Methodologies and metrics for analysing urban economic resilience in China

A systematic literature review

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1 Introduction

Urban economic resilience, defined as a city's capacity to withstand, adapt to, and recover from external economic shocks while maintaining stability and fostering growth, is increasingly recognized as a critical dimension of urban resilience (X. Zhang & Li, 2018). The importance of this concept is officially recognized in China's national policy agenda. In 2021, the "Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035" introduces, for the first time, the goal of building resilient cities, signalling a shift toward a more structured approach to resilience planning at the national level (Xinhua News Agency, 2021). Despite the extensive focus on ecological and social resilience in existing literature, economic resilience remains comparatively underexplored. This systematic literature review addresses this gap by examining the methodologies and economic metrics used to assess urban economic resilience in China.

Rather than assessing the effectiveness of specific methodologies, this review focuses on mapping the research landscape. By analysing and comparing diverse methods and metrics, it highlights key trends in the field, identifies frequently used economic indicators, and explores variations in methodological approaches. Through this, the review provides a comprehensive overview of the tools and frameworks employed in the study of urban economic resilience. China provides a particularly compelling case study for this review due to its unparalleled economic transformation and rapid urbanization over the past few decades. The relatively rising nature of economic resilience research is reflected in the temporal scope of the studies reviewed, with most published within the last five years, though some draw on economic data spanning up to two decades. The review examines the methods and metrics, temporal trends, and thematic focuses that define this emerging field.

Beyond mapping the current state of research, this review also identifies significant gaps in the literature. Notably, areas such as the integration of environmental metrics, localized analyses, and the use of geospatial data remain underexplored. By pinpointing these gaps, the review provides a roadmap for future research. These findings hold practical implications for researchers, urban planners, and policymakers, offering insights to refine existing methodologies and inspiring the development of innovative approaches for analysing economic resilience in diverse urban contexts.

2 Methods

This review applies clear inclusion and exclusion criteria to maintain the relevance and consistency of the selected studies. Peer-reviewed articles from Scopus and Web of Science are chosen due to their comprehensive coverage of academic literature. The review focuses exclusively on studies written in English to ensure consistency in analysis. Additionally, the studies included are required to examine urban economic resilience within the context of China, with an emphasis on the economic metrics and methodologies employed in resilience assessments. While no strict publication date range is enforced, most of the included studies are published within the past five years due to the emerging nature of the topic.

2.1 Data Collection

The literature search was conducted in January 2025 using Scopus and Web of Science as primary sources. These databases are selected for their strong coverage of research on urban resilience, economics, and spatial analysis. Grey literature and conference proceedings were excluded from consideration.

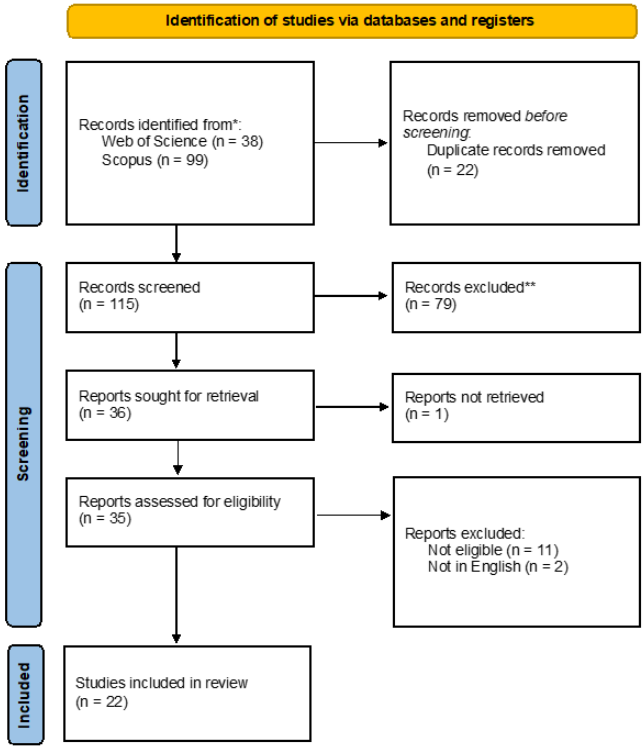
A structured search strategy was employed using keyword-based queries related to economic resilience, urban economies, analytical methods, and metrics. The final search queries were as follows:

Scopus:

TITLE-ABS-KEY (“economic resilience” OR “urban resilience” OR “regional resilience”) AND TITLE-ABS-KEY (“urban economy” OR “city economy” OR “metropolitan economy” OR “urban areas”) AND TITLE-ABS-KEY (methods OR “data sources” OR indicators OR metrics OR measurement) AND TITLE-ABS-KEY (China)

Web of Science:

TS=(“economic resilience” OR “urban resilience” OR “regional resilience”) AND TS=(“urban economy” OR “city economy” OR “metropolitan economy” OR “urban areas”) AND TS=(methods OR “data sources” OR indicators OR metrics OR measurement) AND China



*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all database/registers

** If automation tools were used, indicate how many records were excluded by a human and now many were excluded by automation tools

Figure 1: PRISMA flow diagram showing the screening process from 137 initial records to 22 studies included in the review (adapted from Page et al., 2021)

These queries ensured that the retrieved studies explicitly addressed economic resilience within the context of Chinese urban economies and contained relevant methodological discussions.

2.2 Selection Process

To efficiently manage the screening process, all search results were imported into Zotero, where duplicate removal was performed automatically, reducing the dataset to 115 unique papers. The selection process consisted of two stages:

1. Title and Abstract Screening: With Zotero's tagging features, studies were categorized as "Irrelevant" (63 papers), "Possibly Relevant" (16 papers), or "Highly Relevant" (36 papers), ensuring a structured and organized workflow. Studies were classified as "Highly Relevant" if the title or abstract contained hints on economic resilience, quantitative economic metrics, and outlined a clear methodological approach. Papers lacking a methodological focus or urban resilience analysis were excluded.

2. Full-Text Review: The 36 selected papers underwent a full-text review, refining the dataset to 22 studies that met all inclusion criteria. These studies represent a diverse but methodologically coherent body of work on urban economic resilience in China.

2.3 Data Extraction

A structured approach was implemented to handle the variety of methodological frameworks and economic indicators present in urban resilience research, ensuring consistency and enabling comparative analysis. Key details such as study area, timeframe, economic metrics, methods, publication year, and authorship were highlighted and annotated to capture the essential elements for subsequent analysis. Individual annotations were assigned keywords to create a systematic structure for note-taking and ensure critical details were consistently documented.

To streamline data management, the annotations were transformed into YAML (Yet Another Markup Language), a format well-suited for organizing hierarchical data (YAML Language Development Team, 2021). Using a large language model (LLM), the annotations were integrated into a predefined YAML structure. This structured format allowed for seamless querying and further analysis in Python, enabling efficient exploration of the collected data.

