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Urban Polycentric Spatial Structure and Residents' Subjective Well-Being: The Mediating Role of Commuting, Housing and Public Service Delivery

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Urban Polycentric Spatial Structure and Residents' Subjective Well-Being: The Mediating Role of Commuting, Housing and Public Service Delivery

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1 Introduction

According to the United Nations' World Cities Report 2022, the global urbanization rate is expected to reach 68% by 2050, with an additional 2.2 billion urban residents, 255 million of whom will be in China. Urbanization is a key driver of economic and social transformation. However, it has also given rise to challenges such as traffic congestion, soaring housing prices, and disordered population agglomeration, which are commonly referred to as "urban diseases" (Shen and Zhang, 2020). These problems have severe negative impacts on urban residents' living standards and reduced their overall sense of well-being. To address the challenges of urbanization, many countries

(e.g., the United States, Germany, the Netherlands) have been exploring polycentric urban spatial structure. This urban form alleviates the pressure on core urban area by establishing a primary employment center and several secondary employment centers within a city. As one of the fastest urbanizing countries in the world[1], China has also actively promoted the development of polycentric urban spatial structure. Cities such as Beijing, Shanghai, Guangzhou, Nanjing, Hangzhou, and Suzhou have become exemplary cases of polycentric development. With the continued advancement of urbanization, identifying the most suitable intra-urban spatial structure for current economic and social development has become a critical topic for in-depth research.

Existing studies predominantly center on the analysis of urban spatial structure (Garcia-López et al., 2017; Harari, 2020) and its macro-level impacts, including effects on economic development, innovation and environmental performance (Li and Liu, 2018; Sun et al., 2020; Shang et al., 2023). In terms of micro-level impacts, studies on the relationship between urban form and residents' subjective well-being have mainly focused on the compactness (Mouratidis, 2019; Mouratidis, 2022) and sprawl (Bereitschaft and Debbage, 2013; Mun et al., 2024). A polycentric spatial structure enhances compactness advantages while mitigating the adverse effects of sprawl (Holden and Norland, 2005; Hajrasouliha and Hamidi, 2017). However, research on how urban polycentricity affects residents' subjective well-being remains limited. Hoogerbrugge et al. (2021) found a positive correlation between regional polycentricity and residents' subjective well-being in 68 Northwest European districts. However, this study does not explore the potential mechanism through which polycentricity influences residents' subjective well-being. Zhang and Zhong (2024) argued that urban polycentricity affected residents' happiness through employment and income effect,

1 By the end of 2023, China's urban population had exceeded 930 million, resulting in an urbanization rate of 66%.

public service and consumption effect and residential environment effect. Nevertheless, some variables in their study, such as the density of public service and consumption, were not measured at the specific individual level, which may have led to imprecise results and potential errors. Moreover, they estimated a model using Ordinary Least Squares (OLS) on single-item ordinal well-being data, which is statistically inappropriate. To address this gap, this study aims to systematically analyze the impact of urban polycentric spatial structure on residents' subjective well-being and the underlying mechanisms driving this influence from a micro-level perspective within the context of China.

Transitioning from a monocentric to a polycentric urban structure may be an effective strategy for mitigating urban challenges and enhancing urban amenity (Meijers and Burger, 2010; Zhang et al., 2017). Urban amenity refers to the distinctive features and facilities of a specific urban area that make people feel comfortable, pleasant, and attract them to live and work nearby (Smith, 1977). The concept was later extended to include high-quality living environments (Zhang, 2006) or convenient public services in urban areas (Harari, 2020). While definition of urban amenity varies between domestic and international studies, it generally refers to high-quality urban living space. Drawing on the studies by Shang et al. (2023) and Harari (2020), and grounded in the realities of China's current development, this study defines urban amenity through three dimensions: commuting, housing and public service delivery. This definition aligns with China's urban spatial development objectives and tackles critical challenges in its urbanization process, addressing key aspects of residents' daily lives. Studies on residents' subjective well-being have also confirmed that alleviating traffic congestion and improving housing affordability, as well as enhancing public service delivery, positively contribute to enhancing residents' subjective well-being

(Harari, 2020; Liu and Fu, 2023; Deng et al., 2024).

Based on the above, this study conducts empirical examination of the impact of urban spatial structure on residents' subjective well-being, and investigates the key contributing factors and their variations. Specifically, we employ population and economic census data to measure the polycentric spatial structure across Chinese cities, and integrate with data from the China Family Panel Studies (CFPS) spanning 2014 to 2020 to conduct the analysis. By situating China's experience within the global context, the findings aim to provide empirical support for addressing the question of "what type of urban spatial strategy should be developed and how it should be implemented" in the context of future urbanization development.

This study makes three key contributions to the existing literature. First, we empirically examine residents' subjective well-being from the perspective of urban amenity, focusing on three factors: commuting time, housing affordability and public service delivery. It expands the study on the mediating effects through which polycentric urban structure influences residents' subjective well-being. Second, this study conducts micro-level analysis on individual residents to investigate the impact of polycentric urban spatial structures on people-centered, high-quality urban development. Our study complements existing macro-level empirical research (Li et al., 2022b; Shang et al., 2023). Third, we adopt the number of centers, a simple and intuitive measure, to characterize the spatial structure of polycentric urban developments, and the indicators of central balance (e.g., Pareto index) as the robustness measures.

The reminder of this study is structured as follows. Section 2 provides a literature review and the research hypotheses. Section 3 outlines the data sources, variable selection, and econometric model employed. Section 4 presents the analysis methods and empirical results of basic regression, endogeneity, and robustness tests as well as

examinations of the mechanisms through which urban polycentricity influences residents' subjective well-being, and heterogeneity in the results. Section 5 summarizes and discusses the key findings, policy recommendations, and potential directions for further study.

2 Literature review and conceptual hypotheses

2.1 Literature review

2.1.1 Definitions of residents' subjective well-being and its influencing factors

Over the past few years, residents' demand for better quality of life has intensified. As a result, concerns and studies have been focused on the related issues about well-being. The abstract nature of well-being often leads to subjective well-being being used as an indicator in academic studies. Subjective well-being denotes an individual's comprehensive affective and cognitive perception of their life based on personal criteria (Diener et al., 1984). A widely recognized approach to measuring subjective well-being involves asking individuals about their happiness levels or life satisfaction, typically through a single question in a questionnaire (Cheung and Lucas, 2014; Li, 2021; Zhang et al., 2021).

Commuting plays a significant role in residents' lives, and the influence of commuting characteristics on residents' subjective well-being has attracted considerable attention. Several studies have concluded that commuting time does not have significantly negative influence on residents' subjective well-being (Dickerson et al., 2014; Morris and Zhou, 2018). The above conclusion is drawn from data collected in American and European nations. Nie and Sousa-Poza (2018) pointed out that life satisfaction is negatively affected by long commuting time, particularly when commuting time is more than one hour per day, in the context of China. Zhu et al. (2019) also indicated that the increase of commuting time lowered the overall life satisfaction.

