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Research Article

The effect of urban resilience on social stability under external disaster strikes--Evidence from China during COVID-19 pandemic

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ABSTRACT

The robustness of civil society plays a pivotal role in shaping the aftermath of disasters. Following the COVID-19 pandemic, the question arises: why did some cities witness widespread resident protests, while others remained relatively calm? Certain theoretical studies have suggested that urban economic disruptions stemming from external disasters can significantly undermine social stability, yet these studies lack empirical validation of the underlying mechanisms. This research endeavors to explore the factors within urban resilience that influence social stability during major public events, a topic that has received scant attention in existing empirical studies.Utilizing data from the Chinese General Social Survey (2021), this study introduces an empirical causal analysis framework integrating the "entropy value method" and "fuzzy-set Qualitative Comparative Analysis (fsQCA)" to investigate the following: (1) The univariate test reveals that the consistency level of all conditions is below 0.9, indicating that no single-dimensional factor alone can enhance social stability. (2) The absence of urban economic resilience emerges as a critical conditional variable contributing to non-high levels of social stability, thereby serving as the primary driver of social instability. (3) Group analysis identifies three distinct pathways through which urban resilience impacts social stability: the "economic-ecological-resource" support path, the "economic-ecological-risk" mitigation path, and the "economic-ecological-challenge" resolution path.

Keywords: urban resilience; social stability; external disaster; fsQCA; COVID-19

Subject classification codes: R00; Q01

1. Introduction

Following the emergence of the COVID-19 pandemic, the ability of cities to withstand external calamities has garnered the focus of global governments, international entities, and urban scholars [1-4]. The COVID-19 outbreak poses a threat to urban areas globally, as it jeopardizes the societal equilibrium of cities, particularly in developing nations where urban resilience is subpar. The key indicators of these risks to societal equilibrium primarily involve worries over the gradual resurgence of the city's economy, escalating joblessness, and the political turmoil linked to increasing urban dissatisfaction[5,6]. Additionally, the collaboration of these two dangers could significantly harm societal equilibrium. Following the epidemic, the anticipated sluggish recovery of the economy, employment, and social welfare in certain small and medium-

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sized cities, owing to their limited resilience post-disaster, might lead to a continual increase in incremental social complaints linked to social instability[7-11]. Assessing urban resilience against external disturbances and examining its influence on societal equilibrium will aid in the prompt recuperation of cities from COVID-19's effects and ameliorate the existing state of social unrest post-epidemic.

The idea of urban resilience is crucial in tackling the complex issues presented by swift urban growth and shifts in the environment[12-15]. As of 2020, more than 4 billion people had settled in urban regions, and forecasts suggest that by 2050, cities will house 70% of the world's populace. While acting as centers for economic endeavors, these cities face significant risks due to climate change, dwindling resources, and increased susceptibility to calamities such as hurricanes, heatwaves, and societal turmoil. Remarkably, urban regions, occupying a mere 3% of the Earth's surface, account for about 71% of worldwide carbon emissions linked to energy, highlighting the critical need for efficient climate change management. With the swift increase in urban populations, the dangers and susceptibilities of city assets to risks, catastrophes, and disruptions also rise.

Addressing this complex problem, various city regions have adopted frameworks of resilience, focusing on reducing the effects of disasters, gearing up for the consequences of climate change, and enabling faster and stronger recuperation post-shock[16,17]. The concept of urban resilience presents an innovative approach to tackling urban sustainability and linked infrastructure[18-20]. This presents an evolving viewpoint that promotes the creation of operational systems and procedures in cities, enhancing robustness in linked infrastructure and facilitating rapid recuperation from possible disaster-induced disturbances. Even with the growing focus and expansion of various frameworks, the idea of urban resilience continues to be somewhat unclear, owing to its complex and multifaceted characteristics. This concept has gained broad acceptance in multiple urban studies fields, such as ecology, geography, psychology, sociology, public policy and administration, economics, tourism, and civil and environmental engineering[21,22].

In this context, urban resilience denotes the capacity of urban areas to manage, recuperate, and adjust to diverse internal and external obstacles, serving as a key metric for assessing urban sustainability. Amidst the COVID-19 pandemic, what causes certain cities to excel in resilience, others to falter, thereby exacerbating the deterioration of social stability? Numerous academics are captivated by studies exploring how urban resilience is affected, despite the predominance of theoretical and case-based research. In terms of external shock impacts, certain studies categorize urban resilience into two types: resilience to physical harm and resilience to economic and political upheavals. The research aims to pinpoint specific urban resilience forms that more significantly influence social equilibrium and to investigate how these elements, or their amalgamations, adversely affect social stability[23].

