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Tourism Industry Development and Urban Livability: Spatiotemporal Dynamics and Impact Mechanisms in the Middle Reaches of the Yangtze River Urban Agglomeration, China

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Abstract

Tourism industry development has become an important driver of regional economic transformation and urban functional restructuring, while urban livability is a key indicator of high-quality urban development and residents' well-being. However, the spatially heterogeneous and cross-regional effects of tourism development on urban livability remain insufficiently understood. This study examines 28 cities in the Middle Reaches of the Yangtze River Urban Agglomeration, China, from 2000 to 2024. Using kernel density estimation, a two-way fixed effects model, and a spatial Durbin model (SDM), this study investigates the spatiotemporal evolution, spatial spillover effects, and moderating mechanisms of tourism industry development on urban livability. The results show that both tourism industry development and urban livability exhibit significant spatial disparities. Tourism industry development enhances local urban livability, while generating negative spillover effects on neighboring cities, indicating a spatially asymmetric "local gain-neighbor suppression" pattern. Public service provision and infrastructure connectivity amplify the positive effects of tourism development on urban livability. These findings highlight that tourism-led improvements in urban livability are spatially uneven and conditioned by regional development capacity. The study contributes to understanding tourism-livability interactions at the urban agglomeration scale and provides implications for coordinated regional governance. However, this study cannot fully capture micro-level transmission mechanisms due to limitations.

Keywords: tourism industry development; urban livability; spatial spillover effects; moderating effects; urban agglomeration; China

1. Introduction

With the upgrading of consumer demand and the rapid expansion of the service economy, the tourism industry has become an important driver of regional economic growth and urban transformation. Tourism activities not only create employment opportunities and stimulate consumption but also influence urban development through industrial upgrading, infrastructure improvement, and public service enhancement [1–4]. At the same time, the expansion of tourism may generate negative externalities, including resource competition, environmental pressure, and traffic congestion [5,6]. According to statistics released by China's Ministry of Culture and Tourism, domestic tourist trips reached 5.615 billion in 2024, while total tourism expenditure exceeded CNY 5.75 trillion [7]. Against the backdrop of sustained tourism growth, achieving a balance between economic gains and residents' well-being has become a central challenge in destination governance.



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Urban livability, as an important indicator of sustainable urban development and quality of life, has attracted increasing attention from both scholars and policymakers. It reflects residents' overall evaluation of their living environment and living conditions [8–11] and has become an important indicator for assessing progress toward more sustainable, resilient, and people-oriented urban development under the Sustainable Development Goal 11 (SDG 11) framework [12]. As China's urbanization rate continues to rise, cities have generated considerable economic vitality while simultaneously facing challenges such as environmental degradation, traffic congestion, and inadequate public service provision [13]. In this context, understanding whether and how tourism industry development contributes to urban livability is of practical importance for promoting high-quality urban development.

Although tourism industry development and urban livability have both been widely discussed in the existing literature, previous studies have examined tourism industry development from economic, environmental, and social perspectives. Less attention has been paid to its implications for urban livability at the urban agglomeration scale. To address this issue, this study focuses on the Middle Reaches of the Yangtze River Urban Agglomeration, one of China's major regional growth poles. Characterized by abundant tourism resources, strong intercity linkages, and substantial spatial heterogeneity, the region provides an appropriate setting for examining the interaction between tourism industry development and urban livability, particularly in a region characterized by strong spatial interdependence and pronounced core–periphery disparities, which allows for a clearer identification of spatial spillover and heterogeneous effects, also provide a valuable context for investigating how spatial interactions and regional heterogeneity influence the tourism–livability relationship. Using panel data for 28 prefecture-level cities from 2000 to 2024, this study employs kernel density estimation, a two-way fixed-effects model, and a spatial Durbin model to address three questions: (1) What spatiotemporal patterns characterize tourism industry development and urban livability? (2) Does tourism industry development generate spatial spillover effects on urban livability? (3) Do public service provision and infrastructure connectivity strengthen the livability effects of tourism industry development?

This study extends current research in three main ways. First, it develops a multidimensional evaluation framework for tourism industry development and urban livability at the urban agglomeration scale and examines their spatiotemporal evolution. Second, by incorporating spatial econometric methods into the analysis, it examines whether tourism industry development generates spillover influences on livability outcomes in neighboring cities. Third, it further investigates the moderating roles of public services and infrastructure connectivity, shedding light on the contextual factors that influence the contribution of tourism to urban well-being.

2. Literature Review

2.1. Tourism Industry Development

Research on tourism industry development has primarily focused on three interrelated themes: conceptualization, economic and spatial effects, and measurement approaches.