Some recent studies also examined how different commuting modes affect residents' subjective well-being, considering the contribution of commuting time (Hu et al., 2018; Lades et al., 2020; Deng et al., 2024).

Housing has already become another important livelihood problem affecting subjective well-being, and the relationship between housing and subjective well-being has been examined. Liu and Fu (2023) found that housing affordability significantly enhances residents' happiness, primarily through improved health, development opportunities, and enjoyment-based consumption. Wang et al. (2023) revealed that lower housing affordability is strongly associated with poorer self-rated health and higher mortality rate, both of which reduce residents' well-being. Acolin and Reina (2022) identified a negative correlation between housing cost burden and life satisfaction, particularly among low-income households. Similarly, Bratt (2002) argued higher housing expenditure limits other consumption and then reduces happiness, with low-income households being most affected.

Public service is a critical factor influencing residents' well-being, as highlighted by numerous studies. Zhou et al. (2015) found that the quality of public services significantly enhances residents' happiness, with both service quality and delivery methods playing important roles. They also identified public service satisfaction as a key indicator of public service quality. Zhou et al. (2021) further emphasized that public service satisfaction positively affects residents' happiness. Higher-quality public services foster greater trust in the government, which, in turn, leads to increased happiness. Kim (2024) suggested that improving the accessibility of public service facilities enhances social participation, physical activity, and community belonging, thereby boosting life satisfaction, particularly among older adults. Dong et al. (2020) highlighted that public services positively affect residents' well-being, with this impact

strengthening over time. Moreover, public services contribute to well-being by promoting equality of opportunity, improving socioeconomic status, and optimizing the living environment.

2.1.2 Relationships between urban polycentric spatial structure and residents' subjective well-being

Research on the relationship between urban form or spatial structure and residents' subjective well-being has been predominantly examined from the dimensions of compactness and sprawl (Bereitschaft and Debbage, 2013; Mouratidis, 2019, 2022; Mun et al., 2024). Polycentric structure is characterized by two key features: decentralization and concentration. Decentralization involves the movement of people and employment opportunities from the urban core to the surrounding regions, leading to a distributed spatial configuration. Conversely, concentration refers to the clustering of people and employment opportunities from the periphery into sub-centers (Han et al., 2023). Therefore, the compactness and sprawl of urban form alone cannot better reflect the urban polycentric spatial structure.

The measurement of polycentricity has been explored from two primary perspectives: morphological and functional (Burger and Meijers, 2012). Morphological polycentricity, which emphasizes balanced regional development, focuses on internal characteristics, such as the distribution and size of urban centers (Sun et al., 2020). It is primarily characterized using standard deviation, descriptive analysis, the rank-size method, degree of primacy, and the Gini coefficient to measure the degree of balance among centers. These approaches assess the size and distribution of factors, such as population, land use, and enterprises (Dökmeci and Berköz, 1994; Burger and Meijers, 2012). Recently, Shang et al. (2023) used the number of centers as a measurement indicator for urban spatial structure, which produces results that better align with

China's multi-center development model dominated by a main center.

Polycentric spatial structure has the potential to mitigate agglomeration diseconomies by fostering a balanced size distribution. Then the related influence caused by polycentricity has attracted widespread attention. Studies have explored the relationship between polycentric structure and economic growth (Zhang et al., 2017; Li and Liu, 2018; Peng et al., 2023), CO_2 concentrations (Sat, 2018; Sun et al., 2020), urban innovation performance (Li and Du, 2022), and income gap (Sun et al., 2023; Zhang et al., 2023). The interplay between polycentricity and residents' subjective well-being has been investigated on a regional scale using the data in North-West Europe by Hoogerbrugge et al. (2021) However, studies exploring the interplay between polycentricity at a fine spatial scale within a city and residents' subjective well-being remain limited. Therefore, we seek to examine the relationship between the intra-urban polycentric spatial structure and residents' subjective well-being.

2.2 Study hypotheses

Empirical research directly linking urban polycentric spatial structure to subjective well-being remains limited. However, urban polycentric spatial structure significantly influences the economic dimensions, which are partially associated with residents' subjective well-being. Previous studies have suggested that urban polycentric spatial structure enhances economic performance by mitigating regional disparities, improving operational efficiency, and fostering overall labor productivity (Sun et al., 2015; Li et al., 2022b). A polycentric spatial structure, from a microeconomic perspective, promotes a more balanced distribution of resources and opportunities across regions by decentralizing urban functions and activities. This decentralization results in increased employment opportunities for residents, supporting personal income growth and consumption capacity (Wang et al., 2022; Li et al., 2024). Increased labor participation

rates and employment opportunities positively impact residents' subjective well-being (Gudmundsdottir, 2013). Consequently, the following hypothesis is proposed:

Hypothesis 1: Urban polycentric spatial structure significantly improves residents' subjective well-being.

Transportation is an important element of urban development that significantly influences individuals' daily lives. Studies have shown that commuting time adversely affects residents' subjective well-being. Extended commuting time often results in negative emotions that potentially harm physical and mental well-being, reduce work efficiency, and creativity, ultimately affecting residents' overall well-being (Yin et al., 2019; Wang et al., 2023; Deng et al., 2024). Consequently, reducing the daily commuting time is likely to enhance subjective well-being. Few studies have explored the connection between urban polycentricity and average commuting time and concluded that polycentricity alleviates traffic burdens and decreases residents' commuting time (Sun et al., 2016; Jun, 2020; Huai et al., 2021). Accordingly, the following hypothesis is proposed:

Hypothesis 2: Urban polycentric spatial structure enhances residents' subjective well-being by reducing commuting time.

Housing affordability refers to the extent to which households can meet their housing needs without exceeding their income capacity. It reflects the balance between housing cost and other expenses, playing a crucial role in influencing subjective well-being. The polycentric spatial structure, by decentralizing employment and public service nodes, breaks the monopoly of traditional monocentric land market and significantly expands the supply of developable land in the urban periphery area (Zheng et al., 2021). This reconfiguration of the land market flattens the land price gradient and slows the growth of housing price (Yu et al., 2008), thereby creating favorable

conditions for reducing the proportion of housing expenditure in household income. The improvement in housing affordability reduces household financial stress, and enables greater expenditure on education, healthcare, and leisure. These factors positively contribute to residents' subjective well-being (Li and Liu, 2018; Liu and Fu, 2023). Based on this, this study proposes:

Hypothesis 3: Urban polycentric spatial structure enhances residents' subjective well-being by improving housing affordability.