ID	Author	Method Category	Metric Category	Timespan
1	Chen et al., 2023	Weighting Models; Theory-based Methods; Index-based Methods	Social & Living Standards; Population & Employment; Economic & Investment; Industrial & Structural; Technology & Innovation	2010 - 2020
2	Fu et al., 2023	Index-based Methods; Spatial Analysis Tools; Regression and Mediation Models	Economic & Investment; Finance & Revenue; Industrial & Structural; Retail & Consumption; Social & Living Standards	2020
3	Ge et al., 2024	Weighting Models; Index-based Methods; Coupling Coordination Models	Industrial & Structural; Finance & Revenue; Economic & Investment; Retail & Consumption; Social & Living Standards	2012 - 2021
4	Han et al., 2023	Weighting Models; Coupling Coordination Models	Economic & Investment; Industrial & Structural; Finance & Revenue; Social & Living Standards; Retail & Consumption	2005 - 2020
5	He et al., 2023	Regression and Mediation Models	Economic & Investment; Social & Living Standards; Miscellaneous & Others; Population & Employment; Retail & Consumption; Finance & Revenue; Technology & Innovation; Industrial & Structural; Urban & Infrastructure	2004 - 2017
6	Lin et al., 2022	Weighting Models; Coupling Coordination Models	Economic & Investment; Finance & Revenue; Industrial & Structural; Technology & Innovation; Population & Employment; Social & Living Standards	2008 - 2017
7	H. Lu et al., 2022	Network and Optimization Models; Weighting Models; Density Estimation; Spatial Analysis Tools	Economic & Investment; Social & Living Standards; Finance & Revenue; Retail & Consumption; Industrial & Structural	2015 - 2019
8	R. Lu & Yang, 2023	Weighting Models; Network and Optimization Models; Spatial Analysis Tools	Economic & Investment; Population & Employment; Retail & Consumption; Urban & Infrastructure; Environment & Resources; Technology & Innovation; Social & Living Standards	2013 - 2020
9	F. Ma et al., 2020	Weighting Models; Distance and Similarity Measures	Economic & Investment; Finance & Revenue	2009 - 2016
10	X. Ma & Jia, 2024	Weighting Models; Density Estimation; Inequality and Efficiency Measures; Spatial Analysis Tools	Miscellaneous & Others; Industrial & Structural; Social & Living Standards; Economic & Investment; Population & Employment; Finance & Revenue; Environment & Resources; Urban & Infrastructure; Retail & Consumption; Technology & Innovation	2006 - 2021
11	Tan et al., 2017	Statistical Tests; Theory-based Methods	Industrial & Structural; Finance & Revenue; Environment & Resources; Social & Living Standards; Economic & Investment; Population & Employment; Miscellaneous & Others; Technology & Innovation	2003 - 2013
12	B. Tang & Tan, 2022	Weighting Models; Index-based Methods	Economic & Investment; Social & Living Standards; Industrial & Structural; Finance & Revenue	2010 - 2020
13	D. Tang et al., 2023	Weighting Models; Visualization Tools	Economic & Investment; Finance & Revenue; Industrial & Structural; Retail & Consumption	2010 - 2019
14	J. Wang & Zhou, 2024	Theory-based Methods; Weighting Models; Inequality and Efficiency Measures; Coupling Coordination Models	Urban & Infrastructure; Population & Employment; Finance & Revenue; Economic & Investment; Industrial & Structural; Retail & Consumption; Technology & Innovation; Miscellaneous & Others	2003 - 2021
15	K.-L. Wang et al., 2023	Weighting Models; Regression and Mediation Models	Economic & Investment; Finance & Revenue; Industrial & Structural	2003 - 2019
16	Xu et al., 2022	Fuzzy-based Methods; Coupling Coordination Models	Economic & Investment; Industrial & Structural; Social & Living Standards; Population & Employment; Urban & Infrastructure; Finance & Revenue	2019
17	Xun & Yuan, 2020	Fuzzy-based Methods; Distance and Similarity Measures; Weighting Models	Economic & Investment; Industrial & Structural; Finance & Revenue; Social & Living Standards; Technology & Innovation	2013 - 2017
18	Yang & Wang, 2024	Weighting Models	Social & Living Standards; Economic & Investment; Finance & Revenue; Urban & Infrastructure; Industrial & Structural; Technology & Innovation; Miscellaneous & Others	2005 - 2021
19	H. Yu et al., 2018	Weighting Models; Distance and Similarity Measures; Density Estimation; Miscellaneous	Population & Employment; Industrial & Structural; Miscellaneous & Others; Urban & Infrastructure; Economic & Investment; Finance & Revenue; Social & Living Standards; Technology & Innovation; Environment & Resources	2004 - 2016
20	Y. Yu et al., 2024	Statistical Tests; Regression and Mediation Models	Economic & Investment; Finance & Revenue; Industrial & Structural; Miscellaneous & Others	2002 - 2018
21	M. Zhang et al., 2019	Weighting Models; Spatial Analysis Tools	Finance & Revenue; Population & Employment; Industrial & Structural; Social & Living Standards; Economic & Investment; Retail & Consumption	2006 - 2017
22	Y. Zhang & Li, 2024	Weighting Models; Coupling Coordination Models; Index-based Methods	Economic & Investment; Retail & Consumption; Industrial & Structural; Finance & Revenue	2010 - 2021

Table 1: Overview of the 22 reviewed studies, including methodological categories, metric categories, and temporal scope.

2.4 Data Cleaning and Standardizing

Once extracted, the data underwent a cleaning and standardisation process to resolve inconsistencies. A controlled vocabulary was established for both economic metrics and methodological approaches, ensuring that equivalent terms were grouped under standardised labels. As a result, the 201 extracted metrics were reduced to 129 distinct indicators, which were further categorised into 10 thematic clusters. Similarly, the 66 identified methods were refined into 45 unique analytical techniques, organised into 14 methodological groups. This structured approach transformed the dataset into an organised and queryable resource, forming the foundation for subsequent analyses. Table 1 provides an overview of the reviewed studies, showing the methodological categories applied, the types of metrics used, and the temporal scope of analysis. The table consolidates the cleaned dataset into a clear and accessible format.

2.5 Methodological Analysis

A structured computational approach was used to analyse the methodologies and economic metrics used in urban economic resilience research. The data was processed using Python scripts, enabling efficient categorization, visualization, and network analysis. The methodological analysis was divided into descriptive and network analysis.

2.5.1 Descriptive Analysis

The first step involved quantifying the distribution of methods and economic metrics across the selected studies. The YAML dataset was parsed to extract frequency distributions of key methodological approaches and indicators. Using Python's Counter library, the frequency of individual methods, method categories, metrics, and metric categories was computed.

Temporal coverage was examined by extracting timeframes used in each study, calculating average timespans, and assessing the number of economic metrics used per study to determine the depth of methodological frameworks. Additionally, the analysis examined the co-occurrence of methods and metrics to identify overlaps across different methodological frameworks and metrics, as well as to highlight dominant clusters within these categories.

2.5.2 Network Analysis

To uncover relationships between methods and economic metrics, a network-based approach was applied. Using NetworkX, bipartite graphs were constructed, linking studies with the methods and metrics they employed (Hagberg et al., 2008). A projected graph of studies was then created, where edges between papers indicated shared methodological approaches. The Louvain community detection algorithm was applied to identify clusters of studies with similar profiles (Blondel et al., 2008). Network diagrams were generated, where node size represented frequency and colour intensity indicated connectivity. These visualizations illustrated interconnections between research themes and methodological diversity in urban economic resilience studies.

3 Results

Given the number of studies included in this review, inline citations were mostly omitted in this section to maintain readability, as frequent references to multiple sources in a single sentence would have made the text cumbersome. Instead, findings are synthesized and structured based on overarching trends, highlighting dominant methodological approaches and the distribution of economic metrics. All relevant information, including specific study details, is provided in the corresponding table and on GitHub.