Early studies concentrated on defining the boundaries and scope of the tourism industry. From a demand-side perspective, Leipe (1979) suggested defining the tourism industry based on the services and products directly provided to tourists [14]. From a supply-side perspective, Zachary (2014) emphasized the interdependence and integration of different segments within the tourism industry chain [15]. More recently, the tourism industry has expanded beyond the confines of traditional tourism resources, facilities, and service provision [16]. Tian and Weng (2026) highlight the growing importance of tourism-oriented industrial integration within the Chinese context under the “Tourism Plus” development model [17].

The measurement of the development level of the tourism industry is an important basis for revealing the characteristics of regional tourism development. Early studies mainly used single indicators such as tourism revenue and the number of tourists to measure the scale of tourism. Later, they gradually shifted to comprehensive evaluation systems to reflect the economic benefits, resource utilization efficiency, and comprehensive competitiveness of the tourism industry development. For example, Wen and Tisdell (1996) analyzed regional tourism development differences through tourism-related industry indicators [18], while Fuentes (2011) and Goncalves et al. (2012) focused on the matching relationship between tourism efficiency and the input and output of tourism resources from the perspective of tourism efficiency [19,20]. As the tourism industry transitions from scale expansion to high-quality development, scholars have begun to incorporate factors such as transportation conditions, infrastructure, public services, and environmental quality into the evaluation system and use methods such as the entropy value method and data envelopment analysis for comprehensive measurement [21–26]. In addition, the research scale has gradually expanded from a single tourist destination to regional scales such as cities [27], river basins [28], and urban agglomeration scales [29], providing methodological support for analyzing the dynamic evolution and regional differences in tourism industry development.

With the development of spatial analysis methods, the spatial pattern and evolution laws of the tourism industry's development have gradually become an important research direction. Relevant studies have found that the development of the tourism industry exhibits obvious spatial clustering characteristics and is influenced by factors such as resource endowment, economic level, transportation conditions, and policy environment. For instance, Wang et al. (2020) discovered that the tourism resources of Class A scenic spots in China show significant spatial clustering characteristics [30]. At the same time, studies on the spatial effects of the tourism industry have formed different viewpoints. Kim et al. (2021), Hudeček et al. (2017), Vergori & Arima (2020), and other scholars believe that tourism development can promote regional coordinated development through industrial linkage, transportation improvement, and factor flow [31–33]; however, some other studies indicate that in regions with a clear core-periphery structure, tourism resources and development opportunities may continue to concentrate in advantageous cities, thereby strengthening regional imbalance. Fang et al. (2026) found that provincial capital cities may have a “shadowing effect” on surrounding cities [34]. Thus, the spatial influence of tourism industry development has obvious regional dependence and requires further analysis based on specific spatial scales.

A substantial body of literature has examined the broader effects of tourism industry development, with early studies primarily focusing on its contribution to economic growth. Shan and Wilson (2001) proposed the tourism-led growth hypothesis (TLGH), arguing that tourism can serve as an important driver of regional economic development [35]. Subsequent studies further confirmed that tourism promotes employment, investment, income growth, and industrial upgrading [36–39]. More recently, research has gradually shifted beyond purely economic outcomes. For example, Stevic et al. (2024) examined the relationship between tourism development, tourist flows, and urban carrying capacity, highlighting that tourism activities influence not only physical attractions but also local residents' perceptions and destination sustainability [27]. Similarly, Ghahremani et al. (2021) further emphasized the role of urban tourism in shaping urban spatial transformation and enhancing urban competitiveness, suggesting that tourism has become increasingly embedded in broader urban development processes [40]. These findings suggest that tourism is increasingly viewed as a component of broader urban development rather than merely an economic sector. Nevertheless, compared with the extensive literature

examining the economic, spatial, and competitiveness outcomes of tourism development, its implications for urban livability, particularly from a multidimensional and spatially interactive perspective, remain relatively underexplored.

2.2. Urban Livability

As an important concept for measuring the quality of urban development and the well-being of residents, the connotation of urban livability has evolved from the material environment to a multi-dimensional, comprehensive system. Early studies mainly focused on the impact of the natural environment and spatial conditions on the suitability of residents' lives. Howard's Garden City concept emphasized the coordinated relationship between urban development and environmental quality [41]. Subsequently, the World Health Organization (WHO) proposed that livable cities should have characteristics such as safety, health, convenience and comfort [42], which promoted the expansion of livability research from environmental assessment to dimensions such as social services, economic conditions and residents' well-being. In recent years, Gough (2015) further emphasized that livability is a comprehensive quality of life formed by the combined effects of natural environment, built environment and social system [43].