Urban public services play a crucial role in residents' quality of life and well-being. Enhancing the quality of urban public services and improving the accessibility of infrastructure can significantly increase residents' subjective well-being (Zhou et al., 2015; Kim, 2024). Studies have suggested that a polycentric urban structure, where resources are dispersed across several centers instead of being concentrated in the Central Business District (CBD), can improve the provision of public services (Meijers and Burger, 2010). This structure not only improves the accessibility of public services but also promotes more equitable access to services and infrastructure across the metropolitan region. Additionally, polycentric cities are often characterized by better infrastructure and greater diversity in public services, creating improved living and working environments (Peng et al., 2023; Zhou, 2025). Ultimately, improvements in the quality and accessibility of public services contribute to enhancing residents' quality of life and subjective well-being. Based on these insights, the following hypothesis is proposed:

Hypothesis 4: Urban polycentric spatial structure enhances residents' subjective well-being by improving public service delivery.

The polycentric spatial structure, by dispersing employment opportunities, public services, and transportation networks from a single CBD to multiple sub-centers, is

generally expected to improve residents' subjective well-being. However, the extent of this improvement may vary depending on individual characteristics. Urban residents with household registration enjoy institutional advantages in settlement, children's education, healthcare, and social security (Xiang et al., 2018; Zhao et al., 2025), making it easier for them to relocate to neighborhoods near sub-centers. As a result, they can directly benefit from reduced commuting time and more equitable access to public services. Moreover, existing literature indicates that high-income households exhibit significantly higher homeownership rates and a stronger willingness to pay for residential location compared to low-income groups (Glaeser et al., 2008). This allows them to more easily select housing near transit hubs or emerging sub-centers, thereby better capturing the compounded benefits of the polycentric urban development. Accordingly, the following hypothesis is proposed:

Hypothesis 5: Urban polycentric spatial structure enhances residents' subjective well-being, with a more significant effect for urban hukou holders and high-income residents.

In cities with higher administrative hierarchies, governmental power, high-quality education, and major transportation hubs are highly concentrated in the central urban area, leading to intensified traffic flow and public service demand (Zhen et al., 2022). As these cities expand, this spatial polarization further exacerbates congestion and facility overload in the central area, resulting in increasing marginal disutility. By decentralizing some administrative and public service functions to sub-centers, the polycentric urban form can alleviate pressure on central districts and improve urban operational efficiency (Hamidi and Ewing, 2015; Zhu and Zhang, 2025). These marginal benefits are particularly prominent in higher-tier cities. Additionally, high-density cities, characterized by the concentration of population and employment, are

more likely to experience saturation in road networks and public service capacities, leading to a significant increase in congestion cost as population density rises (Chang et al., 2021). The polycentric layout helps mitigate these issues by spatially dispersing population and services, reducing local density and easing the pressures associated with excessive agglomeration. This, in turn, creates greater potential for improving residents' subjective well-being. Based on these considerations, the following hypothesis is proposed:

Hypothesis 6: Urban polycentric spatial structure enhances residents' subjective well-being, with a more significant effect in cities with higher administrative status and greater population density.

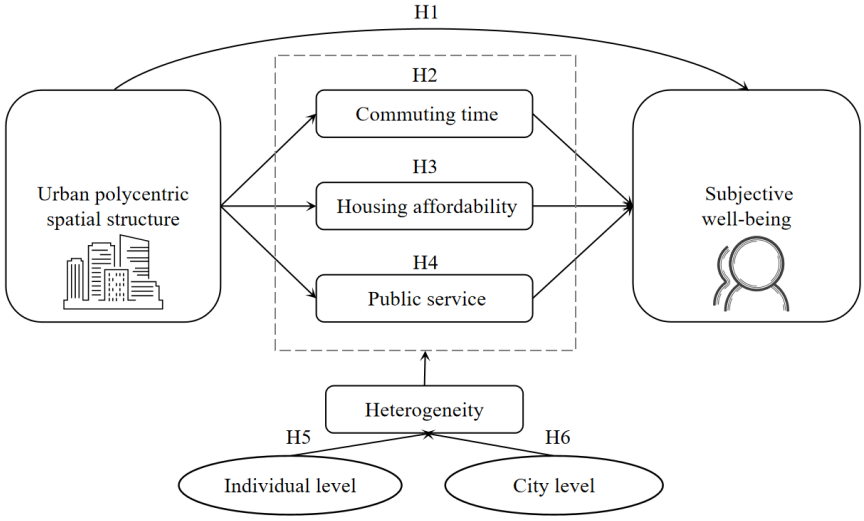

Figure 1. Theoretical framework and hypothesis

3 Data, variables, and model

3.1 Data source

Our study uses data from the China Family Panel Studies (CFPS), which is a national survey conducted by the China Social Science Survey Center at Peking University every 2 years in 25 provinces, municipalities, and autonomous regions of China. This survey collects data at three different levels: individual, household and

community, including residents' personal characteristics, economic activities, educational outcomes, family relationships and family dynamics, community characteristics, public services, and so on. CFPS data has been widely used to investigate various issues related to happiness or life satisfaction (Nie et al., 2021; Zhu et al., 2024). For this study, we obtain an unbalanced panel dataset spanning 2014 to 2020 of 27,996 individuals coming from 113 cities.

Separately, we collect data on the cities included in our CFPS sample. City-level data, such as per capita GDP, urban population and district populations, are obtained from the China City Statistical Yearbook, the China Statistical Yearbook for Regional Economy, and provincial and municipal statistical yearbooks. Meanwhile, data for calculating urban polycentricity comes from nighttime lights data and the LandScan Global Population Database. To address potential endogeneity concerns, we also use urban river density, derived from the vector-based distribution map of rivers provided by the National Geomatics Center of China, as an instrumental variable.

3.2 Data variables

Dependent variable. Residents' subjective well-being serves as the dependent variable, operationalized through the concept of life satisfaction (Veenhoven, 1991). Life satisfaction is measured using respondents' answers to the question, "Are you satisfied with your life?" from the CFPS survey. Responses are assessed on a 5-point Likert scale. In our sample, the average life satisfaction score is 3.958 points, aligning with findings from other related studies (Zhu et al., 2024). Happiness is among the most widely used measures of subjective well-being in the literature (Zhang et al., 2017; Perez-Truglia, 2020; Liu et al., 2024). To assess the robustness of our regression results, we also use happiness as a proxy for residents' subjective well-being in additional analyze. Happiness is measured using the question: "How happy are you?" Responses

are recorded on a scale from 1 (very unhappy) to 10 (very happy). However, happiness scores are available only in 2014, 2018, and 2020, causing a considerable reduction in sample size.

Independent variable. To better reflect the developmental realities of the spatial structure of Chinese cities, we measure intra-city polycentric structure using the number of centers. The LandScan database is first used to identify urban areas, followed by the calculation of the number of urban centers. For the identification strategy, we employ the exploratory spatial data analysis (ESDA) method to identify urban areas. The process involves several steps: First, a spatial weight matrix is constructed based on the Queen contiguity rule, where grid cells sharing a vertex are considered neighbors. Next, the Local Moran's I index is calculated to identify grid cells where both population density and its spatial lag significantly exceed the citywide average, using a significance threshold of 0.1. These significant grid cells are then merged into polygons by connecting adjacent grid vertices. The polygon with the highest population is designated as the central urban area. To address spatial divisions caused by natural features (e.g., rivers in cities), polygons located within 2 km of the central urban area are incorporated into it. This process is repeated iteratively until all remaining polygons are at least 2 km away from the main urban center. Urban centers are identified based on two criteria: (i) the polygon area must exceed 1 km², and (ii) the total population must exceed 50,000. The number of centers in each city is then determined and used as a metric to quantify spatial structure. A higher number of centers indicates a greater degree of urban polycentricity.