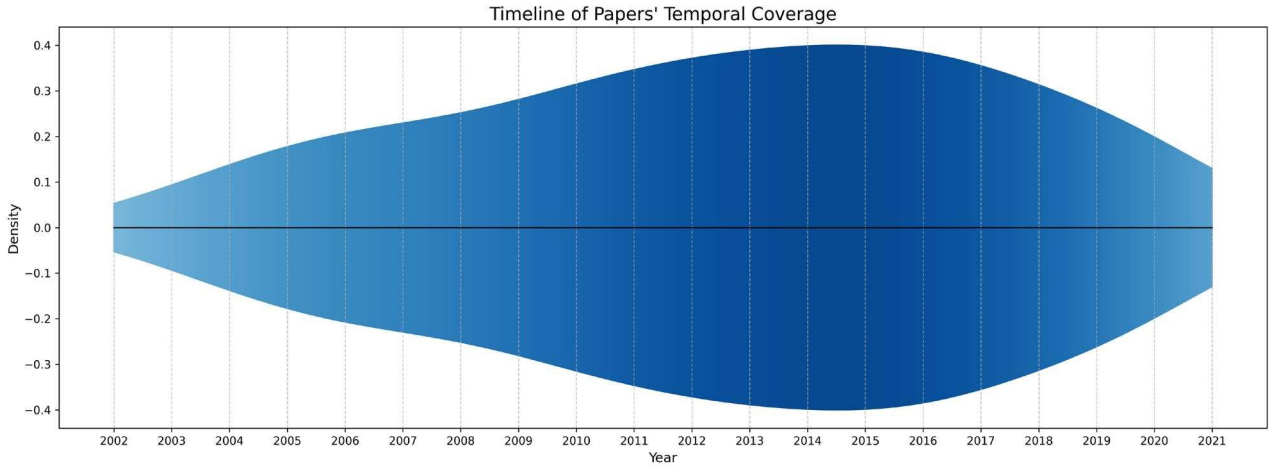


Figure 2: Timeline of papers' temporal coverage, showing a clear concentration between 2008 and 2019.

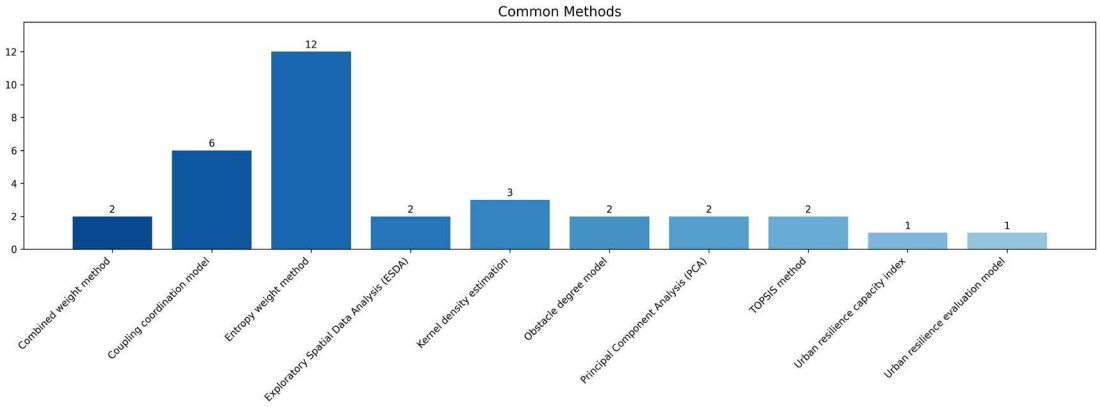


Figure 3: Common methods used in the reviewed studies, highlighting the predominance of weighting models and coupling coordination models.

3.1 Descriptive Analysis

The descriptive analysis explored the distribution of metrics and methods across the selected studies to identify research focus areas and prevailing trends in urban economic resilience. On average, each study employed 10.45 unique metrics, illustrating the multidimensional nature of resilience research. Examples of individual metrics include GDP per capita, fixed asset investment, urban per capita disposable income, and education expenditure, each counted as one indicator within the analysis. The temporal coverage of the studies, shown in Figure 2, was concentrated between 2008 and 2019, a period marked by China's rapid urbanisation and economic transformation. On average, the analysed cases spanned 12.10 years, highlighting the field's growing attention during this decade.

3.1.1 Methods Distribution

The analysis identified 45 distinct methods applied across the selected studies, categorized into 14 methodological groups. Among these, weighting models were the most frequently utilized, appearing in 17 studies. Within this category, the entropy method was the most prevalent, used in 12 out of 22 studies, making it the most widely applied technique overall. This dominance is clearly visible in Figure 3, which shows the most common methods employed across the reviewed studies, with entropy weighting standing out as the central technique. The method proved particularly effective in assigning weights to various metrics, ensuring that indicators were represented according to their relative significance. Studies employing composite indices or those prioritising specific dimensions of urban economic resilience frequently relied on this approach.

Coupling coordination models, featured in six studies, constituted another significant category. These models analysed interdependencies and synergies among various subsystems, such as economic, social, and environmental components. Their application was especially valuable in understanding how different systems interact dynamically to influence overall resilience. For example, coupling coordination models often assessed the balance between economic development and structural transformation in urban areas, offering insights into the interconnected nature of resilience.

Index-based methods were identified in five studies and were primarily employed to aggregate metrics into composite indices that provided a holistic measure of resilience. These methods played a crucial role in studies aiming to synthesize multidimensional data into a single, interpretable score. Additionally, spatial analysis tools, such as kernel density estimation and Exploratory Spatial Data Analysis (ESDA), were utilized in five studies. These tools were particularly useful for identifying geographic patterns and clusters, enabling researchers to map spatial variability in resilience metrics. Regression and mediation models, appearing in four studies, explored causal relationships, such as the impact of economic investment on recovery rates following external shocks, providing statistical evidence to support interpretations of resilience drivers.

The relationships between methodological categories revealed important patterns of co-occurrence. Figure 4 illustrates how different methods were combined within the studies, with weighting models frequently appearing alongside other techniques, underscoring their adaptability and foundational role in resilience analysis. The most prominent pairing was the combination of weighting models with coupling coordination models, observed in five studies. In these cases, the entropy method was often used to assign weights to metrics, which were then analysed through coupling coordination models to assess dynamic interactions between subsystems. This integration offered a comprehensive approach, combining quantitative weighting with a systems-based perspective.