In terms of livability measurement, existing research has gradually developed from a single environmental assessment to a multidimensional comprehensive assessment. Early studies mainly focused on the urban physical environment and infrastructure conditions. Findlay et al. (1988) evaluated the livability level of British cities based on indicators such as health services, cost of living, and public facilities [44]. Subsequently, researchers gradually realized that livability is not a simple environmental attribute, but the result of the combined effects of multiple factors such as natural environment, social services, and urban functions. Glaeser and Gottlieb (2006) categorized urban livability into natural and social environmental dimensions [45]. Huang et al. (2015) proposed a multidimensional framework incorporating environmental quality, public services, and urban functioning [46]. In recent years, with the deepening of the "people-oriented" concept, Zhan et al. (2018) believe that urban livability depends not only on objective urban conditions but also on residents' living experience and subjective evaluation [9]. Dovile et al. (2015) constructed a comprehensive evaluation index of suburban residential environmental quality to assess and compare the current status of the suburban living environment and residents' expectations [47]. Therefore, current livability evaluation is gradually shifting from a single objective indicator measurement to a comprehensive evaluation model that combines objective environmental conditions with residents' perception of well-being.

With the continuous improvement of the assessment system, urban livability research has further focused on its spatial differentiation and dynamic evolution characteristics. Related research has gradually shifted from static level measurement to dynamic evaluation combining spatial analysis and long-term series data [12,48,49]. Foreign research focused earlier on the spatial differences in urban livability and their formation mechanisms. Ghasemi et al. (2019), based on a study of the Tehran metropolitan area, found that the uneven distribution of public services leads to significant differences in livability levels across different regions [50]; Gilbert et al. (2016) analyzed the spatial differences in livability experience between urban and rural areas from the perspective of residents' subjective well-being [51]. With the development of multi-source data and GIS spatial analysis technology, the research scale has further expanded from regional and urban levels to the community level to identify the uneven distribution of livable resources within cities.

In the Chinese context, related research mainly revolves around spatial patterns and evolutionary trends at different scales. Hao et al. (2021) found that urban livability in China exhibits obvious regional gradient characteristics and significant spatial dependence [52];

Wang et al. (2017) further revealed the spatial heterogeneity of ecological livability distribution in Zhejiang Province, China [53]. Overall, urban livability typically exhibits significant spatial differentiation and dynamic changes. However, different studies differ in spatial scale, evaluation objects, and data sources. The application of multi-source data and spatial econometric methods has further propelled urban livability research towards a more dynamic and multi-scale approach.

In summary, existing research on urban livability has formed a relatively systematic research framework. However, related studies mainly focus on traditional factors such as economic development, public services, and environmental conditions, with relatively limited attention paid to how the tourism industry, a significant service sector, influences urban livability and its spatial effects.

2.3. Relationship Between Tourism Industry Development and Urban Livability

As the role of tourism in urban economic and spatial transformation continues to grow, the relationship between tourism development and urban livability has gradually attracted the attention of tourism geography and urban studies. Butler (1980) pointed out that tourism is not only an economic activity but also involves multiple processes, including social, ecological, and spatial aspects [54]. Sharpley (2014) further emphasized that tourism industry development needs to balance economic benefits with social and environmental impacts to promote the well-being of destination communities [55]. Meanwhile, studies on urban livability by scholars such as Veenhoven and Ouwenel (1995) have gradually shifted from physical environmental assessments to humanistic dimensions such as resident satisfaction and quality of life [56]. Therefore, the academic community has begun to explore how tourism development affects the urban living environment and resident well-being.

Previous studies have mainly explored the positive effects of tourism industry development on the urban environment and residents' well-being from aspects such as economic benefits, urban construction, and spatial transformation. At the economic level, Andereck et al. (2005) and Ladkin et al. (2023) demonstrated that tourism industry development can enhance regional economic vitality by stimulating investment, expanding employment opportunities, and driving consumption, thereby improving residents' living conditions [57,58]. At the urban construction level, Zhang et al. (2025) pointed out that tourism industry development is often accompanied by improvements in infrastructure, public service facilities, and urban environmental quality, thereby enhancing the attractiveness of the city and the convenience of residents' lives [59]. Moreover, urban tourism research further revealed that tourism activities can facilitate urban renewal, optimize functional space reconfiguration, and improve urban spatial quality through the creation of cultural spaces and land use optimization [60,61].