In robustness checks, we employ two methods to calculate the polycentricity index as an alternative measure for the number of urban centers. According to Li and Liu (2018), the first method builds on the aforementioned calculation of the number of

urban centers and is expressed by the following formulas:

$$Polycentrcity = 1 - \frac{\sigma_{obs}}{\sigma_{max}} = 1 - \frac{\sqrt{\frac{\sum_{i=1}^{n}(I_i - \bar{I})^2}{n}}}{(I_{max}/2)} \quad (1)$$

$$I_i = x_i d_i \quad (2)$$

$$I_{\max} = x_{\max} d_{\max} \quad (3)$$

where n represents the number of urban centers (including both primary and secondary centers); σ_{obs} denotes the standard deviation of "importance" value of all centers within a city; σ_{max} represents the standard deviation of "importance" in a hypothetical two-center city, where the main center has the maximum observed "importance" and the secondary center has zero "importance"; $\bar{I}$ refers to the average "importance" of all centers. The "importance" of a subcenter (I_i) is calculated as the product of its population size (x_i) and its distance (d_i) to the primary center, while that of the main center which is also the maximum observed "importance" (I_{max}) is the product of its population size (x_{max}) and the largest center-subcenter distance (d_{max}). In cities with only one center, the polycentricity degree is 0; in cities with no centers, the index is not calculated. Therefore, the polycentricity index ranges from 0 to 1, where higher value represents a more polycentric urban development.

Furthermore, following the work of Sun et al. (2020), we employ the rank-size based Pareto exponent method to measure the urban polycentric structure. The Pareto index is calculated as follows:

$$\ln(Rank - 1/2) = \alpha + \beta \ln(Size) + \varepsilon \quad (4)$$

where β is the level of morphological polycentricity, with a higher β value indicating higher polycentricity; $Rank$ and $Size$ denotes the population hierarchy

and the scale of subunits in prefecture- or higher-level city region, respectively; α represents the constant; and ε denotes error terms. To address potential biases in the estimation due to the small sample size, we follow Gabaix and Ibragimov (2012) and adjust the subunit rank by subtracting half from the optimal displacement.

Mediating variables. The mediating variables include individual commuting time, housing affordability, and public service delivery. The first variable is measured based on respondents' answers to the CFPS question regarding one-way commuting duration. The second variable, housing affordability, is quantified by the ratio of housing cost (mortgage or rent) to household income. This indicator reflects the financial burden on residents, with a higher ratio indicating lower affordability. Given the significant spatial variation in service density across urban areas, directly matching public service levels to individuals may lead to measurement bias. To address this, the third variable is derived from the CFPS questionnaire, where the related item is "How would you rate the overall situation of public facilities (such as education, healthcare, and transportation) in your community?". Responses are recorded on a five-point Likert scale ranging from 1 (very good) to 5 (very poor). In future research, we aim to use more objective measures, such as person-specific infrastructure density or quality, to better reflect spatial disparities within cities.

Control variables. To strengthen the validity of empirical analysis, we also incorporate control variables that may potentially affect the connection between urban polycentricity and residents' subjective well-being. At the individual level, we include demographic and socio-economic variables derived from the CFPS survey, such as age, gender (Male = 1, Female = 0), self-rated health status (measured on a scale of 1 to 5, where lower scores indicate better health), marital status (Married = 1, Unmarried = 0), trust level (measured on a scale of 1 to 10, with higher scores indicating greater trust in

strangers), satisfaction with the work environment (rated from 1 to 5, with higher scores indicating greater satisfaction), individual income (calculated as total household income divided by household size), and the number of household members. Furthermore, we control for several city-level factors that might influence residents' subjective well-being, including urban population, and urban economic development level. These data are sourced from the China City Statistical Yearbook, the China Statistical Yearbook for Regional Economy, and relevant provincial and municipal statistical yearbooks. The descriptive statistics for the variables employed in the analysis are presented in Table 1.

Table 1
Descriptive statistics.

Variables	Description	Mean	SD	Min	Max
SWB	Life satisfaction	3.958	0.947	1.000	5.000
Happiness	Happiness score	7.668	1.899	1.000	10.000
Poly_number	Number of urban centers	4.959	2.677	1.000	24.000
Poly1	Polycentricity calculated using Landscan and lights data	0.384	0.150	0.000	0.694
Poly2	Polycentricity calculated by the Pareto index	1.647	0.688	0.375	5.195
Age	Age	40.681	12.432	16.000	75.000
Gender	Gender	0.572	0.495	0.000	1.000
Health	Health status	3.231	1.094	1.000	5.000
Marriage	Marital status	0.829	0.376	0.000	1.000
Trust	Level of interpersonal trust	1.101	1.461	0.000	10.000
Environ_work	Work environment	3.547	0.912	1.000	5.000
Income_per	Annual personal income	4.417	6.718	0.050	216.000
Count	Household members	4.244	1.767	1.000	10.000
Population	Urban population	773.166	700.659	89.000	3209.000
Gdp	GDP per capita in yuan (ln)	10.315	1.096	7.148	12.068
River_rate	The product of river density and the inverse of the exchange rate	4.850	5.637	0.729	22.780
Commuting time	One-way commuting duration (minute)	19.809	18.170	1.000	150.000
Housing affordability	The ratio of mortgage or rent expenditure to household income	0.143	0.245	0.000	0.734
Public service delivery	Satisfaction with public facilities in the community, with higher values indicating lower satisfaction	2.627	0.928	1.000	5.000

3.3 Econometric model

3.3.1 Baseline regression model

To identify the relationship between urban polycentric spatial structure and residents' subjective well-being, we develop an ordered logit model, given that well-being variable is measured by a single-item ordinal indicator. This model is based on a latent-variable formulation and estimated by maximum likelihood. Let SWB_{it} denote the observed ordinal well-being of individual i in year t, and let SWB_{it}^{*} be the corresponding latent continuous variable. The latent structure is modeled as:

$$SWB_{it}^{*}=\beta_0+\beta_1 Poly\_number_{it}+\beta_2 Controls_{it}+\mu_r+\gamma_t+\varepsilon_{it} \quad (5)$$

where $Poly\_number_{it}$ denotes the number of urban centers where the *i*-th individual lives in year *t*; $Controls_{it}$ represents control variables, including individual characteristic and city-level control variables; $\boldsymbol{\beta}=[\beta_0,\beta_1,\beta_2,\cdots]$ denotes the corresponding coefficient vector; μ_r and γ_t represent year and city fixed effects, respectively; and ε_{it} is the random error subject to logistic distribution. Furthermore, standard errors are clustered at the individual level to account for potential heterogeneity.