A primary reason for the decline in social stability could be the inferior resilience of cities in economic and public administration, especially when contrasted with their robustness in physical and ecological rejuvenation. Numerous researches have explored how economic and political upheavals, such as deindustrialization or the diminishing status of capital cities, can severely damage societal stability[24-26]. The evidence indicates that the repercussions of the COVID-19 pandemic on societal equilibrium could intensify if there's a lack of robustness in urban economic and public management resilience, like the extensive embrace of telecommuting, or shifts in politics prompting the exodus of businesses and affluent individuals from cities[27,28]. Nonetheless, the majority of research employed conventional approaches like theoretical studies and observational methods to elucidate the negative effects of external catastrophes on societal equilibrium[29,30]. Regrettably, owing to the constraints in theoretical research techniques and data accessibility, no scholars have employed data to illustrate how urban resilience affects social stability. Put differently, these researches highlighted the significant role of urban resilience in maintaining social equilibrium amidst a city's external disturbances, yet they refrained from employing data to illustrate this.

Furthermore, empirical studies employing extensive tracking survey data to investigate the dynamics between urban resilience and social stability are scarce. Numerous scholars have developed an index system and assessed the robustness of selected cities using various measurement techniques[31-35] , uncovering the determinants of urban resilience, specifically the "antecedents study"[36-38].However, the impact of urban resilience on societal stability has been scarcely investigated.

In conclusion, this research utilizes Chinese cities affected by COVID-19 as examples to investigate how urban resilience impacts social stability, utilizing CGSS (Chinese General Social Survey) data to bridge this knowledge gap. The computation of key influencing factors relied on the entropy value approach, utilizing fuzzy set qualitative comparative analysis (fsQCA) to examine the interaction between the outcome variable (social stability) and the condition variable (elements of urban resilience).

2. Method

2.1. Research methods and data sources

The research methodology mainly consists of three parts. The first is the measurement part based on entropy value method to obtain the score values of the six components of urban resilience. And the second is factor analysis method, which is used to measure the level of social stability. Finally, the fsQCA method is used to explore which urban resilience elements or their combinations will have an impact on social stability. The following is a detailed explanation of the three methods.

2.1.1. Urban resilience measurement: entropy method

To examine how urban resilience affects societal steadiness, it's essential to initially assess the explanatory factor of urban resilience. Entropy, a technique for managing information, integrates "entropy" into system theory, serving as a method of objective empowerment. The technique assigns significance to indicators based on the magnitude of data each indicator yields, thereby reducing the subjective randomness inherent in the subjective assignment method (AHP) and curtailing human-induced bias[39-41]. An increase in entropy leads to greater chaos in the system and a reduction in its informational capacity; conversely, a decrease in entropy results in a more structured system with enhanced information capacity[42,43].

The original expression of entropy is: $S = -k_B \sum_i p_i \log p_i$. In this study, the following mathematical model is constructed for the measurement of explanatory variables based on the principle of entropy method using the cross-sectional data of Chinese provinces and municipalities directly under the central government in 2021:

There are m provinces (including municipalities directly under the central government) and n secondary indicators of urban resilience. First, the data are standardized, and the jth indicator of the ith province after processing takes the value of Z_{ij} denote， $i = 1,2,3...m$ and $j = 1,2,3...n$. Since the values of positive and negative indicators represent different meanings (higher values of positive indicators are more favorable to urban resilience, while negative indicators are vice versa), the author uses two algorithms to standardize the data. The positive indicators are processed as (1), and the negative indicators are treated as (2).

$$Z_{ij} = \frac{x_{ij} - min(x_j)}{max(x_j) - min(x_j)} \quad (1)$$

$$Z_{ij} = \frac{max(x_j) - x_{ij}}{max(x_j) - min(x_j)} \ (2)$$

$$P_{ij} = Z_{ij} \Bigg/ \sum_{i=1}^{m} Z_{ij} \ (3)$$

$$e_j = -\mathrm{k} \sum_{i=1}^{m} P_{ij} In(P_{ij}) \ (\text{k is constant}^1 \text{ and k} > 0,\ e_j > 0) \ (4)$$

$$d_j = 1 - e_j \ (5)$$

$$w_j = d_j \Bigg/ \sum_{i=1}^{n} d_j \ (6)$$

$$s_i = \sum_{j=1}^{n} P_{ij} \times w_j \ (7)$$

Furthermore, prior to standardization, the author initially refined the original dataset, mainly by: Firstly, if a marker lacks significant value, promptly discard the entire dataset; subsequently, substitute the null with the sample mean; Secondly, screening and processing of outliers, that is, for the proportion of greater than 1 directly rejected (except for the proportion of special indicators), and then separately calculate the data under each indicator if the data is greater than the mean + 3×standard deviation or less than the mean - 3×standard deviation, the whole data is rejected. In addition, the original data used for urban resilience measurement Z_{ij} were obtained from China Statistical Yearbook 2021, China Financial Yearbook 2021, and China Urban Statistical Yearbook 2021 published by the National Bureau of Statistics, Ministry of Finance and State Administration of Taxation, etc.

