considered a period of recovery after the political struggle). Reform and opening up towards marketization was the main theme of this stage, and the import-export trade became another critical driving force for urbanization, prioritizing eastern coastal areas as the national economic engine. While this open-door policy created an economic boom in cities such as Shenzhen that were selected by the authorities, gaining advanced functional and political positioning as pioneers of emerging global trade, it is also a period considered to be conducive to severe unevenness in China, marked by massive disparities between the eastern sub-national parts and the inland areas (Fig. 3).

Those cities favored by the open-door policy replaced the ones with heavy-industrial distribution as the new cores politically dominating the regional system. Heavy industrial centers like Anshan gradually began to take a back seat. The 1990s witnessed the first import-export leap in the wave of globalization (Fig. 2), allowing these coastal cities to become rich. This resulted in an asynchrony between regional development in inland and coastal areas as the inland regions continued the previous stage’s development model of planned economy. Although some large cities (such as certain provincial capitals) emerged, based on machinery or other heavy manufacturing, they had not established close relations with surrounding smaller cities other than agricultural supply.

In the coastal regions, however, mega-regionalization began to take root, and core-secondary relations were gradually created and strengthened. Politically, these coastal cores were expected to become the driving force of national growth centered on manufacturing, marking the origins of the Chinese reputation as the “world’s factory” (Zhang, 2006). Subsequently, in the wave of global trade, these cores encountered rising land prices and limited development space, and thus focused on more profitable sectors, which triggered industrial spillovers

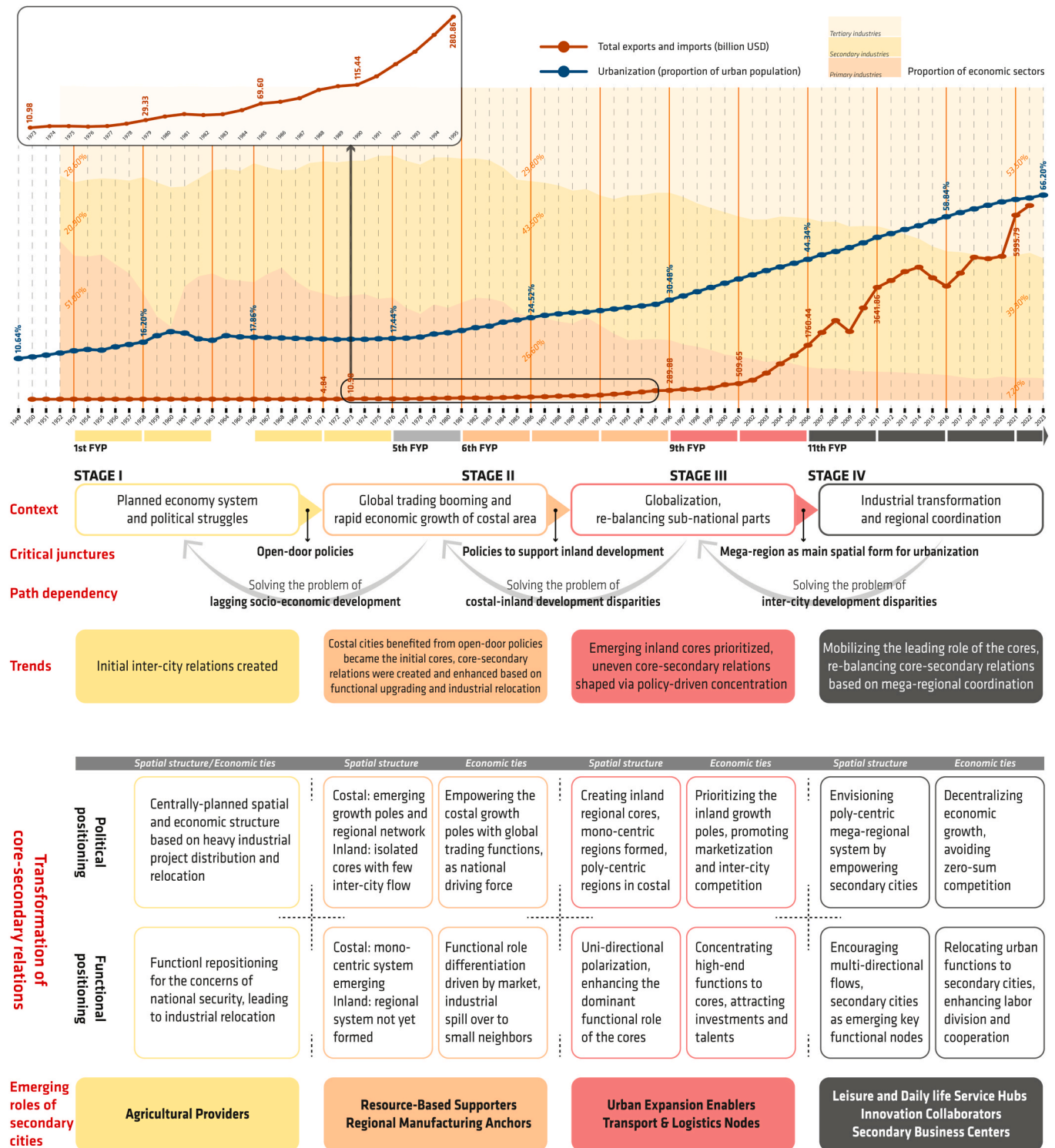


Fig. 2. Mega-regionalization trends and the transformation of core-secondary relations.

across the region. Surrounding smaller cities absorbed the more labor-intensive industries, also driving improvements in inter-city infrastructure (Yeh & Chen, 2020). This effectively formed a mega-regional system with great centrality of the cores, and functional differentiation emerging under the market forces.

The stage of open-door policy and marketization led to the rapid rise of coastal cities as national growth poles at the expense of inter-regional development disparities. As these cores upgraded their functions, industrial relocation shaped and enhanced core-secondary city relations.

For the first time, the authorities officially initiated regionalism at the scale of mega-regions, even though it was limited to well-developed areas along the eastern coast, like the Yangtze River Delta Economic Zone and the Pearl River Delta. Resource-intensive heavy industrial cities were gradually relegated to a secondary position, as mega-regional cores transitioned toward outward-oriented economic development. Manufacturing economies that had previously concentrated in cores began to diffuse toward surrounding cities. As a result, secondary cities started to play new roles as resource-based supporters and regional

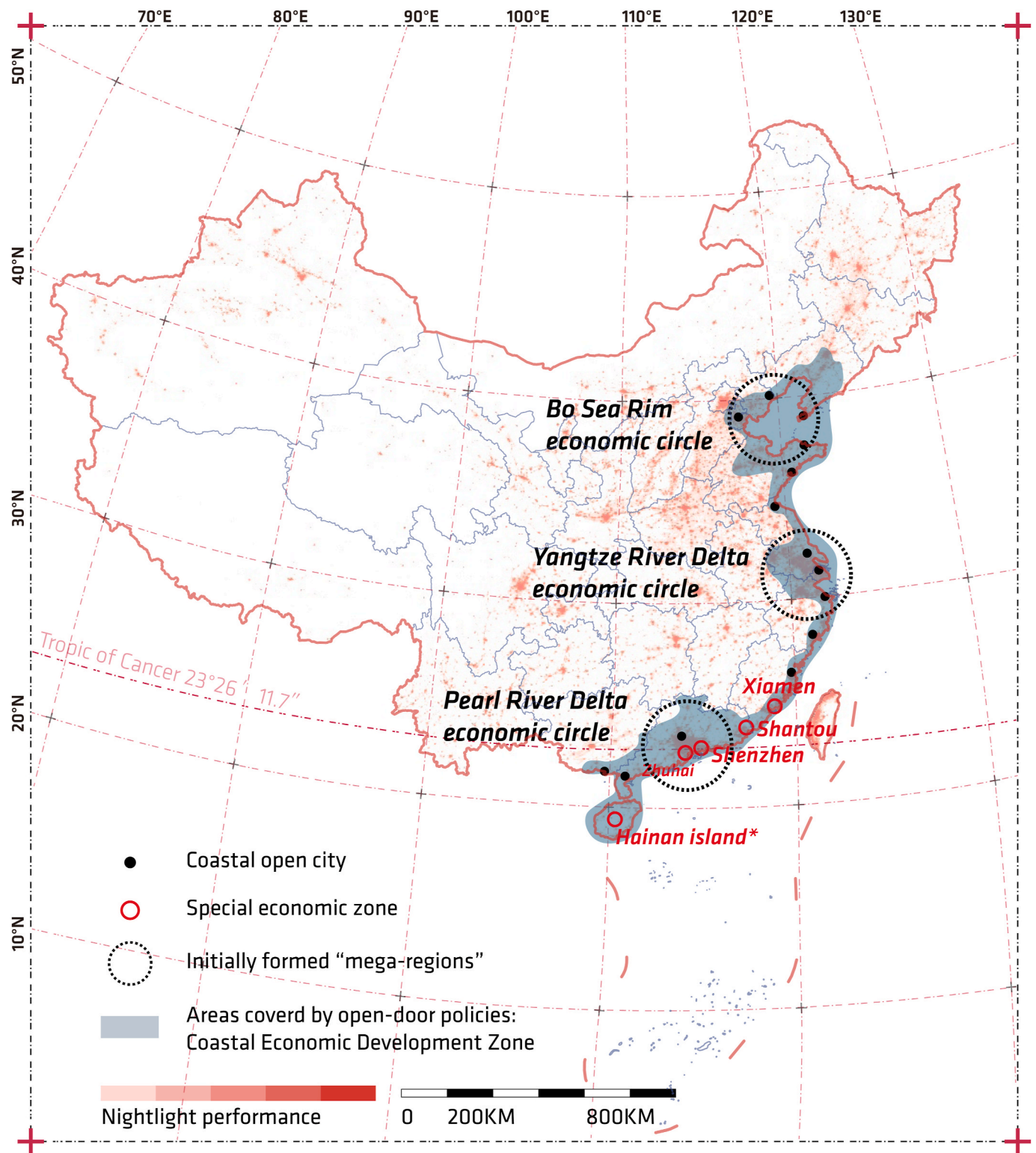


Fig. 3. Pioneering area in the open-door policy (Stage II).
 Note: Hainan was assigned as a special economic zone in 1988.