Specifically, the latent variable SWB_{it}^{*} is defined so that its observed values are categorized into ordered classes through a set of unknown thresholds K_1, K_2, K_3, K_4. These thresholds are estimated by the maximum likelihood as well. When $SWB_{it}^{*} \le K_1$, the observed category of SWB is 1, i.e., SWB_{it}=1. When it falls between two consecutive thresholds, the observed value corresponds to the respective happiness category. If it exceeds the highest threshold K_4, the observed SWB category is 5, i.e., SWB_{it}=5. The relationship between the latent variable SWB_{it}^{*} and the ordered variable SWB_{it} is as follows:

$$SWB_{it} = \begin{cases} 1, & if\ SWB_{it}^{*} \le K_1, \\ 2, & if\ K_1 < SWB_{it}^{*} \le K_2, \\ 3, & if\ K_2 < SWB_{it}^{*} \le K_3, \\ 4, & if\ K_3 < SWB_{it}^{*} \le K_4, \\ 5, & if\ SWB_{it}^{*} > K_4. \end{cases} \tag{6}$$

Further, Eq. (6) can be transformed into the following equation:

$$SWB_{it} = j, \qquad K_{j-1} < SWB_{it}^{*} \le K_j, \qquad j = 1,2,3,4,5 \tag{7}$$

Then the panel ordered logit model can be defined as:

$$\begin{aligned} P(SWB_{it} = j) &= P(K_{j-1} < SWB_{it}^{*} \le K_j) \\ &= \Lambda(K_j - \boldsymbol{\beta}^T \boldsymbol{X}_{it}) - \Lambda(K_{j-1} - \boldsymbol{\beta}^T \boldsymbol{X}_{it}) \end{aligned} \tag{8}$$

where $\Lambda(\cdot)$ denotes the cumulative distribution function of the logistic distribution ($\Lambda(z) = \frac{1}{1+e^{-z}}$), and $\boldsymbol{X}_{it}$ represents the vector of explanatory variables, includes $Poly\_number_{it}$ and control variables.

The ordered logit model assumes proportional odds across categories. To test this assumption, we use the Brant test (Brant, 1990). Define a binary indicator for each threshold $j \in \{1,2,3,4\}$:

$$\eta_j = \begin{cases} 1, & if\ SWB_{it} > j, \\ 0, & if\ SWB_{it} \le j \end{cases} \tag{9}$$

Let $\pi_j = P(\eta_j = 1) = P(SWB_{it} > j)$. Under the proportional odds assumption, the following logit model holds:

$$logit(\pi_j) = -K_j + \boldsymbol{\beta}^T \boldsymbol{X}_{it} \tag{10}$$

If the coefficients differ significantly across, the proportional odds assumption is violated.

3.3.2 Endogeneity Mitigation

To address potential endogeneity between the number of urban centers and subjective well-being, we adopt the Control Function Approach, following Rivers and

Vuong (1988) and Wooldridge (2010).

(1) First Stage: Instrumental Variable Regression

We regress the potentially endogenous independent variable $Poly\_number_{it}$ on an instrumental variable IV_{it} and control variables $Control_{it}$ (e.g., individual and urban characteristics) using Ordinary Least Squares.

$$Poly\_number_{it} = \boldsymbol{\alpha}^T \boldsymbol{Z}_{it} + \mu_r + \gamma_t + \varepsilon_{it}^{(0)} \tag{11}$$

where $\boldsymbol{\alpha}$ is the coefficient vector and $\boldsymbol{Z}_{it}$ includes IV_{it} and $Control_{it}$, $\varepsilon_{it}^{(0)}$ is the first-stage regression residual . We then extract $\hat{\varepsilon}_{it}^{(0)}$ for use in the second stage.

(2) Second Stage: Ordered Logit Model with Endogeneity Control

We include $\hat{\varepsilon}_{it}^{(0)}$ as an additional regressor in the ordered logit model:

$$P(SWB_{it} = j) = \Lambda(K_j - \boldsymbol{\theta}^T \boldsymbol{X}_{it} - \delta\hat{\varepsilon}_{it}^{(0)}) - \Lambda(K_{j-1} - \boldsymbol{\theta}^T \boldsymbol{X}_{it} - \delta\hat{\varepsilon}_{it}^{(0)}) \tag{12}$$

where $\boldsymbol{\theta}$ is a new coefficient vector, δ is the coefficient on the residual term. A significant δ indicates the presence of endogeneity and validates the control function correction.

3.3.3 Mediating effect model

To investigate the mechanisms through which urban polycentric spatial structures affect residents' subjective well-being, we propose a mediating effect model based on the urban amenity perspective. The first channel considers the transportation perspective and examines how urban polycentric spatial structure affects commuting time. The second involves treating the ratio of rent or mortgage to household income for residents as a mediating variable to assess how urban polycentric spatial structure affects housing affordability. The third channel investigates how urban spatial structure affects public service delivery. Drawing on previous research (Chen et al., 2020; Wen et al., 2024), we employ ordered logit models for the subjective well-being equations, and ordinary least squares for the mediating variable equations, in accordance with

variable characteristics. The mediating effect model is specified as follows:

$$SWB_{it}^{*}=\beta_0^{(1)}+a_0 Poly\_number_{it}+\beta^{(1)}Controls_{it}+\mu_r^{(1)}+\gamma_t^{(1)}+\varepsilon_{it}^{(1)} \quad (13)$$

$$M_{it}=\beta_0^{(2)}+a_1 Poly\_number_{it}+\beta^{(2)}Controls_{it}+\mu_r^{(2)}+\gamma_t^{(2)}+\varepsilon_{it}^{(2)} \quad (14)$$

$$SWB_{it}^{*}=\beta_0^{(3)}+a_2 Poly\_number_{it}+bM_{it}+\beta^{(3)}Controls_{it}+\mu_r^{(3)}+\gamma_t^{(3)}+\varepsilon_{it}^{(3)} \quad (15)$$

where the mediating variable M_{it} is sequentially $Traffic_{it}$, $Affordability_{it}$, and $Service_{it}$. Specifically, $Traffic_{it}$ denotes the daily commuting time of resident i in year t, $Affordability_{it}$ represents the proportion of housing costs (mortgage or rent) to household income of resident i in year t, and $Service_{it}$ reflects the resident i's satisfaction with the overall situation of public facilities (such as education, healthcare, and transportation) in community in year t. As for coefficients, a_0 reflects the total effect of urban polycentric spatial structure on residents' subjective well-being. a_1 represents the effect of urban polycentric spatial structure on the mediating variable M_{it}. a_2 is the direct effect of urban polycentric spatial structure on subjective well-being after controlling for the mediating variable, and b is the effect of the mediating variable on subjective well-being. Combining Equations (14) and (15), the mediating effect is $a_1 b$, which reflects the indirect influence of urban polycentric spatial structure on residents' subjective well-being through the mediating variable. The ratio $a_1 b/a_0$ indicates the magnitude of the mediating effect relative to the total effect.