2.1.2. Social stability evaluation: factor analysis

Factor analysis is a method to reduce the number of variables by finding the underlying structure hidden in the data. It assumes that the observed variables are actually governed by a few unobservable factors, and thus extracts these factors for the purpose of dimensionality reduction. In factor analysis, each observation is represented as a linear combination, where the coefficients are called factor loadings. The magnitude and direction of the factor loadings indicate the strength and direction of the relationship between the observations and the corresponding factors. The larger the factor loadings, the stronger the relationship between the observation and the factor. As a common technique for data dimensionality reduction, factor analysis can reduce multiple related variables into a few independent factors, thus helping researchers to better understand and analyze the data. Factor analysis has been widely used in social sciences, including the measurement of social stability, and the method can reduce the number of variables by reducing multiple relevant variables into a few independent factors, thus reducing computational costs and improving analysis efficiency. Also, the use of factor analysis can further explain the meaning of factors through rotation

[1] The constant k is related to the sample size m. Generally k = 1/In(m), then $0 \leq e \leq 1$.

techniques, which can help this study to better explore the structure within the data of each element of social stability and thus better interpret the results.

2.1.3. Causal inference method: qualitative comparative analysis fsQCA

The research deviates from the conventional statistical approach, which relies on the binary interplay of "independent variable-dependent variable," opting instead for a qualitative comparative analysis (fsQCA) grounded in set theory to examine the intricate and varied factors contributing to urban resilience and social stability in China, viewed through a histological lens. The primary reasons for this are as follows:

Initially, the concept of urban resilience encompasses various elements, and to uncover its influence on societal equilibrium, traditional statistical evaluations of economic, material, governmental, and ecological aspects, whether functioning separately or in conjunction with each other, are inadequate. Differing from traditional analytical methods, fsQCA analysis views the interdependence and various causal condition combinations as forming several simultaneous causal links, enhancing our comprehension of how different factors and their combinations affect urban resilience[44-48]. Consequently, employing the fsQCA method proves more apt for investigating the various elements influencing urban stability through comprehensive relationships.

Additionally, the variety in urban stability routes among provinces indicates the possibility of several "Equifinal" causal links culminating in identical results. Conventional statistical analysis techniques are capable of consolidating key elements influencing urban stability and delineating how independent variables impact dependent variables via intermediary and moderating variables. Yet, each only accounts for the changes in the dependent variable through the replacement or aggregate interplay of the independent variables, not through complete equivalence. Conversely, the fsQCA technique is capable of distinguishing various groups of antecedent conditions that are fully equivalent to the outcomes described and do not contradict one another[49-53]. In contrast to conventional statistical analysis techniques, the fsQCA approach is evidently more apt for choosing paths to enhance urban stability.

2.2. Variable selection and analysis

2.2.1. Conditional variable: urban resilience

Based on research related to urban resilience, this study summarizes 48 sets of tri-level data as tertiary indicators to assess urban resilience[54-57]. From these 48 tertiary indicators, 8 are selected as a group to form 6 major secondary indicators, which are: economic resilience, governance resilience, resource resilience, risk response resilience, ecological resilience, and technological resilience. In the final fsQCA analysis, they will serve as key components of the six important indicator systems that influence urban resilience (see **Table 1** and **Table 2**).

Table 1. Indicator system of urban resilience assessment(D1-D24).

Variables	Characteristic	Third-level Indicators
Economic resilience	P	D1: GDP per capita (yuan)
	P	D2: Per capita consumption expenditure of residents (yuan)
	P	D3: Per capita disposable income of urban residents (yuan)
	P	D4: Proportion of tertiary industry in GDP (%)
	P	D5: Foreign direct investment (FDI) inflow per capita (yuan)
	N	D6: Unemployment rate (%)
	P	D7: Annual growth rate of urban employment (%)
	P	D8: Local government fiscal revenue per capita (yuan)
Administration resilience	P	D9: Policy implementation timeliness (days)
	P	D10: Transparency index (based on open data availability)
	P	D11: Online public participation platform usage rate (%)
	P	D12: Urban planning approval rate (%)
	P	D13: Number of urban management personnel per 10,000 residents
	P	D14: Public service delivery efficiency index (based on citizen satisfaction surveys)
	P	D15: Budget allocation for urban management as a percentage of total budget (%)
	P	D16: Number of urban renewal projects completed per year
Resource resilience	P	D17: Water availability per capita per day (cubic meters)
	P	D18: Renewable energy consumption as a percentage of total energy consumption (%)
	P	D19: Urban land use intensity index (square meters per capita)
	P	D20: Municipal waste recycling rate (%)
	P	D21: Per capita green space area (square meters)
	N	D22: Energy consumption per unit of GDP (ton of standard coal equivalent per 10,000 yuan)
	P	D23: Strategic grain and oil reserves (days of consumption)
	P	D24: Number of energy supply sources (diversity index)

Table 2. Indicator system of urban resilience assessment(D25-D48).