manufacturing anchors, supplying raw materials or manufacturing goods to support the evolving functions of the cores. This was explicitly stated in the Sixth and Seventh Five-Year Plans (CNDRC, 1981; 1986): coastal core cities such as Shanghai and Tianjin were expected to upgrade their industries toward knowledge-intensive and finance-oriented economic clusters; other smaller coastal cities benefiting from the opening-up policy were encouraged to accelerate the development of

manufacturing clusters; and smaller inland cities were assigned the role of securing energy, mineral, and raw material supplies.

4.3. Stage III: the rising of new inland superstars as basis of uneven core-secondary relations

The third stage consists of the 9th Five-Year Plan (1996–2000) and

the 10th Five-Year Plan (2001–2005). The critical problem of the disparities among sub-national parts left from the former stage was taken seriously by the authorities, shifting from prioritizing growth of the eastern coastal area to coordinated development across the entire national territory. During this decade, the role of economic engines such as the Yangtze River Delta and the Pearl River Delta was still emphasized, but they were also encouraged to support the inland areas regarding technology and finance. Based on this, in parallel to highlighting the

pioneering role of the eastern parts, three regional coordination policies concerning inland areas were successively promoted (Fig. 4): the Western China Development (since 1999), the Northeast China Industrial Revitalization (since 2003), and the Central China Rising Action (since 2004). The cultivation of emerging inland growth poles became the primary approach to rebalancing these sub-national parts. Namely, the authorities explored the potential of some inland cities through preferential policies. As a result, the inter-regional development gap has

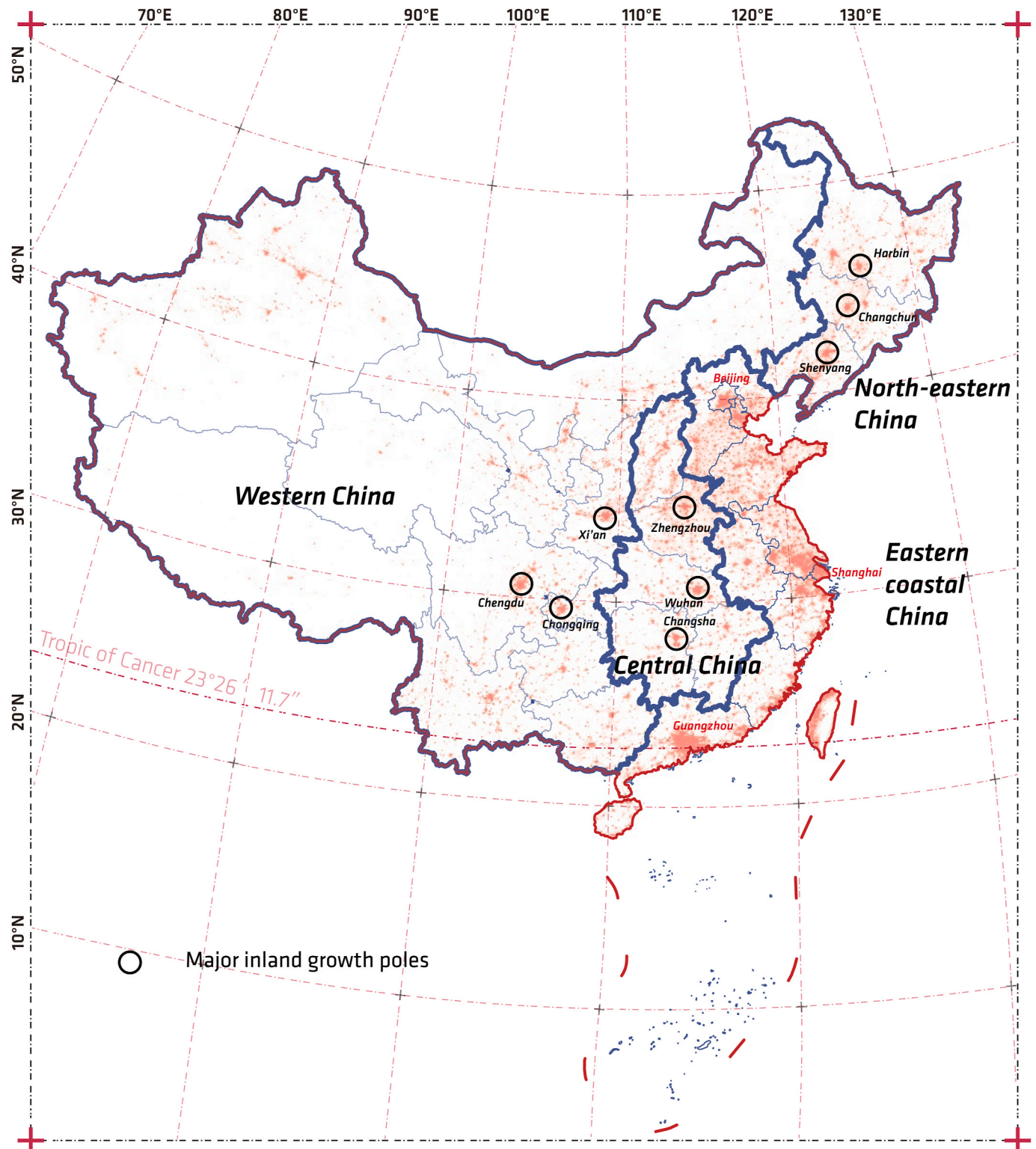


Fig. 4. Four sub-national parts and emerging inland growth poles (Stage III).

been effectively alleviated.

This process promoted the rise of large inland cities, driven by their strong industrial foundation and the policy favoritism. In this process, these cores were often positioned as manufacturing centers, seemingly replicating the development trajectory of coastal core cities in the previous stage, while an increasing number of secondary cities became transportation and logistics hubs serving the needs of the cores. In the coastal mega-regions during this stage, core-secondary relations were

enhanced by industrial spillovers. Cores began to take economic functions in high-end services such as business and finance, while further relocating manufacturing and other industries to surrounding secondary cities, forming a closely connected regional network. In addition, the decentralization of economic development power promoted marketization, leading to a growth model prioritizing inter-city competition. This wave sparked a construction boom, with cities across the board engaging in large-scale building and expansion (Li et al., 2020; Tan