Index-based methods and weighting models co-occurred in four studies, with weighting models playing a critical role in constructing indices by standardizing and prioritizing metrics to ensure composite scores accurately reflected

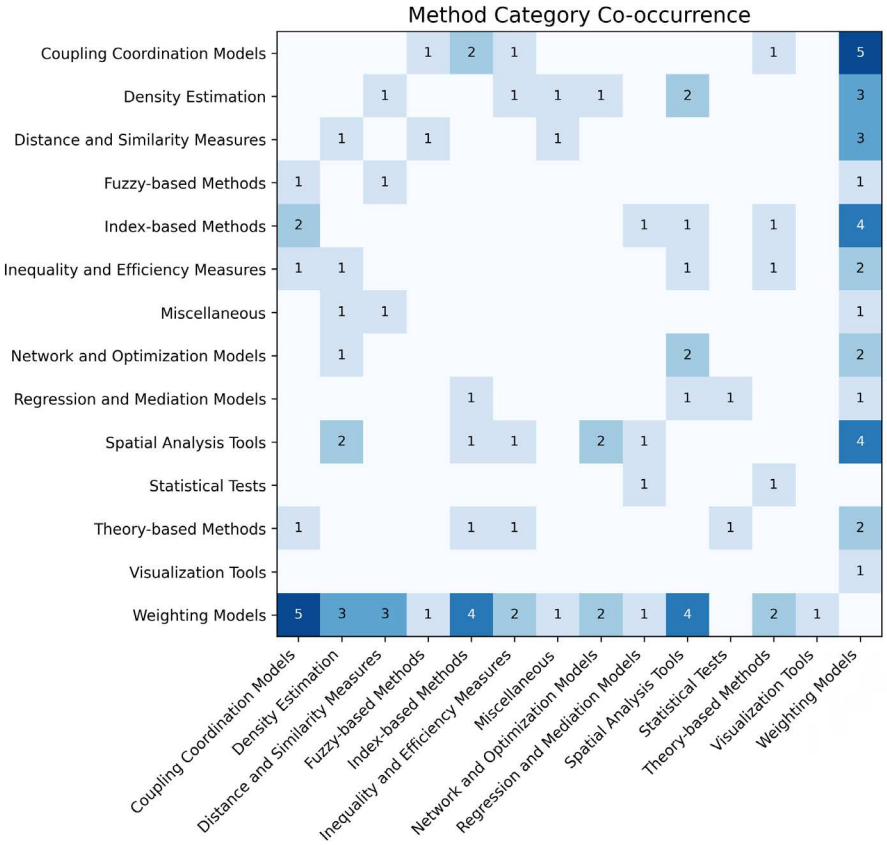


Figure 4: Method category co-occurrences across the reviewed studies, showing frequent pairings of weighting models with coupling coordination, index-based, and spatial analysis approaches.

component significance. Similarly, spatial analysis tools and weighting models were frequently combined, appearing together in four instances. In these cases, spatial tools were used to map resilience indices derived from weighted metrics, enabling visual interpretation of geographic disparities. Other notable pairings included density estimation methods with weighting models in three studies, facilitating spatial distribution analyses of weighted metrics. Additionally, network and optimization models occasionally co-occurred with spatial analysis tools, as seen in two studies, where these methods were used to model spatial aspects of network structures, such as transportation or resource flows.

3.1.2 Metrics Distribution

The analysis identified 129 unique metrics, categorized into ten thematic groups, offering a comprehensive view of their focus and significance in urban economic resilience research. As shown in Figure 5, economic, industrial, and financial indicators dominate, while environmental and infrastructural dimensions are comparatively underrepresented. This imbalance underscores the strong focus on growth and fiscal stability, alongside a gap in integrating sustainability and infrastructure considerations.

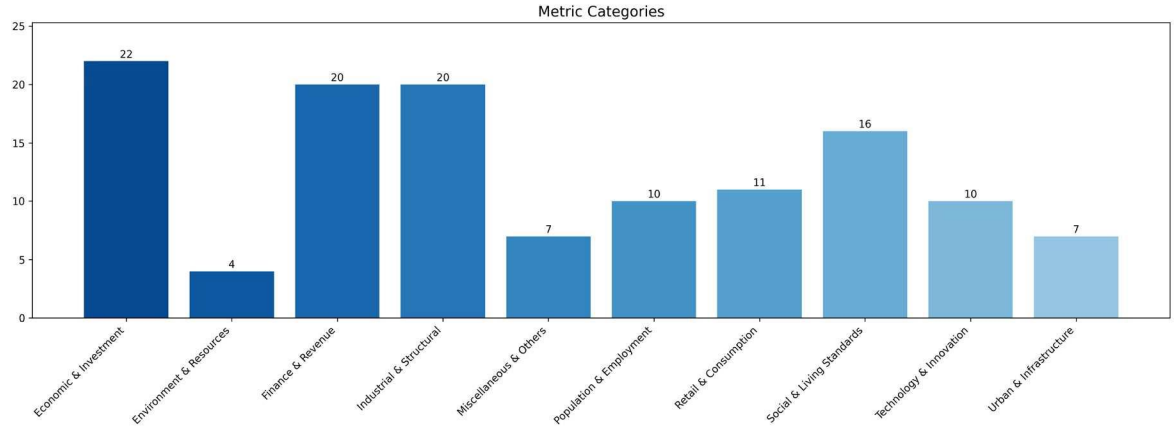


Figure 5: Number of metrics per category, showing the dominance of economic, financial, and industrial indicators, with environmental and infrastructural dimensions underrepresented.

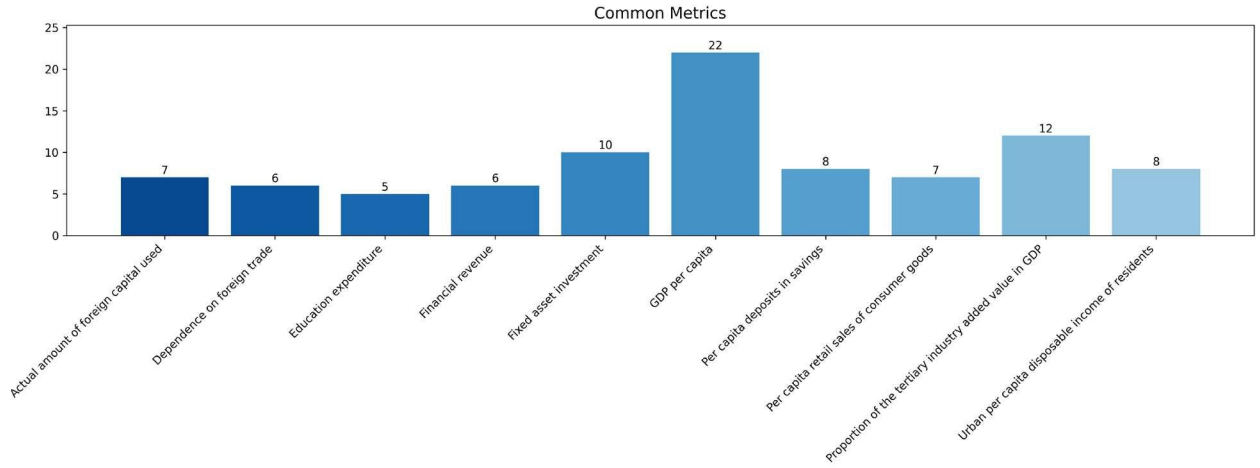


Figure 6: Most frequently used individual metrics across the reviewed studies, highlighting GDP per capita as a central measure of resilience.

The Economic & Investment Metrics category dominated the research landscape, encompassing 22 unique metrics. Indicators such as GDP per capita, cited 22 times across the studies, and fixed asset investment, mentioned 10 times, highlighted the central role of economic growth and infrastructure development in resilience assessments. As illustrated in Figure 6, these metrics were consistently employed, underscoring their importance as foundational measures of urban economic performance.

The Industrial & Structural Metrics category, comprising 20 metrics, focused on structural transitions, particularly the expansion of service-oriented economies. Metrics such as the proportion of tertiary industry added value in GDP (12 mentions) reflected the critical role of structural modernization in enhancing resilience. Similarly, the Finance & Revenue Metrics category, also containing 20 unique metrics, underscored the importance of fiscal health and financial stability. Metrics such as per capita deposits in savings (8 mentions) and financial revenue (6 mentions) demonstrated the reliance of urban resilience on sound financial systems.