Variables	Characteristic	Third-level Indicators
Risk resolution resilience	P	D25: Disaster prevention and emergency management budget as a percentage of GDP (%)
	P	D26: Number of emergency response drills per year
	P	D27: Training hours for emergency response personnel per year
	P	D28: Population coverage of early warning systems (%)
	P	D29: Evacuation plan readiness level (percentage of population covered)
	P	D30: Disaster preparedness index (based on citizen surveys)
	P	D31: Emergency savings per capita (yuan)
	P	D32: Emergency funding availability as a percentage of total fiscal revenue (%)
Ecological resilience	N	D33: Annual average PM2.5 concentration (μg/m³)
	N	D34: Water quality index (based on BOD, COD, etc.)
	N	D35: Day-night average noise level (dB)
	P	D36: Urban green coverage rate (%)
	P	D37: Biodiversity index (based on species richness and abundance)
	N	D38: Per capita emissions of pollutants (kg per capita)
	P	D39: Urban heat island effect mitigation measures effectiveness index
	P	D40: Green infrastructure investment as a percentage of total infrastructure investment (%)
Technical resilience	P	D41: Digitalization level index (based on IoT, big data, etc.)
	P	D42: Number of smart city projects implemented per year
	P	D43: Patent applications per 10,000 residents
	P	D44: R&D expenditure as a percentage of GDP (%)
	P	D45: High-tech enterprises per 10,000 residents
	P	D46: High-speed internet penetration rate (%)
	P	D47: AI-powered urban management applications (number)
	P	D48: Smart grid and renewable energy integration efficiency index

2.2.2. Outcome variable: social stability

Utilizing a survey scale, the study assessed urban social stability based on the participants' overall life satisfaction, marking the first research to evaluate and scrutinize social stability in Chinese urban areas. For maintaining the study's dependability and accuracy, the researcher adhered to the urban social stability criteria, scrutinizing and contrasting information from diverse Chinese social, household, and sociodemographic surveys, ultimately choosing 9 questions from the China General Social Survey (CGSS) 2021, Volume A's social attitude panel to gauge the outcome variables[58-61] (See **Tables 3 and 4**).

Table 3. Social stability measurement scale (Part 1: social attitudes).

	Title item	Answers	Value
	(i) Social attitudes	**Refuse to answer**	**99**
Q1	A33. In general, do you agree that the vast majority of people in this society can be trusted?	No idea	98
Q2	A34. In general, do you agree that in this society, people will find ways to take advantage of you if you are not careful?	Strongly disagree	1
Q3	A35. In general, do you think today's society is fair?	Rather disagree	2
Q4	A36. In general, do you feel that you are happy in your life?	Can't say I agree or disagree	3
		Compare and agree	4
		Strongly agree	5

Note: *Referring to the original CGSS questionnaire, the 7 options of the questionnaire were assigned a value of 5 for "Strongly agree", 4 for "Relatively agree", 3 for "Can't say whether I agree or disagree", 2 for "Relatively disagree", and 1 for "Strongly disagree". In addition, "don't know" was 98 and "refused to answer" was 99. In addition, "don't know" was 98 and "refused to answer" was 99. Any variable with 98 or 99 was considered as an invalid sample and rejected.*

Table4. Social stability measurement scale (Part 2: class identity).

	Title item
	(ii) Class identity
Q5	Could you describe your current position within society?
Q6	Reflecting on the past, where do you believe you stood in society 10 years ago?
Q7	Looking ahead, where do you envision yourself in society 10 years from now?
Q8	Thinking back to your childhood, what was your family's socioeconomic standing when you were 14 years old?
Q9	Considering all factors, doesn't it seem that in today's society, your socioeconomic status belongs to a specific category?
Value	**Answers to questions 5 to 8**
99	Refuse to answer
98	No idea
1	Lower Level 1
2	Lower level 2
3	Lower Level 3
4	Mid Level 2
5	Middle Level 3
6	Mid Level 4
7	Top Floor 1
8	Top Floor 2
9	Top Floor 3
10	Top Floor 4
Value	**Answers to question 9**
99	Refuse to answer
98	No idea
1	lower level
2	Lower middle class
3	Middle Level
4	Upper Intermediate Book
5	Upper Level

According to **Tables 3 and 4**, the above questions basically represent the assessment of the overall satisfaction level of the sample population in urban China, which is consistent with the definition of social stability of urban groups. Following the removal of samples marked with "don't know" and "refused to answer", a total of 12,787 authentic samples were collected from various provinces and cities, subsequently utilizing each province's average value as a criterion to categorize the outcome variable, social stability.