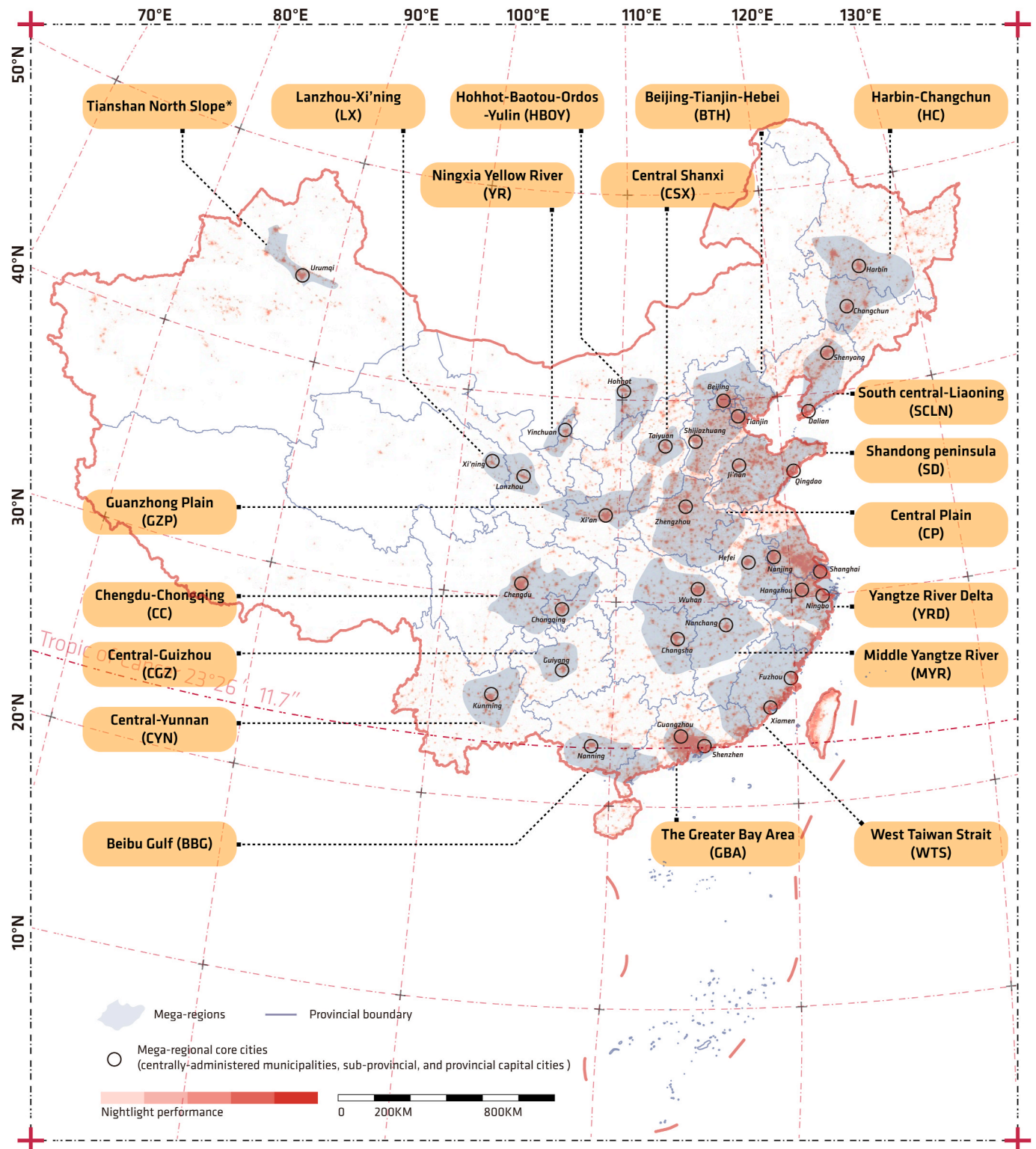


Fig. 5. Chinese mega-regional system and mega-regional cores (Stage IV).

et al., 2005). This trend was evident in both core and secondary cities, as both became drivers of the country's rapid urbanization.

In summary, coastal mega-regions were progressively consolidated in Stage III, with core-secondary relations strengthened through industrial upgrading and transfer. In the inland mega-regions, the role of emerging cores was reinforced through both preferential policies and market competition, along with, severely uneven unidirectionally polarized core-secondary relations. Beyond their previous role as suppliers of manufacturing goods and resource-based materials, these smaller players began to assume two new economic role within the regional system: firstly, supporting the market activities of core cities through transportation and logistics. In the Tenth Five-Year Plan, the development of transportation, logistics, and communication infrastructure was given high priority, and the rise of various cities along these corridors was highlighted as emerging points of economic growth (CNDRC, 2001). This stage also encouraged the rapid development of the land economy, including the financialization of land, the activation of the real estate market, and the promotion of the rapid expansion and development of small and medium-sized towns as an important vehicle for further urbanization (ibid.).

4.4. Stage IV: the coordinating of core-secondary relations by official mega-regional planning

The most recent stage began with the 11th Five-Year Plan (2006–2010) and lasts till today. At this stage, the strategy of rebalancing sub-national parts remained, but more importantly, for the first time, urbanization in the form of mega-regions as the key spatial carriers was explicitly proposed by the authorities. The former strategy of creating new inland cores was upgraded to a comprehensive regionalism approach, emphasizing a more systematic regional structure responding to intra-regional unevenness. In this system, core-secondary relations were enhanced by mobilizing the leading roles of the cores in all kinds of cooperation initiatives. Mega-region became foremost a growth-oriented concept to shape a broader space for nationally and globally competitive development by reinforcing inter-city linkages. However, it is also a collaborative initiative in which zero-sum competition between cities is controlled and more attention is paid to multi-dimensional cooperation in social, economic, and cultural aspects. For example, the authorities guide some industries away from over-concentrated cores to secondary cities, giving these smaller players more important functional positioning. In this way, they outline a more integrated and coordinated spatial planning vision to reshape inter-city relations that includes environmental, social, and institutional systems (Fig. 5).

Spatial planning for mega-regions thus became a governance tool developing spatial structures and axes, functional spatial layouts, and statutory spatial regulations. This is also known as the “planning imaginary”, in which mega-regions are not real geographical entities but future visions (Harrison & Gu, 2021). The plans envision a transformation toward polycentric mega-regional systems, reflecting the growing emphasis on the economic potential of secondary cities. They are expected to develop distinctive economic sectors and achieve functional complementarity with the cores, rather than only receiving the phased-out sectors. Core-secondary integration is emphasized at spatial and economic levels, through strengthened infrastructure connections and guided development corridors, as well as joint economic clusters.

This stage marked the envisioning of a model of core-secondary coordination by formally designating the mega-region as a strategic spatial platform for future urban development. Economic ties between core and secondary cities were further reinforced. Building on previous roles, secondary cities were now expected to serve as new frontiers for industrial upgrading, fostering the development and attraction of high-tech industries and emerging financial and business services. The scope of their functional roles expanded beyond manufacturing, with leisure and recreational service provision for the core also encouraged, aimed at unlocking the potential for greater economic diversification

within secondary cities themselves. This was particularly evident in the Twelfth Five-Year Plan, which emphasized tourism and other emerging service industries as opportunities for less-developed cities, supporting the process of mega-regionalization and fostering regional coordination (CNDRC, 2011).

5. Unsolved problems of unevenness in Chinese mega-regionalization

5.1. Delimitating mega-regional secondary cities and measuring intra-regional unevenness

The historical analysis of mega-regionalization in China reveals two key insights. First, contemporary mega-regionalization is a top-down, recentralized spatial governance process initiated by central authorities (Wu, 2016). Through spatial planning, 19 regional units have been created across the national territory in the Fourteenth Five-Year Plan (CNDRC, 2021). Within these units, core cities are typically centrally administered municipalities, provincial capitals, and sub-provincial cities. These cities hold higher administrative levels, meaning greater political voice (Du et al., 2024b; Zhang et al., 2021). As regional cores, they also benefit from preferential policies and multidimensional support and are positioned as economic growth engines for the respective mega-regions, as exemplified by the widely implemented “strengthen provincial capital” strategy (Zhou & Yang, 2024). Accordingly, in this study, we categorize these cities as mega-regional cores, while **all remaining prefecture-level cities within each mega-region are classified as secondary cities for the subsequent analysis.**

Second, tackling intra-regional unevenness is a comparatively recent policy concern. While the open-door policy during Stage II triggered severe inter-regional disparities, Stage III sought to address this by cultivating inland growth poles. It was not until Stage IV, when mega-regionalization was formally implemented at the national scale, that the unevenness between cores and secondary cities became a direct focus of policy intervention. Building on this, this section aims to examine whether this mega-regional gap has been effectively mitigated since the onset of Stage IV.

Our conceptualization of secondary cities stems from their political and functional positioning within regional systems, characterized by multiple uneven relations with the cores both at spatial and economic levels. Political positioning in mega-regions is shaped by the authorities' interventions in areas such as fiscal capacity, infrastructure provision, and the allocation of space for further development, directly reflecting the local government capacity. We also focus on the developmental potential of secondary cities. This is because, political positioning not only determines the policy attention a city receives but also channels resources, preferential policies, and institutional support that consolidate its development prospects (Chan & Zhao, 2002). In Chinese secondary cities, the pace of urban growth—often measured in terms of population expansion and economic performance—has long been used as a proxy for local governmental “performance”, and served as a central benchmark to evaluate local officials by higher-level state actors (Chien & Woodworth, 2018). Following this rationale of politically driven growth, we adopt GDP and population as proxy measures for political positioning. On the other hand, functional positioning refers to a city's preferred combination of functional sectors aiming at economic vitality, social attractiveness, regional embeddedness, and innovation and knowledge concentration. We developed an evaluation system with 10 specific indicators (Table 1) to explore the unevenness between core and secondary cities during Stage IV by comparing data from 2006 to 2023. Core and secondary cities within each mega-region are grouped separately, and our analysis focused on the disparities between these two groups. **The specific indicator selection and justification are provided in the Supplementary Material.**

Notably, unlike previous stages, the mega-region in Stage IV remains a spatial imaginary rather than a fully realized geographic entity,

Table 1
Indicators to measure core-secondary unevenness.