Social & Living Standards Metrics, featuring 16 unique indicators, captured the socio-economic dimensions of resilience. Indicators such as urban per capita disposable income (8 mentions) and education expenditure (5 mentions) emphasized the significance of societal well-being in fostering resilience. In contrast, Environment & Resources Metrics and Urban & Infrastructure Metrics were underrepresented, containing only 4 and 7 metrics, respectively. This disparity highlights a gap in integrating environmental sustainability and infrastructure development into resilience research, despite their acknowledged importance in urban systems.

The temporal distribution of common metrics from 2017 to 2024, shown in Figure 7, reveals evolving research priorities and external influences shaping urban resilience

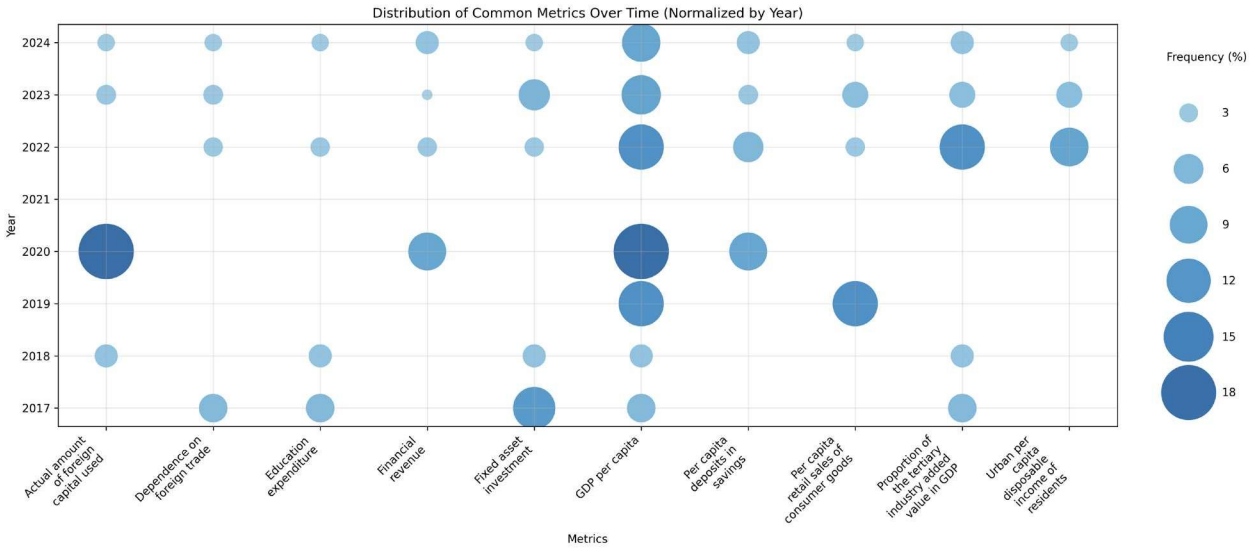


Figure 7: Temporal distribution of common metrics normalized from 2017 to 2024, with peaks in 2020 reflecting the heightened emphasis on economic recovery and structural adaptation during the COVID-19 pandemic.

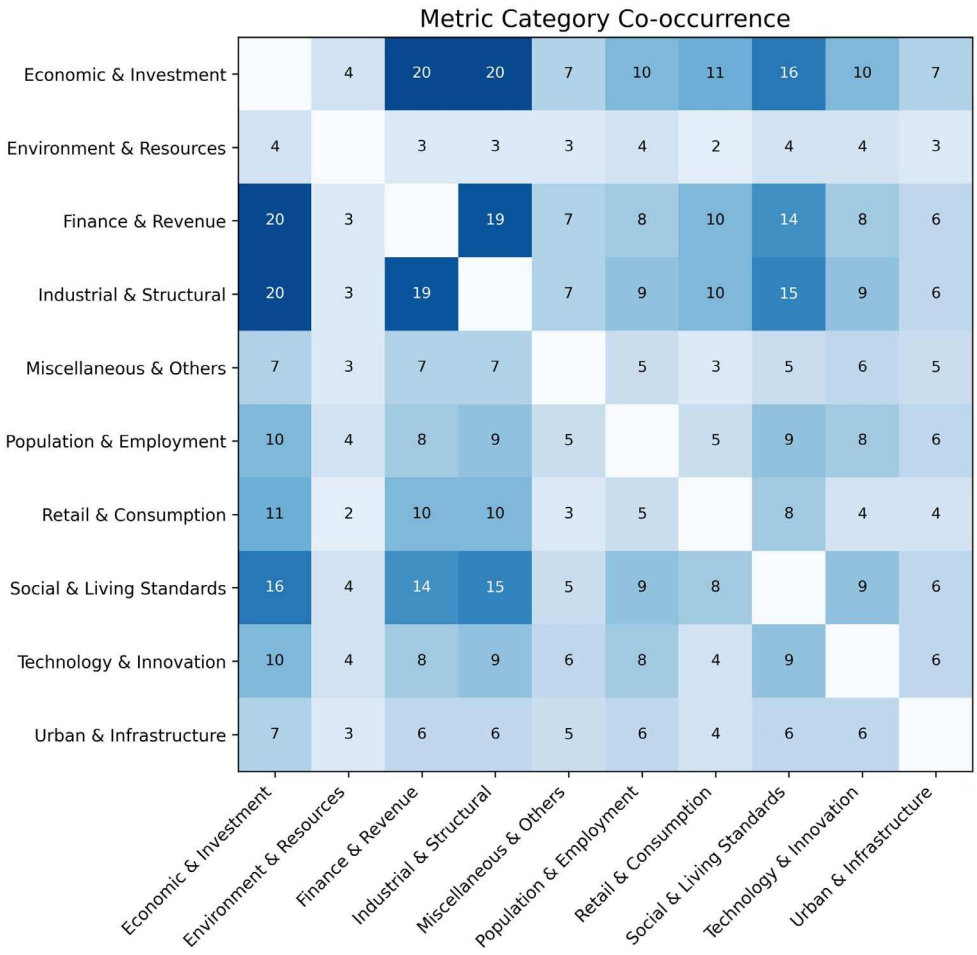


Figure 8: Metric category co-occurrences across the reviewed studies, illustrating strong interconnections between economic, industrial, financial, and social dimensions.

studies. Metrics like GDP per capita and the proportion of tertiary industry added value in GDP exhibited consistent use throughout the timeframe, reflecting their foundational status in resilience research. These metrics peaked in usage during 2020, coinciding with global economic disruptions caused by the COVID-19 pandemic. This surge suggests that resilience research during this period prioritized economic recovery and structural adaptation. Other metrics, such as education expenditure and dependence on foreign trade, were used more sporadically, reflecting their secondary importance compared to economic and financial indicators. The increasing prominence of fixed asset investment in later years indicates a growing recognition of infrastructure's role in resilience, aligning with global priorities on sustainable urban development.