2.3. Urban resilience measurement results

Utilizing the developed urban resilience assessment index system, the extensive urban resilience score was determined using Stata15.0 (SE) software, adhering to the entropy method formula, resulting in the acquisition of the sample's urban resilience score (**Table 5**).

Table 5. City resilience composite score.

Ranking	Province	Score	Ranking	Province	Score	Ranking	Province	Score
1	Jiangsu	3.607	12	Anhui	3.444	23	Qinghai	3.400
2	Shandong	3.534	13	Hubei	3.440	24	Jiangxi	3.377
3	Zhejiang	3.520	14	Guizhou	3.436	25	Xinjiang	3.373
4	Beijing	3.512	15	Hunan	3.434	26	Ningxia	3.356
5	Shanghai	3.510	16	Hainan	3.430	27	Jilin	3.344
6	Chongqing	3.497	17	Gansu	3.425	28	Shanxi	3.340
7	Guangdong	3.483	18	Henan	3.422	29	IMongolia	3.327
8	Yunnan	3.477	19	Tibet	3.419	30	Guangxi	3.297
9	Fujian	3.475	20	Heilongjiang	3.415	31	Shaanxi	3.291
10	Sichuan	3.475	21	Liaoning	3.400			
11	Tianjin	3.474	22	Hebei	3.400			

3. Results

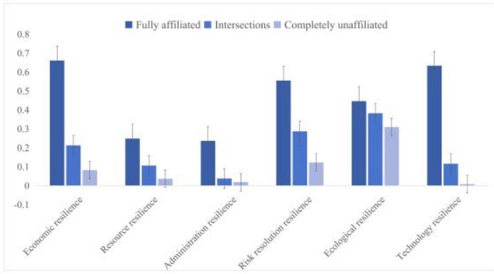
3.1. Data calibration

Before using fsQCA for conditional variable necessity analysis, data calibration, i.e., converting the data from a fixed-order or interval scale to an affiliation in the target set, needs to be performed[62-65]. For studies that take scale scales, researchers need to first deal with the relationship between the measurement scale and the actual distribution of the sample. The study set the 0.95 quantile, 0.5 quantile, and 0.05 quantile of the sample descriptive statistics for the antecedent condition and outcome as the anchor points for full affiliation, crossover, and full disaffiliation, respectively[66-69]. In addition, to avoid the problem of group attribution in the antecedent condition where the case affiliation happens to be 0.50, this paper also adjusts the 0.5 affiliation plus 0.001 to a non-0.5 constant to make the attribution accurate. In this way, the calibration anchors and descriptive statistics tables for the condition and outcome variables were derived (See **Fig.1a,b**).

a

Fuzzy set calibration			
Condition variables	Fully affiliated	Intersections	Completely unaffiliated
1_Economic resilience	0.6608	0.2125	0.0822
2_Resource resilience	0.2485	0.1059	0.0363
3_Administration resilience	0.2367	0.0376	0.0186
4_Risk resolution resilience	0.5548	0.2866	0.1222
5_Ecological resilience	0.4462	0.3823	0.3093
6_Technology resilience	0.6336	0.1156	0.0074

b



c

	Y	E	S	G	A	R	T
Y	1.000						
E	0.854	1.000					
S	0.748	0.745	1.000				
G	0.790	0.794	0.860	1.000			
A	0.756	0.795	0.674	0.699	1.000		
R	0.797	0.801	0.748	0.788	0.717	1.000	
T	0.848	0.924	0.717	0.763	0.875	0.862	1.000

d

	Y	E	S	G	A	R	T
Y	1.000	0.849	0.748	0.758	0.756	0.797	0.752
E	0.854	1.000	0.745	0.767	0.795	0.801	0.825
S	0.727	0.719	1.000	0.801	0.674	0.748	0.618
G	0.790	0.794	0.860	1.000	0.699	0.788	0.706
A	0.713	0.745	0.654	0.633	1.000	1.717	0.732
R	0.723	0.723	0.699	0.686	0.690	1.000	0.694
T	0.848	0.924	0.717	0.763	0.875	0.862	1.000

Figure 1. Data calibration and univariate analysis.