4 Study findings

4.1 Baseline regression results

The ordered logit model is based on the proportional-odds assumption, which requires that each independent variable exerts the same effect across all cumulative thresholds of the ordered outcome. We assess this assumption using the Brant test.

The results show that the parallel-lines assumption holds (chi-square = 44.2, degree of freedom = 33, *p*-value = 0.092), supporting the model's suitability and justifying its use in subsequent analysis.

Building on this validated model, we investigate the effect of urban polycentricity on residents' subjective well-being, with results reported in Table 2. Column (1) reports the regression results for the core variables, while Column (2) incorporates individual characteristic controls, and Column (3) adds city-level controls. The stepwise inclusion of these control variables reveals that urban polycentricity is positively correlated with subjective well-being, supporting Hypothesis 1.

Table 2
Results of the baseline regression.

Dependent variable		(1)	(2)	(3)
		SWB	SWB	SWB
Poly_number		0.051***	0.055***	0.057***
		(0.009)	(0.009)	(0.009)
Individual variables	Age		0.014***	0.014***
			(0.001)	(0.001)
	Gender		-0.001	-0.002
			(0.026)	(0.026)
	Health		0.312***	0.312***
			(0.013)	(0.013)
	Marriage		0.351***	0.351***
			(0.037)	(0.037)
	Trust		-0.006	-0.006
			(0.010)	(0.010)
	Environ_work		0.299***	0.299***
			(0.014)	(0.014)
	Income_per		0.065***	0.064***
			(0.016)	(0.016)
City variables	Count		0.028***	0.028***
			(0.008)	(0.008)
	Population			0.001***
				(0.000)
	Gdp			0.003
				(0.061)
	Year FE	√	√	√
	City FE	√	√	√
	Observations	27996	27996	27996

Note: Robust standard errors are reported in parentheses, and *, **, and *** represent the 10%, 5%, and 1% significance levels.

The regression results for the control variables also align with theoretical expectations and previous research findings (Zhang et al., 2021; Wang et al., 2023).

Residents' subjective well-being exhibits a significantly positive association with age, likely reflecting the cumulative social experiences that accompany aging, which enhance emotional regulation and the perception of happiness. Additionally, residents in good health and happy marriages report higher levels of subjective well-being. Improved work environments enhance job satisfaction and mental health, thereby contributing to overall subjective well-being. Furthermore, higher personal income and larger household size are positively associated with greater subjective well-being. At the urban level, urban population size is positively associated with subjective well-being.

4.2 Robustness checks

Instrumental variable method. To enhance the reliability of our findings and address potential endogeneity, we employ the Control Function Approach within the ordered logit framework to identify the causal effect between urban polycentric spatial structure and residents' subjective well-being. Government intervention, physical geography, and socio-economic factors are crucial in shaping the development of urban polycentric spatial structure (Li et al., 2022a). Among physical and geographical factors, water sources play a crucial role (Bosker and Buringh, 2017). Population concentrations are often found along rivers, which fragment land use and encourage clustering near different river sections. Additionally, the distribution of natural resources, such as water sources, is exogenous, making it a suitable basis for constructing an instrumental variable. However, as river density remains relatively static in the short term, a macroeconomic shock variable with a temporal trend is required. Exchange rates are selected as the macroeconomic shock variable, as evidence indicates that increased openness promotes factor concentration, while exchange rate appreciation can hinder exports, influencing employment and population distribution in cities (Liu et al., 2017).

Consequently, this study uses the product of river density and the inverse of the exchange rate as an instrumental variable for polycentric urban spatial structure.

Table 3 reports the regression results based on the control function approach. Column (1) presents the regression results of the instrumental variable on the endogenous variable number of urban centers. The instrument's coefficient is significantly positive, and the first-stage *F*-statistic is 22367.19, well above the threshold of 10, indicating a strong correlation between the instrumental variable and the number of urban centers, effectively ruling out weak instrument issue. Column (2) shows the ordered logit regression results after incorporating the first-stage residual. The residual term is significant at 1% level, confirming the existence of endogeneity and the effectiveness of the control. Meanwhile, the positive effect of the number of urban centers on residents' subjective well-being remains statistically significant.

Because the core empirical analysis relies on the ordered logit model, we also conduct the Brant test to verify the proportional odds assumption for the instrumental variable ordered logit model. The results show that the parallel-lines assumption holds (chi-square = 28.6, degree of freedom = 33, *p*-value = 0.686). This confirms the suitability of the ordered logit specification, and supports the reliability of the estimated effect of the number of urban centers on residents' subjective well-being.

Table 3
Endogeneity test results: Control Function Approach.

Variables	(1)	(2)
	Poly_number	SWB
Poly_number		0.769***
		(0.046)
River_rate	1.461***	
	(0.034)	
e_hat		-0.757***
		(0.048)
F-sattistic	22367.19	
Controls	√	√
Year FE	√	√

City FE	√	√
Observations	27996	27996

Note: "e_hat" denotes the residual from the first-stage regression, used to control for endogeneity. Robust standard errors are reported in parentheses, and *, **, and *** represent the 10%, 5%, and 1% significance levels.

To further evaluate the robustness of our regression findings, we conduct several robustness checks. These include substituting the measures of the core independent variable, adjusting the dependent variable, altering the regression method, modifying the clustering criteria, and excluding municipalities. The corresponding results are presented in Table 4.

Substituting the measures of the core independent variable. We use the polycentricity index and the Pareto index as alternative measures for urban polycentric spatial structure. Columns (1) and (2) of Table 4 report significantly positive coefficients. This suggests that regardless of whether the spatial structure is measured by the number of centers or polycentricity index, polycentric spatial structure can significantly improve residents' subjective well-being, thereby validating Hypothesis 1.

Table 4
Robustness test results.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	SWB	SWB	Satisfaction	SWB	SWB	SWB
Poly_number			0.026***	0.017***	0.057***	0.019*
			(0.009)	(0.004)	(0.010)	(0.013)
Poly1	1.338***					
	(0.223)					
Poly2		0.066***				
		(0.029)				
Constant				1.921***		
				(0.320)		
Controls	√	√	√	√	√	√
Year FE	√	√	√	√	√	√
City FE	√	√	√	√	√	√
Observations	27996	27996	19254	27996	27996	24125

Note: Robust standard errors are reported in parentheses, and *, **, and *** represent the 10%, 5%, and 1% significance levels.

Adjusting the dependent variable. We replace the dependent variable Life satisfaction with Happiness score. The coefficient in Column (3) of Table 4 remains

significantly positive, indicating that urban polycentric spatial structure significantly enhances residents' subjective well-being, thereby supporting Hypothesis 1.