On the other hand, existing studies have also pointed out that the expansion of tourism activities may generate a range of adverse consequences on urban systems. From a sustainable development perspective, Gössling (2002) has noted that tourism-related economic activities may affect the environmental system through increased energy consumption, changes in land use, and intensified ecological pressure, and that the tourism development model oriented towards economic gains may further exacerbate resource consumption and environmental pressure [62,63]. In recent years, Dodds & Butler (2019) and other scholars have further focused on the "over-tourism" phenomenon caused by insufficient tourism carrying capacity, that is, the phenomenon where the scale of tourists exceeds the carrying capacity of urban infrastructure, public services, and the community [64]. Relevant studies show that such tourism pressure may reduce residents' well-being in the form of traffic congestion, environmental degradation, and noise interference [6,65–67]. At the same time, Gotham (2005) and other scholars believe that the gentrification brought

by tourism may change the commercial structure of the destination and drive up living costs, forcing some local residents to move out of the tourism development area [68–70]. Moreover, the urban development strategy mainly oriented towards tourism may further intensify the competition for public spaces and urban land resources, leading to rising housing prices and decreased housing affordability [71], increased short-term population density [72], and fragmentation of urban landscapes [73], which in turn affect residents' perception of the living environment and reduce urban livability satisfaction [74–76]. In summary, existing studies have shown that tourism development is not necessarily an improvement of urban livability, but rather forms a complex trade-off between economic vitality, residents' well-being, environmental quality, and urban carrying capacity.

Overall, existing studies have demonstrated that tourism industry development influences urban livability through both positive and negative pathways, reflecting the multidimensional nature of tourism-led urban change. However, existing research has paid relatively limited attention to tourism–livability relationships from a regional perspective, particularly regarding spatial interactions and the contextual conditions shaping these effects.

2.4. Research Gap

The existing literature has generated substantial insights into tourism industry development, urban livability, and the relationship between the two. Existing tourism–livability studies have generally confirmed that tourism contributes to economic growth, infrastructure improvement, and urban well-being, while spatial panel studies have increasingly been applied to examine regional interaction and spillover effects in urban and regional development. Overall, a growing body of research has highlighted the interconnections between tourism industry development and urban livability from economic, spatial, and sustainability perspectives.

First, although previous tourism–livability studies have generated important evidence on how tourism influences urban development, most of them focus on individual cities, tourism destinations, or specific regions. Relatively limited attention has been paid to urban agglomerations as integrated regional systems. As regional integration continues to deepen, intercity flows of people, capital, information, and industries have become increasingly important. Under such circumstances, the effects of tourism industry development are no longer confined to individual administrative units. Analyses conducted solely at the city level may therefore overlook broader regional interactions and development dynamics.

Second, existing tourism–livability studies have primarily examined the direct effects of tourism industry development on local urban livability, while spatial panel studies have mainly explored regional spillover effects in areas such as economic growth, innovation, and environmental governance. However, relatively limited attention has been paid to whether tourism industry development generates spatial spillover effects on urban livability within urban agglomerations. Whether these influences generate positive spillovers through regional diffusion or negative spillovers through resource siphoning remains an open empirical question.

Third, although previous studies have increasingly recognized that the effects of tourism industry development on urban livability may vary across contexts, limited attention has been paid to the conditions under which tourism contributes to urban livability within urban agglomerations. Public service provision and infrastructure connectivity may shape the extent to which tourism industry development translates into improvements in urban livability. However, the moderating roles of these factors have yet to be systematically examined.

To fill these research gaps, this study focuses on 28 prefecture-level cities in the Middle Reaches of the Yangtze River Urban Agglomeration. By constructing comprehensive evaluation systems for tourism industry development and urban livability, the study first examines their spatiotemporal evolution. It then employs a baseline regression model and spatial Durbin model to investigate the direct effects, spatial spillover effects, and moderating mechanisms of tourism industry development on urban livability. By integrating tourism-livability analysis with spatial econometric methods, this study extends existing research from local direct effects to regional interaction processes and further explores the contextual conditions under which tourism contributes to urban livability.

3. Research Framework and Hypothesis Development

3.1. Direct Effect of Tourism Industry Development on Urban Livability

Urban livability is shaped by multiple dimensions, including environmental quality, economic vitality, social development, and living conditions. Tourism industry development may influence these dimensions simultaneously through its interaction with urban systems.

From an environmental perspective, tourism industry development may contribute to improvements in urban environmental quality. Since environmental quality constitutes an essential tourism resource, tourism destinations possess stronger incentives to protect ecological assets than non-tourism-oriented cities [29]. Such institutional incentives facilitate environmental improvement. In addition, the growth of ecotourism and green tourism promotes environmentally friendly development practices and encourages a transition toward low-carbon urban development [77]. Tourism-generated revenues may further provide financial support for ecological restoration and environmental governance, thereby contributing to a more livable urban environment [78].