	Measure perspective	Indicators and data source
Political positioning	Population concentration	Population, Yearbook (NBS, 2007; 2024)
	Economic strength	GDP, Yearbook (NBS, 2007; 2024)
	Space for growth for a poly-centric system	Built up area, National Land Survey (MNR, 2023)
	Investment for urban construction	Infrastructure investment per capita, Yearbook of Urban Construction (MHURD, 2006; 2023)
Functional positioning	Local governmental capacity	Governmental expenditures per capita, Yearbook (NBS, 2007; 2024)
	Social vitality	Nighttime light, Harvard Dataverse (Wu et al., 2021)
	Regional embeddedness	Regional transportation land, Yearbook of Urban Construction (MHURD, 2006; 2023)
	Advanced industries	Tertiary sector income, Yearbook (NBS, 2007; 2024)
	Innovation cultivation	Teachers of higher education, Yearbook (NBS, 2007; 2024)
	Innovation capacity	Patent per capita, collected from www.cnki.net , 2024

reflecting the top authorities' ambitions for territorial governance (Harrison & Gu, 2021). The 14th Five-Year Plan clearly outlines three distinct developmental phases for all mega-regions:

- **Optimizing:** those that have already formed close and developed regional systems, often including the largest cities, including Beijing-Tianjin-Hebei (BTH), Yangtze River Delta (YRD), Guangdong-Hong Kong-Macao Greater Bay Area (GBA), Chengdu-Chongqing (CC), and Middle Yangtze River (MYR);
- **Expanding:** those with an initial development foundation but where highly integrated and coordinated inter-city relations have yet to be established, including Shandong Peninsula (SD), Western Taiwan Strait (WTS), Central Plain (CP), Guanzhong Plain (GZP), and Beibu Gulf (BBG);
- **Cultivating:** mega-regions that largely remain at the level of planning imagination, with low levels of both development and coordination. In this chapter, we excluded mega-regions with very low development levels or too few cities, focusing mainly on Harbin-Changchun (HC), South-central Liaoning (SCLN), and Central Shanxi (CSX).

5.2. First impression: significant disparities remain between core and secondary cities

We first compared the changes of inter-city disparities between core and secondary cities from 2006 to 2023. The results show that the gaps between core and secondary cities are still pronounced across nearly all dimensions (Appendix 1). For example, regarding population, in 2006, the cores in some mega-regions did not particularly stand out; however, by 2023, they demonstrated significantly stronger population agglomeration capacity, especially in some inland mono-centric mega-regions. Moreover, the population centrality of some “second cores” has also risen significantly, for instance, Nanjing and Hangzhou in the Yangtze River Delta and Shenzhen in the Greater Bay Area. The rapid population growth in core cities marked the success of the national growth pole strategy in Stage III, contributing to a narrowing of disparities between regions while making the intra-regional unevenness between core and secondary cities more pronounced. For secondary cities, we find that in GDP, higher education students, and regional transportation indicators they remain in a disadvantaged position as cores have maintained their central roles in economic agglomeration, talent cultivation, and transport hubs. In other dimensions, however, some secondary cities have made notable progress, particularly in attracting governmental

expenditures. This suggests an improvement in the political positioning of secondary cities.

5.3. Changes in core-secondary unevenness

For further exploration, we calculated the core-secondary unevenness between the two groups using two approaches: the Theil index and the Dagum Gini coefficient (Fig. 6). The results from these different methods were closely aligned. The core-secondary unevenness in 2023 shows variations across mega-regions. For instance, Beijing-Tianjin-Hebei, Chengdu-Chongqing, Guanzhong Plain, Harbin-Changchun, and Central Shanxi exhibit higher levels of unevenness across most dimensions, indicating that cores continue to dominate in both political and functional positioning.

For specific indicators, especially regarding economic agglomeration, the gap is striking (for example the Theil index reaches 0.68 in Chengdu-Chongqing). Unevenness is even more evident in infrastructure investment per capita, where Guanzhong Plain records 0.73. This is not surprising, since despite a relatively balanced governmental capacity, secondary cities still face a significant gap in their ability to attract socio-economic activities and urban expansion investment compared to cores. For functional indicators, core-secondary unevenness is particularly strong in higher education students and tertiary industry income. In Central Shanxi, higher education is concentrated in the provincial capital Taiyuan, with a Theil index of 1.3; in Chengdu-Chongqing, the two cores dominate most high-end industries, reflected by a Theil index of 0.83 of tertiary industry income. As cores continue to hold these advantages over smaller players, they further consolidate their dominant position in the regional functional system.

Based on this understanding of the current state of core-secondary unevenness, we further measured its changes from 2006 to 2023 (Fig. 7). From the perspective of urban size, both economic agglomeration and total population show a notable widening of the gap between core and secondary cities, with only Yangtze River Delta and Central Shanxi showing a slight decrease in GDP unevenness. Governmental expenditures have declined to some extent, particularly in more developed mega-regions such as Beijing-Tianjin-Hebei and Greater Bay Area. These two mega-regions also show the most significant decrease in built-up area unevenness, largely due to strict control over urban expansion in their cores. In contrast, other mega-regions, such as Guanzhong Plain and Beibu Gulf, exhibit continued expansion of the built-up area in the cores, reflecting the mega-regional ambitions to further strengthen them. Functionally, tertiary sector development has become increasingly polarized across almost all mega-regions, with only a slight reduction observed in Yangtze River Delta. More developed mega-regions show a decline in unevenness across other dimensions, particularly in nighttime light and patents, suggesting improvements in social vitality and innovative capacity. In less developed mega-regions, however, such improvements are not evident.

In summary, mega-regionalization has indeed mitigated unevenness, but the effectiveness is limited. Secondary cities have gained more development space and improved governmental capacity, alongside progress in social vitality, talent cultivation, and innovation. However, many secondary cities continue to face uneven challenges, particularly regarding size and the dominance of advanced industries. Combining these findings with our assessment of the current state of core-secondary unevenness, we argue that while mega-regionalization has generated some positive outcomes in addressing unevenness—such as improvements in per capita GDP, government fiscal expenditure, or social vitality—secondary cities remain constrained by developmental disparities across multiple dimensions. Cores continue to benefit from larger socio-economic agglomeration, stronger investment attraction, platforms for talent development, and more advanced economic structure. This consolidation of their dominant position reinforces core-secondary unevenness, which remains a fundamental barrier that secondary cities must overcome.

Theil Index

Mega-region	GDP Per Capita	GDP total	Population	Built up area	Infrastructure investment Per Capita	Governmental expenditures Per Capita	Nighttime light	Regional transportation land	Tertiary Industry income total	Higher education students	Patent Per Capita
BTH	0.07176	0.39835	0.09404	0.16404	0.56231	0.05321	0.05075	0.04785	0.57791	0.33291	0.25496
YRD	0.00581	0.16209	0.09833	0.07049	0.07455	0.01134	0.02866	0.12724	0.26421	0.35907	0.02605
GBA	0.02671	0.31264	0.14350	0.03651	0.03475	0.03256	0.00725	0.26783	0.49482	0.59907	0.01448
CC	0.01196	0.67646	0.45161	0.58452	0.05848	0.00246	0.50982	0.56412	0.82707	0.97701	0.16408
MYR	0.01373	0.23068	0.07952	0.09822	0.21427	0.00048	0.11298	0.05951	0.30968	0.69378	0.12653
SD	0.01933	0.11737	0.01996	0.02132	0.38300	0.00706	0.01492	0.06686	0.18532	0.19489	0.11438
WTS	0.02291	0.09984	0.01619	0.02104	0.19784	0.00300	0.00776	0.01897	0.17131	0.25014	0.06370
CP	0.00909	0.13635	0.03399	0.05971	0.11305	0.00036	0.02377	0.06080	0.18181	0.68370	0.09131
GZP	0.01705	0.39094	0.17942	0.18275	0.72960	0.00016	0.08478	0.01473	0.60584	0.90080	0.51281
BBG	0.00015	0.06476	0.05586	0.07532	0.27167	0.00032	0.04770	0.19528	0.14847	0.63389	0.05984
HC	0.00861	0.31038	0.19374	0.14500	0.57721	0.00373	0.15389	0.07374	0.43337	0.81365	0.26289
SCLN	0.02266	0.45005	0.25324	0.22111	0.58617	0.00018	0.12752	0.29094	0.50604	0.70633	0.06023
CSX	0.01822	0.15495	0.05222	0.08607	0.21376	0.00051	0.00769	0.00004	0.31183	1.28859	0.37530

Dagum Gini Coefficient

Mega-region	GDP Per Capita	GDP total	Population	Built up area	Infrastructure investment Per Capita	Governmental expenditures Per Capita	Nighttime light	Regional transportation land	Tertiary Industry income total	Higher education students	Patent Per Capita
BTH	0.03460	0.35877	0.18630	0.23719	0.50118	0.11199	0.07729	0.06894	0.50819	0.38217	0.33219
YRD	0.02065	0.10846	0.12964	0.01645	0.06609	0.03042	0.04911	0.17494	0.20450	0.29156	0.02656
GBA	0.08171	0.36719	0.24309	0.06825	0.00000	0.00000	0.02861	0.33833	0.46690	0.50525	0.04831
CC	0.05397	0.49522	0.39429	0.45617	0.07396	0.00983	0.42228	0.44712	0.55396	0.60711	0.22267
MYR	0.03951	0.25766	0.14135	0.15899	0.24703	0.00233	0.17194	0.08869	0.30507	0.48541	0.18325
SD	0.03552	0.18474	0.04577	0.04865	0.35915	0.02596	0.03041	0.13549	0.23840	0.24523	0.18212
WTS	0.07606	0.04933	0.03474	0.02614	0.24731	0.00817	0.01939	0.00962	0.20495	0.22590	0.11718
CP	0.02774	0.13882	0.06144	0.08499	0.12400	0.00000	0.05020	0.08589	0.16542	0.37994	0.10914
GZP	0.05963	0.34241	0.21848	0.22079	0.49185	0.00000	0.14301	0.03797	0.44166	0.55519	0.40090
BBG	0.00000	0.12779	0.11783	0.13890	0.28597	0.00000	0.07526	0.23692	0.20290	0.46485	0.12237
HC	0.00000	0.35805	0.27810	0.23809	0.49754	0.00000	0.24580	0.13623	0.42782	0.59341	0.32757
SCLN	0.05603	0.44448	0.32849	0.30571	0.50937	0.00407	0.22834	0.35351	0.47234	0.55967	0.03766
CSX	0.07971	0.24671	0.13830	0.18022	0.29317	-0.01266	0.04910	0.00356	0.35895	0.73740	0.39630

Fig. 6. Core-secondary unevenness in 2023.