3.2. Univariate analysis

Adhering to the standard QCA methodology, this study initially examines if a solitary condition (encompassing its non-sets) is essential for urban society's stability. Within QCA, the robustness and uniformity of connections between set subsets are mirrored in consistency and coverage, serving as crucial indicators of essential conditions[70,71]. A condition is deemed essential for an outcome when its consistency exceeds 0.9, akin to R-Square in linear regression analysis. Fig.1c,d illustrates the outcomes of testing necessary conditions for both high and low-level outcome variables using the fsQCA software. Observing Fig.1c,d reveals that the uniformity across all scenarios remains below 0.9. Consequently, it's fair to state that urban social stability isn't influenced by just one essential factor. Put differently, within the six facets of economic, administrative, resource, risk resolution, ecological, and technical resilience, no singular dimension is crucial for improving urban stability.

3.3. Configuration solution analysis

Unlike the analysis of necessary conditions described above, the group state analysis attempts to reveal the sufficiency of different group states consisting of multiple conditions to cause the generation of outcomes. From a set-theoretic perspective, it explores whether the set represented by a grouping consisting of multiple conditions is a subset of the set of outcomes. Consistency is also used to measure the sufficiency of a grouping, but the minimum acceptable criteria and calculation methods differ from the analysis of necessary conditions. Academics generally agree that the consistency level of adequacy should not be lower than 0.75. the frequency threshold should be determined based on the sample size, with a frequency threshold of 1 for small and medium samples and greater than 1 for large samples. the final consistency threshold determined in this study was 0.80, the frequency threshold was 2, and the PRI threshold was set at 0.70. Table 6 shows the 13 configuration solutions obtained by fsQCA analysis, from which you can see the frequency and percentage of all configurations (see **Table 6**).

Table 6. Descriptive statistics for configuration solutions.

Configuration	Frequency	Percentage	Cum.
ESGART	3	12.50	12.50
ESGaRT	3	12.50	25.00
ESgArt	1	4.17	29.17
EsGART	2	8.33	37.50
EsgArT	2	8.33	45.83
EsgaRT	1	4.17	50.00
eSGArt	1	4.17	54.17
eSGaRt	1	4.17	58.33
eSgart	2	8.33	66.67
esgART	1	4.17	70.83
esgArT	1	4.17	75.00
esgaRt	1	4.17	79.17
esgart	5	20.83	100.00
Total	24	100.00	100.00

The consistency level of the three histories presented in **Fig.2** is higher than the minimum acceptable standard of 0.75 for both individual solutions (histories) and the overall solution, with 0.943 for the overall solution and 0.578 for the overall solution coverage. the three histories in Fig.2 can be considered as a sufficient combination of conditions for a high level of social stability.

Under Scenario 1, the roles of economic support and ecological restoration are pivotal, with technical governance capacity serving as an auxiliary element. This histogram's uniformity stands at 0.948, its distinct coverage at 0.018, and the initial coverage at 0.276. This suggests that this route accounts for approximately 27.6% of cases in government public health governance. Furthermore, approximately 1.8% of the instances were solely attributable to this particular route.

Under Scenario 2, economic support and ecological restoration capacities are pivotal, complemented by government response and technical governance capacities, augmented by an increased capacity for resource supply. According to Histogram 2, provinces possessing greater economic and ecological restoration capabilities can swiftly modify their emergency strategies to alleviate public emergencies and foster social equilibrium amidst external disaster events, bolstered by resource availability, governmental actions, and conditions of technical governance capacity. This category's uniformity stands at 0.935, its distinct coverage at 0.595, and the initial coverage at 0.503. This suggests that this approach accounts for approximately 50.3% of cases in government public health governance. Furthermore, approximately 60% of the instances could solely be accounted for by this route.

Under Scenario 3, economic backing and the ability to restore ecosystems remain pivotal, complemented by governmental reactivity and technical governance skills, both of which are augmented by significant risk reduction capabilities. Government intervention and technical oversight once more serve an auxiliary function, enabling the government to manage external disturbances and attain societal equilibrium effectively, even in the absence of substantial resource provision capabilities. This category's uniformity stands at 0.935, its distinct coverage at 0.595, and the initial coverage at 0.503. This suggests that this route accounts for approximately 50.3% of cases in government public health governance. Furthermore, approximately 60% of the instances can solely be accounted for by this route.