Finally, the analysis of metric co-occurrences in Figure 8 highlighted the interdependencies between metric categories. The most frequent pairing was found between Economic & Investment Metrics and Industrial & Structural Metrics (20 co-occurrences), underscoring the interconnectedness of economic growth and structural transformations in resilience research. Similarly, Economic & Investment Metrics frequently co-occurred with Finance & Revenue Metrics (20 co-occurrences), illustrating the reliance of economic stability on robust financial systems. Other notable pairings included Industrial & Structural Metrics with Social & Living Standards Metrics (19 co-occurrences) and Finance & Revenue Metrics with Social & Living Standards Metrics (16 co-occurrences).

These combinations highlighted the integration of structural and financial dimensions with socio-economic well-being, reinforcing the multidimensional nature of resilience. Less frequent but notable pairings, such as Economic & Investment Metrics with Retail & Consumption Metrics and Technology & Innovation Metrics, reflected an emerging interest in consumption patterns and technological advancements in resilience studies.

3.2 Network Analysis

The network analysis provided critical insights into the interconnections between methodologies and metrics used across the analysed studies, offering a deeper understanding of how approaches were shared and

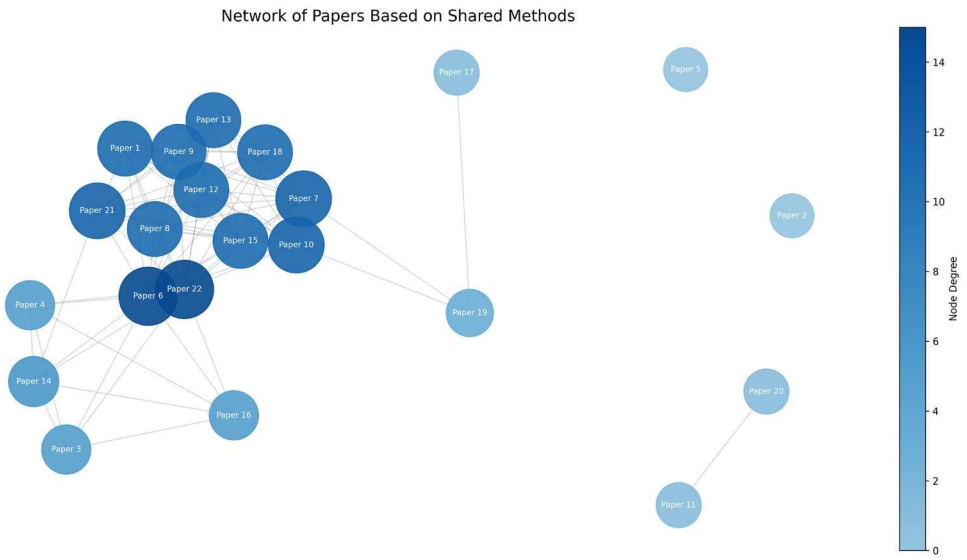


Figure 9: Network of papers based on shared methods, showing a central cluster dominated by weighting and coupling coordination models, alongside peripheral studies employing niche or emerging approaches.

clustered within urban economic resilience research. By mapping relationships based on shared methods, the analysis revealed key methodological clusters, highlighted influential studies, and identified isolated approaches that may represent emerging or specialized methods.

3.2.1 Method Networks

The network visualisation represented individual studies as nodes, with edges indicating shared methodologies. The size and colour intensity of each node corresponded to its degree, reflecting the number of methodological connections a study maintained with others. As shown in Figure 9, the structure revealed a prominent central cluster of highly connected studies, several smaller thematic subclusters, and a set of peripheral or isolated nodes.

Central Clusters of Shared Methods

A prominent central cluster dominated the network, indicating a high degree of methodological overlap among studies. This cluster was characterized by the frequent use of weighting models, particularly the entropy method, often combined with different approaches. These methods form the analytical backbone of urban resilience research, linking a wide array of studies.

Within this central cluster, studies such as Paper 22 (Y. Zhang & Li, 2024) and Paper 6 (Lin et al., 2022) emerged as key hubs, sharing weighting and coupling coordination models with numerous other studies. Their high connectivity suggests that they play a crucial role in shaping and standardizing analytical approaches within the field.

Peripheral and Isolated Studies

In contrast to the central cluster, several studies, including Paper 17 (Xun & Yuan, 2020), Paper 2 (Fu et al., 2023), and Paper 5 (He et al., 2023), appeared as peripheral or isolated nodes. These studies employed unique or less commonly shared methods, indicating either niche applications or the exploration of emerging approaches within the field. Their isolation highlights potential opportunities for integrating novel methodologies into the broader research ecosystem.

Subclusters and Thematic Groupings

Smaller subclusters, such as those centred around Paper 4 (Han et al., 2023) and Paper 3 (Ge et al., 2024), reflected thematic groupings where shared methods were applied to specific research contexts. In these cases, coupling coordination models were combined with specialised approaches, such as fuzzy-based or theory-based methods, tailored to particular research questions within urban resilience.

The analysis confirmed the dominant role of weighting models, particularly the entropy method, in connecting diverse studies. These models formed the methodological core of the network, providing a flexible and widely applicable framework for resilience research. Weighting models were often combined with coupling coordination models and index-based approaches, leveraging their complementary strengths to address both systemic dynamics and aggregated resilience measures.

The network also highlighted the emergence of specialised methods that were less commonly used. Peripheral nodes represented studies employing approaches such as network optimisation models or unique density estimation

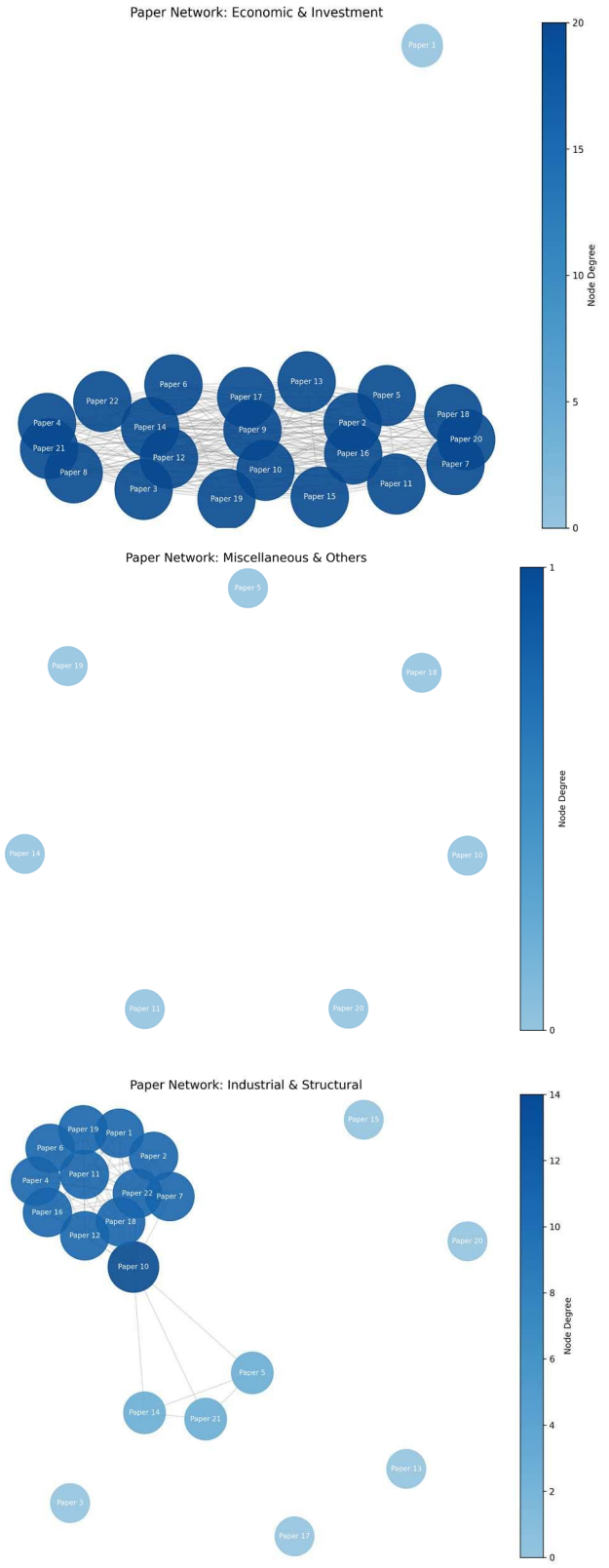


Figure 10: Paper networks by metric category. Economic & Investment shows a dense cluster, Urban & Infrastructure is sparse with isolated nodes, and Industrial & Structural forms a moderately connected cluster with peripheral studies.