Based on this, we argue that secondary cities within Chinese mega-regions still face two main challenges. First, the unevenness factors stemming from their political positioning in the mega-region have clearly intensified and the centrality of cores continues to strengthen. We observe the rise of some “second cores”, such as provincial capitals beyond Shanghai in the Yangtze River Delta, which seems to be partially aligning with the authorities’ vision of a polycentric regional system. However, most secondary cities have not benefited from this trend. From an economic perspective, there has been some alleviation of unevenness in infrastructure investment and government expenditure, signaling a gradual shift toward decentralization, but disparities are still significant. This resembles an “accelerator” effect, promoting cores further ahead and leaving their smaller neighbors behind. Under such conditions, secondary cities face the risk of becoming increasingly *peripheralized* spatially, economically, and politically.

Similarly, the unevenness across the functional positioning indicators remains significant. In all mega-regions, the unevenness in the tertiary sector continues to worsen. Moreover, although some secondary cities have made progress in innovation capacity, the large absolute gap exposes them to the challenge of functional *polarization*: cores dominate high-end economic sectors while holding superior innovation capacity, leading to further concentration of consumer markets, talent, industries, and investment. In parallel, secondary cities face the outflow of development resources and fail to benefit from positive network externalities.

6. Surviving polarization and peripheralization: different roles of secondary cities

The exploration of unevenness between core and secondary cities leads us to define two general challenges, polarization and peripheralization. Building on this, we further reflect on the diversity among secondary cities by examining the roles they play within the mega-regional system, to gain deeper insight into the context-dependent vulnerabilities they encounter in the two unevenness challenges.

As various forms of core-secondary relations have been established, strengthened, and optimized along the mega-regionalization, secondary cities have begun to assume a range of roles, or at least, have been increasingly expected (particularly in spatial planning) to occupy more critical positions. These roles also shape the distinct challenges. In Stage I, they served as agricultural suppliers to industrializing cores. In Stage II, they gradually evolved into resource-based supporters and regional manufacturing anchors, forming the initial foundation for functional complementarity with the core by taking on productive roles that supported the development of high-tech industries, finance, and business services in the cores. In Stage III, they contributed to urban expansion and transportation-logistics development. Finally, in Stage IV, they have been envisioned as sites for the development of leisure, innovation, and commercial sectors, forming more competitive economic networks with core cities.

Building on this, we classify the anticipated roles of secondary cities into eight categories (Table 2). Using data from the Seventh National

Theil Index



Dagum Gini Coefficient



Fig. 7. Changes in core-secondary unevenness from 2006 to 2023.

Table 2
Roles of secondary cities and related proxies.

Expected roles of secondary cities	Related economic sectors as proxies	Data source
Agricultural Providers (Since Stage I)	Agriculture	The Seventh National Population Census (2020)
Resource-Based Supporters (Since Stage II)	Mining industry	
Manufacturing Anchors (Since Stage II)	Electricity and energy	
Urban Expansion Enablers (Since Stage III)	Manufacturing	
Transport & Logistics Nodes (Since Stage III)	Building construction	
Leisure and Daily life Service Hubs (Since Stage IV)	Transportation and logistics service	
Innovation Collaborators (Since Stage IV)	Hospitality and catering	
	Retail business	
	Information industries service	
	Scientific research and high-tech service	
Secondary Business Centers (Since Stage IV)	Real estate, business, and financial sectors	

Census (NBS, 2021), we measure the proportion of employment across different economic sectors to capture each city’s economic profile. To emphasize the core-secondary relations, we calculate the difference in employment proportion between each secondary city and its

corresponding cores across sectors, to reflect their functional complementarity in a straightforward way. We then apply K-means clustering analysis to group the secondary cities. The number of clusters (value of K) is determined using the silhouette coefficient, which is widely regarded as a reliable method (Saputra et al., 2020).

The K-means clustering analysis allows us to identify five distinct types of secondary cities, each characterized by notable differences in economic sector composition compared to their respective core cities. Overall, three economic sectors remain significantly more prominent in cores than in secondary ones (Fig. 8c): leisure and daily life services, high-tech industries, and finance and business services. These are precisely the sectors that, since Stage IV, the authorities has encouraged secondary cities to develop in coordination with core cities for industrial upgrading and competitiveness improving within mega-regions. However, these policy aspirations appear to have fallen short, as these sectors remain the most critical markers distinguishing core and secondary cities.

In addition, we find that across all types of secondary cities, the proportion of agricultural employment is significantly higher than in their corresponding core cities. This suggests that secondary cities continue to play a key role in regional agricultural supply, while also indicating their comparatively lower levels of urbanization.

Among the five types of secondary cities identified through the clustering analysis, we find that Type 3 shows no particular strengths across any specific economic sectors. The gap between these cities and their respective cores appears relatively moderate: they exhibit

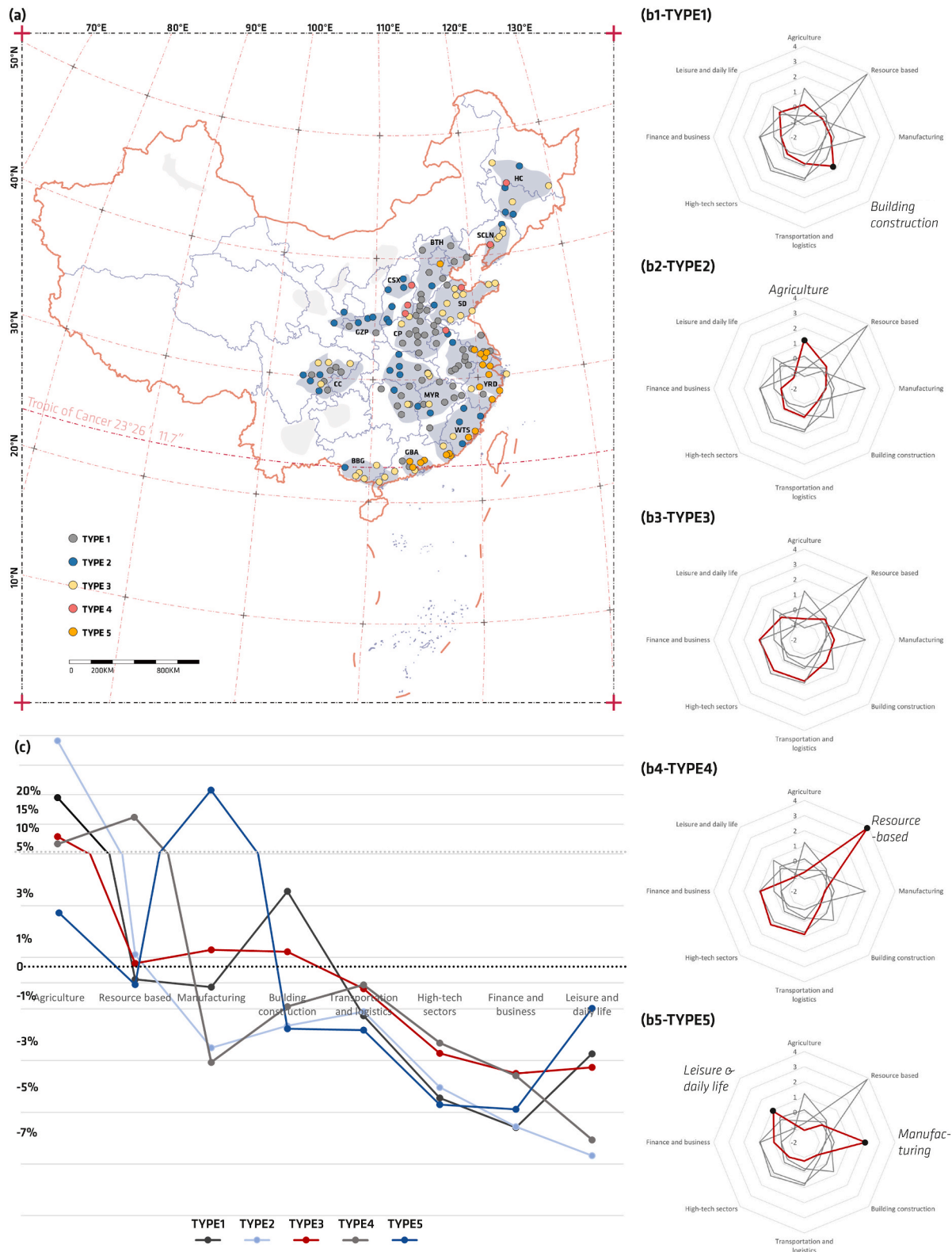


Fig. 8. Typology of secondary cities with distinctive roles (a): distribution of different types of secondary cities; (b): profile of each type based on standardized data; (c): difference of employment in each economic sectors between core and secondary cities.