Configuration (High level social stability)			
Conditional variable	Configuration 1	Configuratio 2	Configuratio 3
E	●	●	●
S	⊗	•	
G	⊗	•	•
A	⊗		•
R	●	●	●
T	•	•	•
Original coverage	0.503	0.485	0.267
Unique coverage	0.595	0.055	0.018
Consistency level	0.935	0.938	0.948
Overall coverage		0.578	
Overall consistency		0.943	

Configuration (Non-high level of social stability)					
Conditional variable	Configuration 1	Configuratio 2	Configuratio 3	Configuratio 4	Configuratio 5
E	⊗	⊗	⊗	⊗	⊗
S		⊗	⊗	•	•
G	⊗	⊗	⊗	•	•
A	⊗	⊗	•	•	⊗
R	⊗			⊗	•
T	⊗	⊗	•	⊗	⊗
Original coverage	0.530	0.566	0.348	0.272	0.295
Unique coverage	0.329	0.011	0.072	0.023	0.051
Consistency level	0.966	0.971	0.978	0.985	0.978
Overall coverage			0.786		
Overall consistency			0.955		

Figure 2. Configuration solution.

Additionally, this research delves into the conditional histories of low-level social stability, with Fig.3 showcasing the five distinct histories of such stability. Based on the fundamental conditional traits of these groups, the absence of economic support consistently forms a key factor in the conditional aspect of moderate social stability, suggesting that the primary reason for social instability during disasters is the absence of economic resilience in urban areas.

4. Further analysis

4.1. Analysis of the influence mechanism

The examination of these findings reveals three key strategies for enhancing social stability through urban resilience: Initially, the "economic-ecological-technological empowerment" approach, rooted in local economic robustness and ecological rejuvenation, complemented by technical governance skills; next, the "economic-ecological-resource support" strategy, grounded in economic and ecological principles, dependent on urban areas; next, the "economic-ecological-resource support" strategy, focusing on economic and ecological aspects and primarily on urban resources; and finally, the "economic-ecological-risk mitigation" strategy, rooted in the groundwork of urban economic growth and ecological preservation, aimed at bolstering risk reduction capabilities. The convergence of these three routes forms the rationale behind the selection of policy instruments by local authorities for urban resilience development. Figure 1 illustrates the development process of the previously mentioned trio of influencing factors. In-depth examination is available underneath:

(1) Path of economic, ecological, and technological empowerment.

The term 'economic-ecological-technological enabling urban resilience' denotes the enhancement of cities' economic, ecological, and technological robustness to manage diverse emergencies and pressures, ensuring their stability and sustainability. The trajectory is evidently mirrored in Condition Group State 1. In what ways does this method of fostering resilience in cities aid in maintaining social equilibrium? Initially, developing economic resilience plays a crucial role in the development of urban resilience. Enhancing the financial robustness of urban areas ensures their economic growth and steadiness, achieved by adeptly managing disruptions in city economies due to economic turmoil and crises. Such measures aid in diminishing social turmoil and economic turmoil, thereby preserving societal equilibrium. Additionally, the development of ecological resilience forms a crucial component of urban resilience development. Enhancing urban ecological robustness enables it to manage the strain on city ecosystems due to natural calamities and ecological deterioration, while safeguarding the city's ecological landscape and the well-being of its inhabitants and properties. Such measures aid in diminishing social discord and ecological harm, thereby preserving societal equilibrium. Ultimately, the development of technical resilience stands as another crucial element in urban resilience enhancement. Enhancing urban technological robustness enables it to combat risks to city technology, including technological breakdowns and cyber threats, ensuring the cities' technological security and consistent functioning. Such measures aid in diminishing technological hazards and social instability, thereby preserving societal equilibrium. To sum up, enhancing urban resilience through economic, ecological, and technological means can bolster social equilibrium by fortifying the cities' economic, ecological, and technological robustness in managing diverse crises and pressures.

(2) Path of economic, ecological, resource-supportive nature.

The path of economic, ecological, and resource support highlights the robust ecological systems of cities, each with its unique economic foundation and ecological robustness, with urban resources serving as the primary pillar of support. The selected instances of this route bolster societal equilibrium by enduring environmental shifts and the unpredictability of risks, stemming from the interplay and responses within their economic, societal, ecological, and infrastructural systems. Cities along this trajectory can effectively showcase the robust collective potential of resource distribution, implementation, and usage in the urban framework, encompassing diverse facets and dimensions, especially in managing a range of natural and human-induced catastrophes and disruptions, including securing resources for transport, water, electricity, healthcare, and essential services.

(3) Path of reducing economic, ecological, and risk factors.