Altering the regression method. We use the ordinary least squares (OLS) model to examine the robustness of results. A comparative analysis of Table 2 and Column (4) of Table 4 reveals that the directions of the coefficients for the core explanatory variables remain consistent across both the ordered logit and the OLS specifications, aligning with the finding of Ferrer-i-Carbonell and Frijters (2004). The main differences lie in the size and significance of the coefficients. This consistency highlights the robustness of the findings across different regression models.

Modifying the clustering criteria. The benchmark regression initially employs individual-level clustering of standard errors to address potential heteroskedasticity and autocorrelation issues. However, behaviors in the same city are likely to be similar, while those across different cities may vary. To account for this, the clustering level is adjusted to the city level, and the regression is re-estimated. As shown in Column (5) of Table 4, the coefficient of urban polycentricity remains positive even after this adjustment, further supporting the robustness of the findings.

Excluding municipalities. We adjust the research sample by excluding municipalities directly governed by the central government. Even after this adjustment, the coefficient in Column (6) remains significantly positive. By removing these municipalities from the analysis, we reduce the potential influence of their unique economic characteristics and urban planning advantages, thereby further validating Hypothesis 1.

4.3 Mechanism analysis

In this subsection, we examine how polycentric spatial structure affects residents' subjective well-being through three key channels from urban amenity perspective:

commuting time, housing affordability and public service delivery.

4.3.1 Mediating effect of commuting time

Higher urban polycentricity is associated with shorter commuting times, as evidenced by the significantly negative coefficient reported in Column (1) of Table 5. This finding is consistent with prior studies of Sun et al. (2015) and Sun et al. (2020). In Column (2) of Table 5, when both the independent variable and the mediator are included, the coefficient on polycentric urban structure remains significantly positive, whereas the coefficient on commuting time remains significantly negative. Specifically, the evolution of a polycentric urban structure is associated with reduced commuting duration, which in turn enhances the subjective well-being of residents. Longer commuting time is often linked to greater fatigue and higher stress, both of which negatively affect residents' subjective well-being. Reducing commuting duration not only enhances the efficiency of daily activities but also fosters a more balanced and less stressful lifestyle. Shorter commute time alleviates the commuting-related stress, creating opportunity for individuals to engage in recreational, familial, or social activities, thereby further improving their happiness (Yin and Shao, 2021; Yu et al., 2024). Thus, urban polycentricity positively contributes to residents' subjective well-being by reducing daily commuting time, providing support for Hypothesis 2.

4.3.2 Mediating effect of housing affordability

The coefficient in Column (3) of Table 5 is significantly negative, indicating that a more polycentric urban spatial structure is associated with a lower ratio of mortgage or rent expenditure to household income, and thus better housing affordability. In Column (4) of Table 5, the impact of the polycentric spatial structure on residents' subjective well-being is significantly positive, while the coefficient on housing affordability is significantly negative. This implies that as the ratio of housing expenditure to income

decreases, residents' subjective well-being increases. The improvement in housing affordability reduces residents' economic burden and alleviates living pressure, which contributes to maintaining good health and, subsequently, enhances happiness (Wang et al., 2021). Moreover, improved housing affordability enables residents to allocate more resources toward developmental and enjoyment-oriented consumption, thereby optimizing their consumption structure and further enhancing their quality of life and happiness (Liu and Fu, 2023). Therefore, the urban polycentric spatial structure enhances residents' subjective well-being by improving housing affordability, thus providing support for Hypothesis 3.

Table 5
Mediation mechanism test results.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Commuting time	SWB	Housing affordability	SWB	Public service delivery	SWB
Poly_number	-0.223**	0.056***	-0.008***	0.056***	-0.017**	0.136***
	(0.084)	(0.009)	(0.001)	(0.009)	(0.008)	(0.017)
Commuting time		-0.002**				
		(0.001)				
Housing affordability				-0.160**		
				(0.061)		
Public service delivery						-0.174***
						(0.019)
Controls	√	√	√	√	√	√
Year FE	√	√	√	√	√	√
City FE	√	√	√	√	√	√
Observations	27996	27996	27996	27996	14250	14250

Note: Robust standard errors are reported in parentheses, and *, **, and *** represent the 10%, 5%, and 1% significance levels.

4.3.3 Mediating effect of public service delivery

In Table 5, Column (5) reports a significantly negative coefficient at the 5% level. Because the satisfaction score is reverse-coded (i.e., a higher value indicates lower satisfaction), this implies that greater urban polycentricity is associated with higher satisfaction with public services. A polycentric spatial structure improves residents' accessibility to, quality of, and diversity in public services (Meijers and Burger, 2010;

Peng et al., 2023), thereby enhancing the living environment and overall quality of life. Moreover, Column (6) shows that the improvement in surrounding public facilities significantly boosts residents' subjective well-being. Improvements in public services (such as more convenient transportation and a richer supply of educational and medical resources) can optimize residents' daily living experiences and lead to higher satisfaction. Thus, urban polycentricity enhances residents' subjective well-being by improving public service delivery, providing support for Hypothesis 4.

4.4 Heterogeneity analysis

The impact of polycentric structure on well-being may exhibit extensive heterogeneity at the individual level and city level. At the individual level, personal income and household registration type are considered as heterogeneous variables. The selection of personal income is based on its well-established association with subjective well-being (Ye et al., 2023). Household registration type (hukou) is another key variable in the Chinese context. At the city level, we explore the heterogeneity between city tier, population density and residents' subjective well-being. City tier reveals differences in resource allocation and development levels among cities, while population density directly impacts living space and environmental pressures, significantly influencing subjective well-being.

4.4.1 Individual heterogeneity

(1) Household registration type. Household registration refers to China's hukou system, an identity registration system based on a citizen's place of residence and birthplace. Residents are categorized into urban and rural groups based on their household registration type (Afridi et al., 2015; Li et al., 2023). Columns (1) and (2) of Table 6 show that the urban polycentric spatial structure significantly enhances the well-being of urban residents, whereas its effect on rural residents' well-being is not

statistically significant. Urban household registration is often associated with access to a broader range of public service resources. Individuals with urban residency status typically enjoy higher social and economic status, as well as improved access to these resources. The polycentric spatial structure offers greater employment opportunities, a richer cultural environment, and increased opportunities for social interaction, all of which contribute to higher life satisfaction among urban residents (Li et al., 2024). Conversely, rural residents face geographic and economic constraints, as well as challenges related to social integration and economic mobility, which hinder their well-being. Consequently, the benefits of the polycentric spatial structure are less pronounced for rural residents. These findings suggest that accelerating household registration reform could help dismantle the urban-rural dual structure and strengthen the positive effects of polycentricity on residents' subjective well-being. However, the household registration (hukou) system does not fully reflect the complexity of rural–urban migration and urbanization. Some areas have urbanized while residents still hold rural hukou, leading to potential misclassification. Likewise, individuals with rural hukou living in urban areas may not be accurately represented. While hukou type remains a relevant factor, it may not capture actual living conditions. Future studies should adopt more refined urban–rural classifications to better assess the impacts of migration and hukou reform on well-being.