techniques. Although less connected, these studies suggest innovative directions in resilience research that could benefit from greater integration with mainstream methodologies.

3.2.2 Metric Networks

The analysis of metric categories provided a detailed understanding of the thematic focus of urban economic resilience research. By visualizing study connections based on shared metrics, the research identified key patterns of collaboration and focus areas.

Economic & Investment Metrics

This category exhibited the most extensive network, reflecting its dominance in the field with 22 distinct metrics. As shown in Figure 10, papers in this cluster demonstrated high interconnectivity, underscoring the central role of economic indicators such as GDP per capita and fixed asset investment in resilience studies. Paper 1 (Chen et al., 2023) was identified as an outlier, disconnected from the network, being the only paper using the ratio of local fiscal revenue to GDP as an identifying metric.

Technology & Innovation Metrics

The network for this category was sparser, with fewer connections among studies. Paper 10 (X. Ma & Jia, 2024) emerged as a central node, linking studies on metrics such as the number of patents and internet penetration. The limited connectivity suggests that technology-focused resilience studies remain a developing research niche.

Industrial & Structural Metrics

This category featured a dense network, with Paper 10 (X. Ma & Jia, 2024) again serving as a central hub. In Figure 10, this cluster stands out for its strong interconnections, built around metrics such as the proportion of tertiary industry value added to GDP. The shared focus on structural economic dynamics highlights a collaborative and methodologically aligned strand of resilience research.

Social & Living Standards Metrics

Social resilience metrics, including urban per capita disposable income and education expenditure, formed a moderately connected network. Paper 10 (X. Ma & Jia, 2024) played a significant role in connecting clusters, underscoring its influence. However, several peripheral nodes indicated opportunities for further integration of social metrics into broader studies.

Urban & Infrastructure Metrics

This category exhibited the least connectivity, with several isolated nodes. As shown in Figure 10, metrics such as

urbanisation rates and postal business revenue appeared only sporadically, suggesting a lack of cohesion in this area. Papers focusing on this category often diverged in their approaches, reflecting the nascent stage of infrastructure-related resilience research.

Finance & Revenue Metrics

This category demonstrated a moderately dense network, with Paper 10 (X. Ma & Jia, 2024) and Paper 22 (Y. Zhang & Li, 2024) acting as influential hubs. Metrics such as per capita deposits in savings and financial revenue were commonly used, reflecting the financial dimension's established role in resilience assessments. The presence of peripheral nodes suggests that some studies explored unique financial metrics, contributing to the category's diversity.

Population & Employment Metrics

Connections within this category were limited, forming smaller clusters of studies sharing common metrics such as the registered unemployment rate and average wages. Paper 10 (X. Ma & Jia, 2024) was a recurring node, bridging multiple studies and reinforcing its central methodological importance across categories.

Environment & Resources Metrics

The network for environmental metrics was minimal, emphasizing a significant gap in the literature. Metrics such as energy consumption and green area per capita were infrequently studied, with limited collaboration among studies. Paper 10 (X. Ma & Jia, 2024) and Paper 18 (Yang & Wang, 2024) formed a small connection, representing the primary link in this underexplored category.

Retail & Consumption Metrics

This category showed a moderately dense network, with studies connected through metrics such as per capita retail sales and gross tourism receipts. Paper 10 (X. Ma & Jia, 2024) and Paper 7 (H. Lu et al., 2022) emerged as key connectors, indicating shared methodologies and collaborative efforts in retail-focused studies.

Miscellaneous & Other Metrics

As expected, this category displayed the least coherence, with studies connected by unique and diverse metrics such as labour productivity and higher education enrolment rates. The sparse network reflects the exploratory nature of these metrics in resilience research, with no central node or recurring focus.

These network analyses highlight the varying levels of integration and focus within each metric category. Categories such as Economic & Investment and Industrial & Structural demonstrated robust connections, while others, like Environment & Resources, revealed significant research gaps. The recurring prominence of Paper 10 (X. Ma & Jia, 2024) across multiple categories underscores its significance, suggesting a potential template for future resilience studies.

4 Discussion

This review provides valuable insights into the state of research on urban economic resilience in China, highlighting key patterns in metrics, methodologies, and research focus areas. It contributes to the growing body of resilience literature while also identifying critical research gaps and opportunities for future studies.

A central finding is the predominance of macroeconomic indicators, such as GDP per capita and fixed asset investment, as primary measures of resilience. This aligns with broader trends in economic resilience research, which often prioritize large-scale analyses of cities or regions. Methodologically, the field is dominated by weighting models and coupling coordination approaches, reflecting a strong preference for quantitative, index-based evaluations. However, this emphasis on aggregate metrics frequently comes at the expense of more localized or nuanced investigations.

Despite the strengths of these widely adopted methods, significant gaps remain. Environmental and infrastructure-related metrics are notably underrepresented, suggesting a potential oversight in capturing critical dimensions of resilience. Moreover, many studies aggregate data across hundreds of cities without accounting for specific local contexts (Fu et al., 2023; He et al., 2023; K.-L. Wang et al., 2023; H. Yu et al., 2018). While such an approach facilitates large-scale comparisons, it risks overlooking key contextual factors—such as governance structures, socioeconomic disparities, and infrastructure quality—that significantly influence resilience outcomes. This can lead to generalized conclusions that lack the depth needed for context-sensitive policymaking.

Another notable limitation is the predominant reliance on statistical data rather than geospatial data, which restricts the granularity of analyses. The absence of geospatial methodologies prevents researchers from identifying spatial patterns of resilience at finer scales, such as neighbourhoods or districts. Additionally, most studies focus on city- or regional-level resilience, often neglecting localized, community-level impacts that could provide deeper insights into vulnerabilities and recovery processes.

These findings have important implications for both practice and policy. By identifying dominant metrics

and methodologies, this review offers a roadmap for practitioners seeking to assess economic resilience more systematically. At the same time, the gaps highlighted in this analysis underscore the need for a more holistic approach—one that integrates multiple dimensions of resilience to inform more comprehensive and context-sensitive policy decisions.

In conclusion, while the existing body of research provides a solid foundation for understanding urban economic resilience, it remains incomplete in several critical areas. Addressing these gaps will require expanding the range of resilience metrics, diversifying methodological approaches, and incorporating more localized, geospatially nuanced analyses. Such efforts will not only advance academic understanding but also enhance the effectiveness of policy and planning in the face of future urban challenges.