significantly higher proportion of agricultural employment, lower in leisure and daily life services, high-tech sectors, and finance and business services, while sectors such as manufacturing and building construction are slightly more prominent. This pattern closely aligns with the expected dynamics of core-secondary relations: while core cities

continue to dominate higher-end economic sectors, secondary cities are beginning to gain access to these domains, yet still largely serve as key providers of agricultural and industrial outputs. As such, Type 3 cities can be understood as a benchmark category, reflecting a relatively typical or “balanced” relationship between core and secondary cities

regarding economic sectoral differentiation. Based on this, we focus our discussion on the four other secondary city types that display more distinctive characteristics, aiming to uncover the specific difficulties they may encounter in the broader trends of polarization and peripheralization.

Type 1: Drivers of extensive urban construction (N = 62)

Type 1 includes the largest number of cities, widely distributed across mega-regions such as Beijing-Tianjin-Hebei, Central Plain, Middle Yangtze River, Chengdu-Chongqing, and the northern periphery of the Yangtze River Delta. These cities are most notably characterized by a high proportion of employment in the building construction sector, along with relatively high levels of agricultural employment. However, they lag significantly behind the cores in more profitable sectors such as finance and business services and high-tech industries. This suggests that these cities have primarily played the role of driving extensive urbanization within the mega-regional system, through large-scale urban construction and expansion. Over the past two decades, promoting urbanization has been a key developmental objective set by authorities (Chaolin et al., 2012), and these cities have shouldered a significant share of this responsibility, acting as drivers of urban expansion and spatial development. This is because, on one hand, since Stage III, decentralization of economic development has fostered inter-city competition, while Land-centered development has widely encouraged growth in the building construction sector (Jin et al., 2019; Zhang et al., 2025). On the other hand, these cities are often located in regions anchored by top-tier metropolitan cores such as Beijing, Shanghai, or Chengdu, which, over the past decade, have been pressured to offload developmental burdens to their smaller neighbors. Under such top-down guidance, these cities have largely turned to expanding their building construction industries (Tang & Meng, 2021).

In sum, instead of developing beneficial relations with their cores and transitioning into more profitable economic sectors, these cities have increasingly relied on building construction as their main growth driver, which has brought a certain prosperity, including population growth, social vitality, and development space (see Appendix 2). However, this development path is proving unsustainable. The recent downturn in Chinese real estate sector have disrupted their growth trajectories (Chan et al., 2025), and development resource have begun to polarize toward large cities (Guo et al., 2020). Also, lacking strong competitive advantages in more profitable and high-end sectors, these cities are increasingly peripheralized as the rise of emerging regional cores like Zhengzhou and Wuhan.

Type 2 & 4: Underdeveloped peripheral cities (Type 2, N = 36; Type 4, N = 7)

Type 2 and Type 4 are both categorized as underdeveloped peripheral cities, facing the most severe challenges of polarization and peripheralization. These cities are mostly located on the geographical periphery of mega-regions, for instance, in the southwestern area of Chengdu-Chongqing (e.g., Ya'an), the hilly area of West Taiwan Straits (e.g., Sanming), and the mountainous area in western Middle Yangtze River mega-region (e.g., Jingmen). Type 2 cities exhibit significantly higher agricultural employment than their core cities, while Type 4 cities show a strong reliance on resource-based industries (Fig. 8). These lagging economic structures are accompanied by relatively low political and functional positioning. Consequently, these cities exhibit limited progress in multiple indicators such as population and innovation capacity (see Appendix 2). However, we find that their per capita governmental expenditure is relatively high compared to other types, suggesting that their political positioning may have been elevated in response to the unevenness.

For Type 2, in addition to secondary cities located at the mega-regional peripheries, nearly all cities within Guanzhong Plain and

Central Shanxi mega-regions fall into this group. These two mega-regions exemplify the implementation of the “strong provincial capital” strategy, aiming to cultivate powerful core cities such as Xi'an and Taiyuan. The surrounding secondary cities often experience left-behind in the mega-regionalization process, as political attention and resources tend to concentrate on nearby cores, as in the Guanzhong Plain, Xi'an receives pronounced policy priority (Jaros, 2016). Despite formalized cooperation with Xianyang marked by emerging industrial collaboration platforms, the process remains core-dominated, and has led to talent, investment, and industrial outflows from cities such as Tongchuan and Weinan. Type 4 includes only seven post-industrial cities, such as Changzhi in Central Shanxi and Daqing in Harbin-Changchun mega-regions. These cities served as national heavy industrial hubs during Stage I and II, but have lost competitiveness since the Stage II shifted development focus to opening up and global trade. As a result, they now face the difficulties of industrial decline and developmental shrinkage (Hu et al., 2021), with the search for new growth paths becoming their most urgent concern (Li et al., 2021).

Type 5: Manufacturing-dependent mega-regional pillars (N = 20)

Type 5 cities represent the best performing group of secondary cities. They exhibit a remarkably high share of manufacturing employment. Geographically, they are concentrated in the southeastern coastal mega-regions: Yangtze River Delta, West Taiwan Strait, and Greater Bay Area, which were the key beneficiaries of the national open-door policy during Stage II. Type 5 cities have developed strong partnerships with their corresponding cores. While the cores typically specialize in finance and business services, these secondary cities have taken on the role of regional manufacturing hubs. Through well-established global trade networks, they have achieved substantial economic development based on functional complementarity with the cores (Yeh & Chen, 2020), such as Dongguan (paired with Shenzhen) and Changzhou (paired with Shanghai). These partnerships are often seen as optimal models of intercity collaboration, defined by clear divisions of labor and deeply integrated through regional consumption and global production chains. This synergistic relationship also translates into superior performance in multiple dimensions of political and functional positioning, including economic strength, developmental space, social vitality, and innovation capacity (see Appendix 2). On this basis, secondary cities like Handan and Baoding in the Beijing-Tianjin-Hebei mega-region seek to emulate this trajectory by absorbing manufacturing industries relocated from Beijing to fuel their own future economic growth (Li et al., 2021).

These cities face a potential risk of becoming trapped in low-end industrial lock-in, as they have significant gaps with cores in high-tech sectors and financial and business services. However, we also observe that this group performs significantly better than others in the leisure service sectors. This indicates that, in addition to their manufacturing strengths, these cities have also developed tourism and daily leisure as emerging crucial economic pillars. Cities like Jiaying and Wenzhou have long served as key destinations for tourism consumption by nearby cores (Ruan & Zhang, 2021). In sum, these secondary cities are among the few facing relatively less challenges of polarization and peripheralization. This is largely due to their early gains from national open-door policies and global trade, which laid the foundation for mutually beneficial complementarities with their cores. Our measurements of core-secondary unevenness further confirm this, as these three mega-regions consistently show lower levels of unevenness across almost all dimensions compared to others.

7. Discussion and conclusion

The growing development disparities between cities has increasingly become a bottleneck for Chinese regional development. Mega-regionalization, oriented toward inter-city coordination, is expected to play a stronger role in addressing the unevenness issue. However,

previous research and policymaking have overly focused on the cores, underestimating other smaller but also crucial players. We innovatively introduce the concept of secondary cities to reflect on mega-regional unevenness, by taking the relations between core and secondary cities as primary analytical lens. Based on this, we first construct a conceptual framework grounded in theoretical literature to define and interpret secondary cities within Chinese mega-regional context. These cities are often situated in politically and functionally disadvantaged positions, and as a result, suffer from uneven core-secondary relations in both spatial structures and economic ties. We then examine the historical development and evolution of Chinese mega-regionalization, focusing on how the political and functional positioning of secondary cities has shaped the establishment, strengthening, and optimization of core-secondary relations. This leads us to define four major stages of mega-regionalization, along with the expected roles assigned to secondary cities in each stage. In the final stage, mega-regionalization has evolved from a concept centered on geographic agglomeration into a strategic spatial planning unit for national territorial development: it is a top-down, spatial planning-driven regional governance process initiated by authorities. This process aims to promote multidimensional coordination between core and secondary cities to address the challenges of excessive unevenness.