(2) Personal income. We examine the impact of urban polycentric spatial structure on residents' subjective well-being with different income levels. The sample is divided into two categories based on per capita income: high-income and low-income groups. Table 6 shows that the regression coefficient for the high-income group is significantly positive, while the coefficient for the low-income group is not significant. These results indicate that urban polycentricity significantly enhances the subjective well-being of

high-income individuals. This phenomenon may be related to the higher quality of life and greater access to social resources enjoyed by the high-income group, allowing them to better utilize the benefits brought by urban polycentricity. For example, high-income individuals typically reside in areas with well-developed infrastructure and convenient transportation (Glaeser et al., 2008), making it easier for them to engage in cultural activities and build social network, which in turn boosts their subjective well-being. In contrast, low-income individuals, due to income constraint, may not fully enjoy the advantages of polycentricity, resulting in no significant improvement in their well-being.

4.4.2 City heterogeneity

(1) City Tier. We further examine how urban polycentric spatial structures influence residents' subjective well-being across different city tiers. Cities are categorized into tiers based on business resources, urban hubs, and urban activity indicators, ranging from first-tier to fifth-tier. For analytical clarity, first-tier and new first-tier cities are grouped into a single category. Table 6 reports a significantly positive coefficient for first-tier cities, whereas the coefficient for non-first-tier cities is not significant. These findings suggest that urban polycentricity significantly enhances residents' subjective well-being in first-tier cities. This effect can be attributed to the abundant job opportunities and well-developed infrastructure in these cities. Polycentric spatial structures in first-tier cities facilitate easier access to social resources and cultural activities, thereby improving residents' well-being (Zhang et al., 2023). In contrast, while non-first-tier cities exhibit polycentric spatial structures, their underdeveloped infrastructure and transportation systems fail to adequately meet residents' needs, diminishing the positive impact of polycentricity on subjective well-being.

(2) Population density. The data was divided into two groups based on the median population density level. As shown in Table 6, the regression results are not significant

for the low-density city sample but are significantly positive at the 1% level for the high-density city sample. These findings indicate that urban polycentricity has a stronger impact on residents' well-being in high-density cities. In such cities, a polycentric structure is more effective in balancing resource distribution, fostering social interactions, and providing abundant economic opportunities (Huai et al., 2021), thereby enhancing residents' quality of life and significantly improving their subjective well-being. Conversely, in low-density cities, where resources are more dispersed, social networks are weaker, and economic opportunities are more limited, the impact of polycentricity on residents' subjective well-being is relatively muted, with its contribution to increasing happiness being less significant.

Table 6
Heterogeneity results.

Dependent variable	Household registration		Personal income		City tier		Population density	
SWB	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Poly_number	0.083***	0.010	0.012	0.126***	0.146***	0.003	0.004	0.105***
	(0.013)	(0.014)	(0.013)	(0.016)	(0.018)	(0.011)	(0.013)	(0.014)
Controls	√	√	√	√	√	√	√	√
Year FE	√	√	√	√	√	√	√	√
City FE	√	√	√	√	√	√	√	√
Observations	15852	12144	13991	14005	6052	21944	13942	14054

Note: Robust standard errors are reported in parentheses, and *, **, and *** represent the 10%, 5%, and 1% significance levels.

5 Discussion and conclusions

With the rapid progress of urbanization, Chinese cities are increasingly confronted with "urban diseases," such as traffic congestion and soaring housing prices, which significantly undermine residents' happiness (Li et al., 2016). Optimizing urban spatial structure presents a potential solution to enhance residents' subjective well-being. This study conducts a comprehensive analysis of the impact of urban polycentricity on

residents' subjective well-being in China, while also exploring the underlying mechanisms from the perspective of urban amenities. The results reveal that urban polycentric spatial structure significantly improves residents' subjective well-being, aligning with findings in international contexts. For example, Hoogerbrugge et al. (2021) found a positive correlation between regional polycentricity and residents' subjective well-being in 68 regions across Northwestern Europe. Additionally, Brown et al. (2016) showed a negative correlation between urban centralization (the relative proportion of the population in core areas) and residents' life satisfaction in 33 cities across five OECD countries (i.e., France, Japan, Netherlands, Spain and Sweden). Our findings contribute empirical evidence in the Chinese context. Moreover, this study identifies the positive impact of urban polycentricity on subjective well-being by reducing commuting time, increasing housing affordability, and enhancing public service delivery. Furthermore, the positive effects of urban polycentricity are particularly pronounced among residents with urban household registration, high-income groups, first-tier cities, and regions with higher population density.

These findings suggest that optimizing urban spatial structures through the development of a coordinated polycentric framework is an effective strategy to enhance residents' subjective well-being. The housing, commuting, and public service conditions for Chinese residents living in polycentric cities play a significant role in shaping their subjective well-being, underscoring the importance of these factors as critical societal issues that directly impact residents' lives. Consequently, governments should prioritize housing, transportation, and public service concerns within the broader context of urban planning.

Specifically, the design of polycentric spatial structures must be carefully aligned with urban development dynamics to avoid unplanned expansive growth patterns, such

as “pancake-like” sprawl. Strategic planning of transportation infrastructure is also essential to improve traffic accessibility and ensure equitable access for all residents. Additionally, industrial layouts should be guided with a focus on promoting mixed-use development near industrial areas to stimulate housing investment. Furthermore, optimizing the allocation of public resources and enhancing the quality and diversity of public services can drive sustainable social development. Finally, strengthening reforms to the household registration system is crucial to ensure that residents, particularly high-income group, can fully benefit from urban development. Simultaneously, increased infrastructure investment in non-first-tier cities and low-population-density areas is necessary to improve public service levels and promote balanced regional development.

These findings underscore the importance of people-oriented urban spatial structure planning. However, this study has some limitations. First, the use of morphological polycentricity may restrict the comprehensiveness of understanding how spatial structure influences residents’ happiness. Future research should integrate functional polycentricity to provide a more nuanced analysis. Second, this study faces limitations in the measurement of subjective well-being. The outcome variable is based on a single-item indicator, which may not fully reflect the multidimensional nature of subjective well-being. In addition, the dataset has temporal discontinuities due to the absence of happiness data in the 2016 wave of the CFPS. Future studies should adopt validated multi-item scales and utilize more continuous panel data to enhance the robustness of the analysis. Third, this study does not account for housing supply-side pattern, which would significantly affect the lot size, built environment and living condition of the residents (Huai et al., 2025). In polycentric urban contexts, these variables may influence residents’ subjective well-being by shaping the physical form, quality, and affordability of housing. Future research should incorporate these

indicators to more comprehensively examine how urban spatial structure interacts with the built environment in shaping subjective well-being. Finally, our study identifies that the positive impact of urban polycentricity on subjective well-being is strongly associated with three mediating mechanisms in the Chinese context. Due to substantial differences in culture, institutions, and urban governance models across countries, future research is needed to further test the applicability of these mechanisms through cross-national comparative studies.

Disclosure statement

No potential conflict of interest was reported by the authors.

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