References

Blondel, V. D., Guillaume, J.-L., Lambiotte, R., & Lefebvre, E. (2008). Fast unfolding of communities in large networks. Journal of Statistical Mechanics: Theory and Experiment, 2008(10), P10008. https://doi.org/10.1088/1742-5468/2008/10/P10008

Chen, N., Guo, H., & Xiang, H. (2023). Evaluation of urban resilience level and analysis of obstacle factors: A case study of Hunan Province, China. Frontiers in Earth Science, 10. Scopus. https://doi.org/10.3389/feart.2022.1033441

Fu, H., Hong, N., & Liao, C. (2023). Spatio-temporal patterns of Chinese urban recovery and system resilience under the pandemic new normal. Cities, 140, 104385. Scopus. https://doi.org/10.1016/j.cities.2023.104385

Ge, Y., Jia, W., Zhao, H., & Xiang, P. (2024). A framework for urban resilience measurement and enhancement strategies: A case study in Qingdao, China. Journal of Environmental Management, 367, 122047. Scopus. https://doi.org/10.1016/j.jenvman.2024.122047

Hagberg, A. A., Schult, D. A., & Swart, P. J. (2008). Exploring Network Structure, Dynamics, and Function using NetworkX. 11–15. https://doi.org/10.25080/TCWV9851

Han, S., Wang, B., Ao, Y., Bahmani, H., & Chai, B. (2023). The coupling and coordination degree of urban resilience system: A case study of the Chengdu–Chongqing urban agglomeration. Environmental Impact Assessment Review, 101, 107145. Scopus. https://doi.org/10.1016/j.eiar.2023.107145

He, S., Yang, S., Razzaq, A., Erfanian, S., & Abbas, A. (2023). Mechanism and Impact of Digital Economy on Urban Economic Resilience under the Carbon Emission Scenarios: Evidence from China's Urban Development. International Journal of Environmental Research and Public Health, 20(5), 4454. Scopus. https://doi.org/10.3390/ijerph20054454

Lin, Y., Peng, C., Chen, P., & Zhang, M. (2022). Conflict or synergy? Analysis of economic-social- infrastructure-ecological resilience and their coupling coordination in the Yangtze River economic Belt, China. Ecological Indicators, 142, 109194. Scopus. https://doi.org/10.1016/j.ecolind.2022.109194

Lu, H., Lu, X., Jiao, L., & Zhang, Y. (2022). Evaluating urban agglomeration resilience to disaster in the Yangtze Delta city group in China. Sustainable Cities and Society, 76, 103464. Scopus. https://doi.org/10.1016/j.scs.2021.103464

Lu, R., & Yang, Z. (2023). Analysis on the structure and economic resilience capacity of China's regional economic network. Applied Economics, 56(32), 3920–3938. Scopus. https://doi.org/10.1080/00036846.2023.2208852

Ma, F., Wang, Z., Sun, Q., Yuen, K. F., Zhang, Y., Xue, H., & Zhao, S. (2020). Spatial–Temporal Evolution of Urban Resilience and Its Influencing Factors: Evidence from the Guanzhong Plain Urban Agglomeration. Sustainability, 12(7), 2593. Scopus. https://doi.org/10.3390/su12072593

Ma, X., & Jia, F. (2024). Spatiotemporal Evolution and Convergence Analysis of Urban Economic Resilience in China—A Case Study of Jiangsu Province. Sustainability, 16(21), 9440. https://doi.org/10.3390/su16219440

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. BMJ, n71. https://doi.org/10.1136/bmj.n71

Tan, J., Zhang, P., Lo, K., Li, J., & Liu, S. (2017). Conceptualizing and measuring economic resilience of resource-based cities: Case study of Northeast China. Chinese Geographical Science, 27(3), 471–481. Scopus. https://doi.org/10.1007/s11769-017-0878-6

Tang, B., & Tan, Z. (2022). The research on spatial-temporal evolution and influence factors of urban resilience: A case study in the Guangzhou metropolitan area. Frontiers in Environmental Science, 10. https://doi.org/10.3389/fenvs.2022.1052930

Tang, D., Li, J., Zhao, Z., Boamah, V., & Lansana, D. D. (2023). The influence of industrial structure transformation on urban resilience based on 110 prefecture-level cities in the Yangtze River. Sustainable Cities and Society, 96, 104621. Scopus. https://doi.org/10.1016/j.scs.2023.104621

Wang, J., & Zhou, X. (2024). Measurement and synergistic evolution analysis of economic resilience and green economic efficiency: Evidence from five major urban agglomerations, China. Applied Geography, 168, 103302. Scopus. https://doi.org/10.1016/j.apgeog.2024.103302

Wang, K.-L., Jiang, W., & Miao, Z. (2023). Impact of high-speed railway on urban resilience in China: Does urban innovation matter? Socio-Economic Planning Sciences, 87, 101607. Scopus. https://doi.org/10.1016/j.seps.2023.101607

Xinhua News Agency. (2021). Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035. https://www.gov.cn/xinwen/2021-03/13/content_5592681.htm

Xu, X., Wang, M., Wang, M., Yang, Y., & Wang, Y. (2022). The Coupling Coordination Degree of Economic, Social and Ecological Resilience of Urban Agglomerations in China. International Journal of Environmental Research and Public Health, 20(1), 413. Scopus. https://doi.org/10.3390/ijerph20010413

Xun, X., & Yuan, Y. (2020). Research on the urban resilience evaluation with hybrid multiple attribute TOPSIS method: An example in China. Natural Hazards, 103(1), 557–577. Scopus. https://doi.org/10.1007/s11069-020-04000-0

YAML Language Development Team. (2021). YAML Ain't Markup Language (YAMLTM) revision 1.2.2. https://yaml.org/spec/1.2.2/#fn:team

Yang, T., & Wang, L. (2024). Did Urban Resilience Improve during 2005–2021? Evidence from 31 Chinese Provinces. Land, 13(3), 397. Scopus. https://doi.org/10.3390/land13030397

Yu, H., Liu, Y., Liu, C., & Fan, F. (2018). Spatiotemporal Variation and Inequality in China's Economic Resilience across Cities and Urban Agglomerations. Sustainability, 10(12), 4754. https://doi.org/10.3390/su10124754

Yu, Y., Yang, C., Hu, Q., & Kong, S. (2024). Towering sustainability: Unraveling the complex effects of skyscrapers on urban resilience. Environmental Impact Assessment Review, 108, 107614. Scopus. https://doi.org/10.1016/j.eiar.2024.107614

Zhang, M., Chen, W., Cai, K., Gao, X., Zhang, X., Liu, J., Wang, Z., & Li, D. (2019). Analysis of the Spatial Distribution Characteristics of Urban Resilience and Its Influencing Factors: A Case Study of 56 Cities in China. International Journal of Environmental Research and Public Health, 16(22), 4442. Scopus. https://doi.org/10.3390/ijerph16224442

Zhang, X., & Li, H. (2018). Urban resilience and urban sustainability: What we know and what do not know? Cities, 72, 141–148. https://doi.org/10.1016/j.cities.2017.08.009

Zhang, Y., & Li, Y. (2024). A Study on the Coupling Coordination of Urban Resilience and the Tourism Economy in the Beijing–Tianjin–Hebei Region. Sustainability, 16(12), 4946. Scopus. https://doi.org/10.3390/su16124946