We further examine the current trend of unevenness by measuring multidimensional development disparities between core and secondary cities regarding political and functional positioning. Using 10 relevant indicators, we find that although the advancement of mega-regionalization has somewhat alleviated overall unevenness, secondary cities still face pronounced challenges of peripheralization and polarization. Most smaller cities remain politically marginalized within the mega-regional system, where development is still dominated and directed by the cores (Li & Wu, 2020). Functionally, cores also dominate high-tech and more profitable economic sectors, serving as powerful magnets for investment, industry, and talent. In contrast, secondary cities often face the outflow of development resources.

Building on this, we adopted a typological approach to explore the specific roles of secondary cities by measuring differences in economic structure between cores and secondary cities. We identify three major types of secondary cities based on their developmental conditions and vulnerabilities facing unevenness challenges. First, drivers of extensive urban construction, which exhibit significant high proportion of employment in the building construction sector. Their heavy dependence on land-driven development has weakened their competitiveness in higher-end sectors. Second, underdeveloped peripheral cities, which are either characterized by high agricultural employment, indicating under-industrialization, or reliant on resource-based industries, signaling lagging economic structures and urgent transformation pressures. Third, manufacturing-dependent mega-regional pillars, represent more optimistic cases. These cities are often seen as exemplary models of positive core-secondary relations. They benefited early from national open-door policies and gradually established clear functional divisions with their cores, supporting them as regional manufacturing bases while the cores focus on finance and business services. Additionally, these cities become destinations for regional leisure and tourism, reflecting a more diversified economic structures and a stronger attractiveness within mega-regions.

In the global context, regionalization is primarily a governance process (Harrison & Hoyler, 2015). Globalization have driven localities to integrate resources, prompting cities and regions to enhance intra-regional cooperation to attract investment, talent, and industries for greater competitiveness. Market dynamics and policy interventions are widely recognized as the key driving forces. Secondary cities, due to their flexibility and close interactions with neighboring cores, are often seen as potential beneficiaries (Szapak et al., 2023). This is also evident in Chinese mega-regionalization. During Stage II and Stage III, marketization fostered the formation of mega-regional systems, yet a core-centric development model significantly exacerbated the

developmental gap between core and secondary cities. In Stage IV, the authorities have committed to addressing this challenge by emphasizing core-secondary coordination. Although this has not yet yielded tangible benefits for secondary cities, we argue that it represents a necessary stage for promoting mega-regionalization. Second, the strategic position and potential roles of secondary cities within regional systems have received growing attention. Beyond their traditional functions as manufacturing or resource-based industrial hubs, many secondary cities in Europe have demonstrated more critical roles in promoting social vitality, innovation, and differentiated functional positioning (Mayer, 2022). These capabilities have enabled them to benefit substantially from regionalization. However, our study reveals that Chinese secondary cities have largely failed to achieve such outcomes. Even the best-performing manufacturing-oriented secondary cities in the Yangtze River Delta and Greater Bay Area remain at risk of being locked into low-end industrial trajectories. Third, the development of polycentric regional systems is widely considered a promising strategy for alleviating unevenness (Burger et al., 2014a). The Randstad urban region in the Netherlands is frequently cited as a successful example, illustrating how inter-city interactions can promote a more efficient, competitive, and balanced regional system (Burger et al., 2014b). This is also the long-term goal of Chinese mega-regionalization. However, the path dependency on the growth pole model prioritizing cores has reinforced a monocentric development trajectory, exposing secondary cities to intensifying challenges of polarization and marginalization.

Therefore, this study highlights secondary cities as a critical lens through which to examine the persistent unevenness within Chinese mega-regionalization. On one hand, it offers a deeper reflection on the root causes of such unevenness, namely, the weak political and functional positioning, which makes them particularly vulnerable to polarization and peripheralization. This perspective challenges the traditionally core-centric discourse, calling for greater scholarly and policy attention to these smaller yet equally significant actors. On the other hand, it enables a more nuanced understanding of the specific challenges secondary cities face within this uneven system, shedding light on their roles and the constraints they encounter in navigating mega-regionalization.

Based on the findings, we propose the following three policy recommendations. First, policy-making should shift toward the perspective of secondary cities. Nearly all secondary cities face different types of unevenness: Type 1 cities rely heavily on land-driven development; Type 2 and Type 4 cities face lagging economic structures; and Type 5 cities risk being locked into low-end manufacturing. These challenges suggest that planning solely from the perspective of cores is insufficient to achieve coordinated regional development. Reframing spatial governance through the lens of more vulnerable cities can help identify existing blind spots and biases in regional policy design. Second, mega-regionalization remains a promising spatial strategy. In particular, Type 5 cities exemplify how regionalization can foster functional complementarity with core cities. This demonstrates the value of continuing efforts in infrastructure integration, inter-city collaboration, and open market. Third, we advocate for differentiated strategies considering the distinct characteristics of secondary city types. For Type 1 cities, the focus should shift from land-driven urban expansion to upgrading toward high-value-added industries. For Type 2 and Type 4 cities, targeted fiscal support, industrial support, and talent attraction policies are needed to strengthen their political and functional positioning. For Type 5 cities, it is crucial to prevent stagnation in low-end manufacturing by fostering growth in advanced services and high-tech sectors, while also leveraging their emerging strengths in leisure and tourism industries.

This study focuses on the conceptualization and typological identification of “secondary cities” within the context of Chinese mega-regionalization, aiming to provide a macro-level portrait of their spatial-economic characteristics and the diverse challenges they face. While we offer a solid conceptual framework and an overall understanding on secondary cities, two key limitations remain. First, the study

does not delve into the specific developmental trajectories, policy implementations, or governance barriers of individual secondary cities within the mega-regionalization process, leaving a gap in understanding how top level policies are functioning on the ground. Second, although we identify the unevenness challenges faced by secondary cities, we have yet to systematically explore the underlying causal mechanisms, particularly why mega-regionalization has failed to effectively alleviate core-secondary disparities. In light of these limitations, we propose two directions for future research: conducting in-depth case studies to examine how local stakeholders implement under national policy frameworks in diverse regional contexts; and employing causal inference approaches to systematically uncover the internal mechanisms driving the evolution of unevenness between core and secondary cities. This will further enhance our understanding of the logic behind mega-regional governance and the effectiveness at local scale towards core-secondary coordination.

CRedit authorship contribution statement

Yizhao Du: Writing – review & editing, Writing – original draft,

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.habitatint.2025.103619>.

Appendix

Visualization, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Rodrigo V. Cardoso:** Writing – review & editing, Funding acquisition, Conceptualization. **Roberto Rocco:** Writing – review & editing, Funding acquisition, Conceptualization.