This route depends on the cities' economic growth and environmental conditions to bolster their resilience and foster social steadiness by fortifying their inherent risk resistance. This approach highlights the robustness, flexibility, and robustness of city systems against disasters, bolsters the role of urban risk management in mitigation, addresses risks promptly, decelerates disaster risk progression, and enhances risk management techniques to reduce the adverse effects of outside disasters on societal equilibrium. Significant crises typically undergo a developmental cycle of "risk incubation - concealed threat creation - ongoing build-up - intensification beyond control", and the dense urban population coupled with minimal social interaction spatial separation renders them more susceptible to severe crises and large-scale occurrences compared to rural regions, leading to diminished societal equilibrium. An in-depth comparative study of fsQCA indicates notable variances in urban resilience among cities with varying levels of risk-resilience, and those with more robust risk-resilience can effectively halt the "risk-potential-event-disaster" sequence in response to external disturbances. The workings of this process are clearly illustrated in Condition Group 3.

4.2. Robustness test

This research employed a qualitative comparative analysis (QCA) approach for a comparative case study of the sample, with the study's strength confirmed through variable sensitivity analysis and multiple nested decision tree analysis. (1) Analysis of Variable Sensitivity: Altering the sequence and method of variable inclusion, among other changes, helped us assess any alterations in the study's results. Following multiple analyses of variable sensitivity, the results of the study stayed consistent, signifying the study's strong robustness. (2) Analyzing decision trees with various nesting levels: this study's findings were shaped by developing a multi-nesting decision tree model. The outcomes of the decision tree analysis largely align with the QCA method's results, thereby reinforcing the solidity of our research. When correctly utilized, the QCA approach offers a potent qualitative research technique that can offset the limitations inherent in quantitative research methods. Nonetheless, the QCA technique is hindered by its subjective nature and the need for large sample sizes, necessitating cautious management by researchers in its application. Subsequent studies should delve deeper into the application range and constraints of the QCA technique, along with its integration with other qualitative research approaches.

5. Conclusions and policy implications

The research opts for the 2021 China General Social Survey (CGSS) tracking survey as its primary data source, focusing on how urban resilience influences social stability. It utilizes the fsQCA approach to examine the elements of urban resilience that impact social stability, aiming to elucidate how urban resilience factors influence social stability in the face of external public crises like COVID. Furthermore, the goals of "influence mechanisms peth of urban resilience in response to external public emergencies" were successfully met.

The research indicates that within the six aspects of economic robustness, management, resilience, resource endurance, resilience in risk resolution, environmental resilience, resilience, and technical resilience

There isn't a singular dimensional component crucial for the improvement of societal stability. (2) Analyzing group theory through the lens of set theory, three distinct group strategies emerge to elucidate the influence of urban resilience's six facets on societal equilibrium. These strategies are divided into three primary pathways for urban resilience: the "economic-ecological-technological" enabling route, the "economic-ecological-resource" route, and the "economic-ecological-resource" route, namely the "economic-ecological-resource" support route, the "economic-ecological-risk" mitigation route, and the "economic-ecological-risk" solution route. The primary distinction among these three routes lies in the core components of the supporting function within the group, along with the variances in technical governance skills, resource provision capacity, and risk resolution abilities. (3) The analysis of the conditional categorization of low-level social stability reveals that insufficient economic support capacity is a key factor in this condition, suggesting that this deficiency is the primary reason for social instability during disaster events.

To sum up, when integrated with the earlier paper on assessing resilient cities, the impact mechanism, fostering induction and reflection, bolstering resilient urban construction methods, and promoting social stability can be achieved through these three key elements:

Initially, the implementation of technical governance techniques and methods, along with the exploration of various application situations. To preserve societal equilibrium and avert social risk management, municipal authorities can create records of community demographics, residential units, and more. Utilizing advanced technologies like big data and AI, the police aim to pinpoint crucial management and service groups impacted by public crises, analyze risk scenarios and patterns, develop a community-oriented, intelligence-driven law enforcement framework, and enhance specific security risks. This approach will be employed to foster accurate policy formulation and precise prevention and management of security threats. Secondly, fortify the robustness of city assets and enhance the implementation and provision of essential emergency resources.

The findings of this paper's urban resilience analysis indicate that cities' capacity to judiciously allocate resources for rapid disaster recovery forms the essence of urban resilience and significantly influences social equilibrium.To enhance urban resource resilience in the future, it's essential to merge the "economic-ecological-resource support path," rooted in natural endowment, with infrastructural development, ensuring minimal disruption to urban ecosystem operations.As a third point, to improve urban risk management and response, an economic-ecological approach to risk resolution should be embraced to halt the progression of "risk-hazard-event-disaster".In light of cities' dense populations and constant movement, addressing significant risks and dangers necessitates recognizing and alerting to risks early, swiftly mobilizing the community and engaging the public, following legal, scientific, and accurate protocols, responding promptly to emergencies, and building combined systems for prevention, control, and group control via exceptional measures, along with efficient strategies to manage risk origins and promptly resolve emergencies.

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