Declaration of competing interest

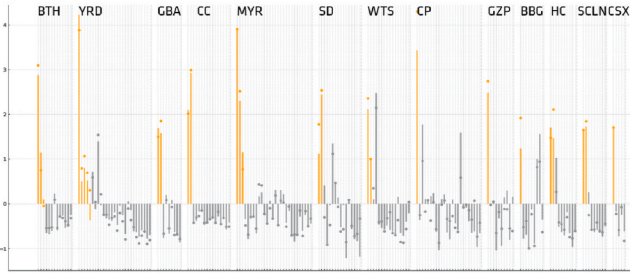
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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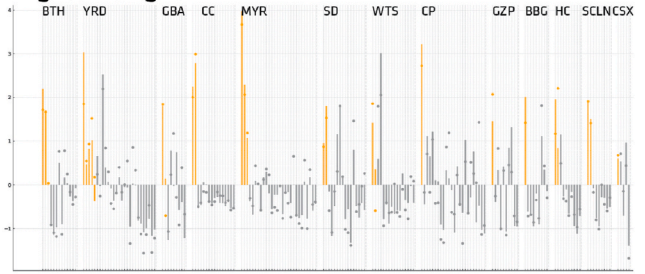
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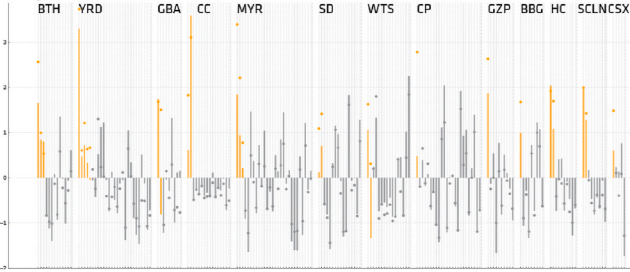
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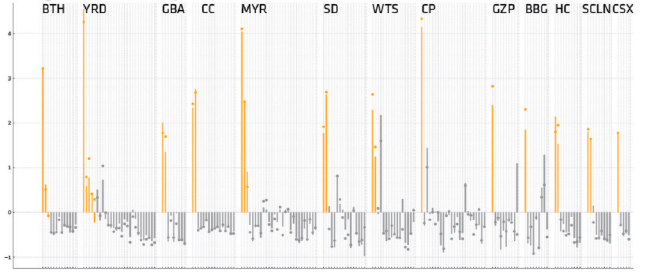
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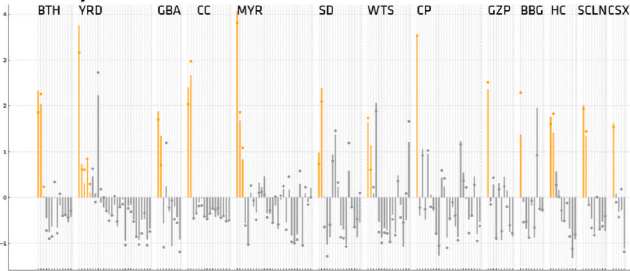
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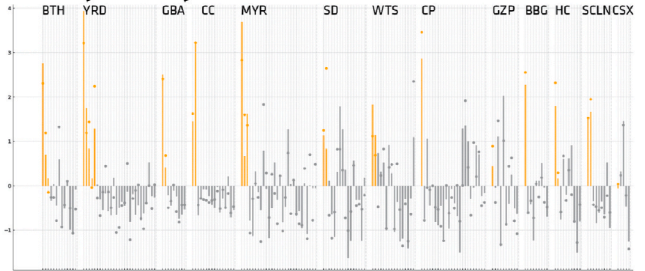
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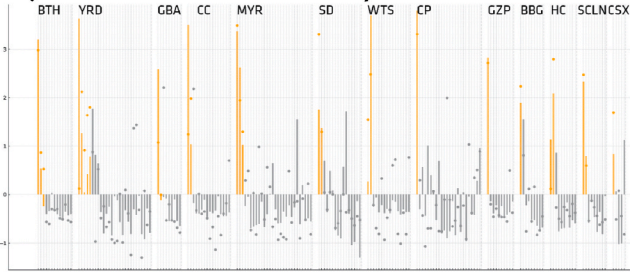
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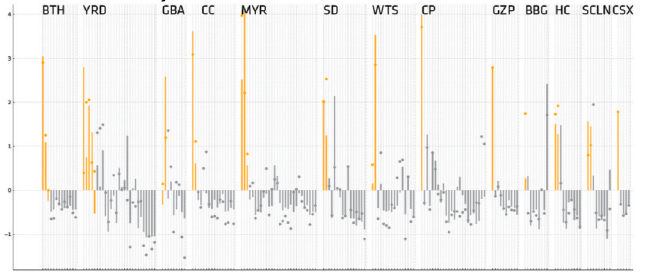
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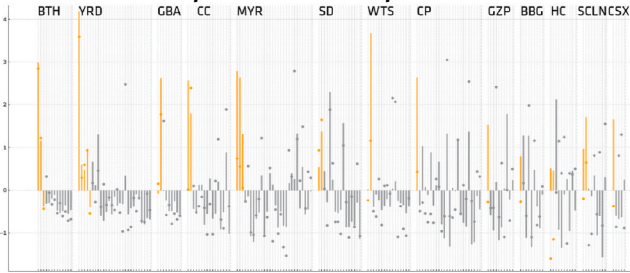
Infrastructure investment Per Capita



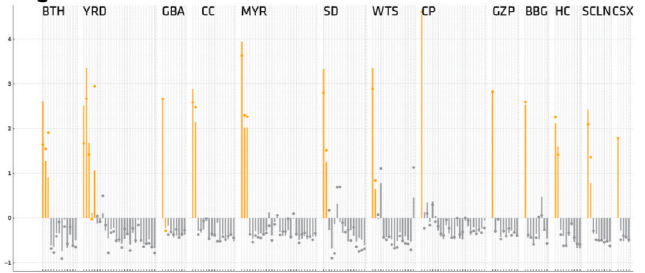
Patent Per Capita



Governmental expenditures Per Capita



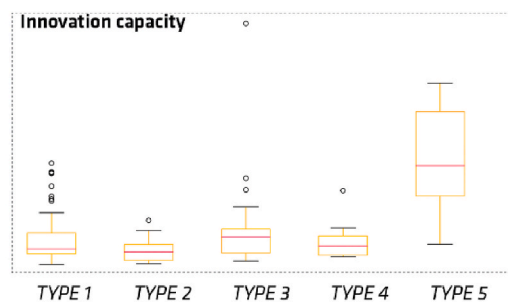
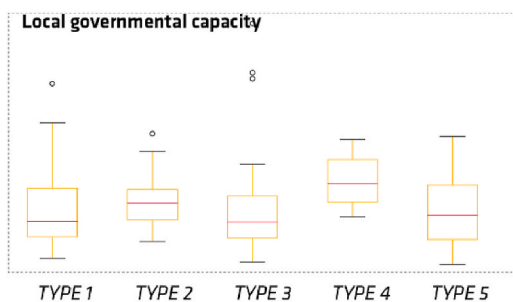
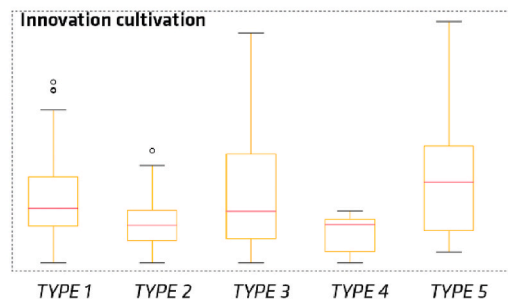
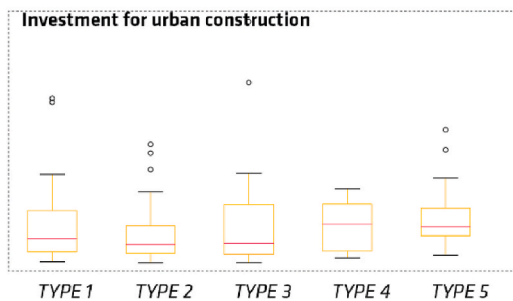
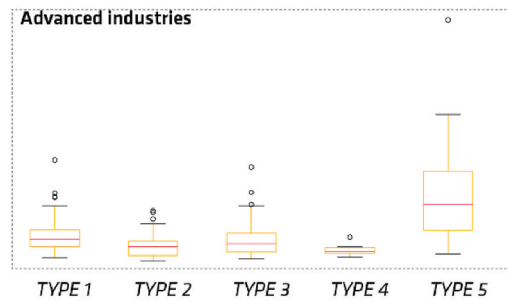
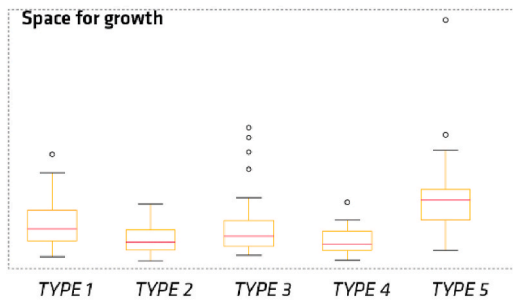
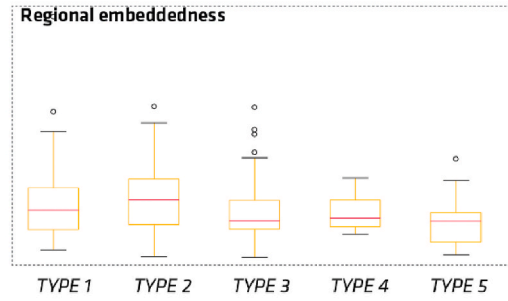
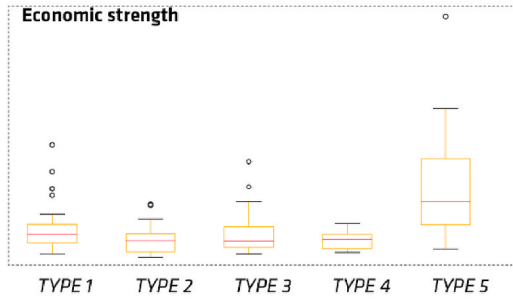
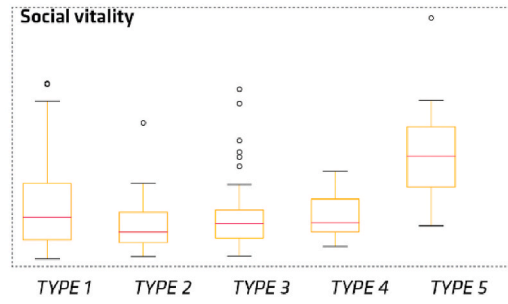
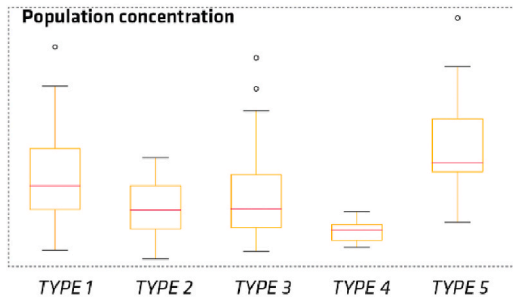
Higher education students



Appendix 1. Comparison of core-secondary political and functional positioning
 Note: Yellow columns/dots represent cores, grey ones represent secondary cities.
 Columns represent 2006, dots represent 2023.

Political positioning

Functional positioning



Appendix 2. Comparison across different types of secondary cities

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