From an economic perspective, tourism industry development can enhance urban livability by strengthening local economic foundations [79]. As an emerging service-oriented industry, tourism promotes the integration of consumption, investment, and employment within urban systems, thereby strengthening local economic vitality and improving residents' income opportunities [28,80]. Moreover, the expansion of tourism-related industries may accelerate industrial diversification and upgrading by stimulating the development of accommodation, catering, transportation, cultural, and other related sectors [81]. These economic transformations provide a material basis for improving public services, employment conditions, and residents' quality of life, ultimately contributing to higher urban livability.

From a social perspective, tourism industry development may improve urban livability through enhanced public service provision and increased social interaction. To accommodate growing tourism demand, cities often invest in transportation systems, healthcare facilities, communication networks, and public safety services [82]. Although these investments were initially driven by the development of tourism, this 'supply ahead' approach often benefits local residents as well [6]. Moreover, tourism facilitates population mobility and cultural exchange, strengthening interactions between visitors and host communities while fostering social inclusion, cultural openness, and local identity [57,83,84]. These processes contribute to the accumulation of social capital and strengthen community cohesion.

From a living environment perspective, tourism industry development may improve residents' quality of life through urban renewal and spatial optimization. Tourism-oriented investment reshapes the organization and utilization of urban space [74,76], thereby promoting the transformation of urban areas from single-purpose production or residential spaces into multifunctional environments that integrate leisure, cultural, and service functions [85]. At the same time, investments in tourism-related amenities and public facilities

can improve daily living conditions, expand recreational opportunities, and enhance overall convenience and well-being for residents [28,86].

Taken together, tourism industry development has the potential to enhance urban livability through improvements in environmental quality, economic vitality, social development, and living conditions. Although the magnitude of these effects may vary across cities, the theoretical arguments presented above suggest that the overall effect of tourism industry development on urban livability is likely to be positive. Accordingly, the following hypothesis is proposed:

H1. *Tourism industry development is expected to positively affect urban livability.*

3.2. Spatial Spillover Effect of Tourism Industry Development on Urban Livability

Tobler's First Law of Geography and New Economic Geography suggest that cities do not operate in isolation but are interconnected through economic linkages, transportation networks, and factor mobility. Given its strong interconnectedness, mobility, and openness, tourism industry development may influence not only local urban livability but also neighboring cities through various spatial interaction mechanisms. The ultimate consequences of these interactions depend on the balance between spatial diffusion and resource competition. Existing studies suggest that tourism industry development may generate spatial spillover effects through several interrelated mechanisms. Building on this literature, four representative pathways are discussed below.

One possible mechanism is the polarization–trickle-down effect. Growth Pole Theory suggests that cities with abundant tourism resources and stronger economic foundations are more likely to emerge as tourism growth centers, attracting capital, talent, information, and other production factors [85]. During the early stages of tourism industry development, this concentration process may generate polarization effects, constraining the development opportunities of surrounding cities. As tourism clusters expand and regional linkages strengthen, however, tourism demand, industrial activities, and public service resources may gradually diffuse to peripheral areas, producing trickle-down effects that stimulate local development and improve public services in neighboring cities [6,87]. Consequently, tourism industry development may either reinforce regional disparities or promote regional coordination, depending on the stage of development and the strength of diffusion mechanisms.

A second mechanism is the demonstration effect. Cities with advanced tourism sectors often accumulate valuable experience in tourism planning, environmental management, public service provision, and urban governance [29]. Through regional cooperation, policy learning, and knowledge diffusion, these experiences can be transferred to neighboring cities, reducing development costs and institutional uncertainties. Such demonstration and imitation processes may enable surrounding cities to improve both tourism performance and urban livability by adopting successful development practices [28,76].

A third mechanism operates through factor mobility. Tourism industry development relies heavily on the circulation of tourists, capital, information, technology, and other production factors [71]. Cross-regional tourist flows not only generate consumption demand but also facilitate knowledge exchange, cultural interaction, and information sharing [88]. At the same time, tourism industry development may strengthen transportation connectivity and regional industrial networks, promoting the reallocation of tourism resources, public services, and market opportunities across cities [29,74,85]. By transcending administrative boundaries, these flows can extend the benefits of tourism industry development beyond the originating city and contribute to broader improvements in regional livability [76].

Nevertheless, tourism industry development may also generate negative spillovers through competitive effects. When neighboring cities possess highly similar tourism resources and product structures, competition for tourists and market share may inten-

sify [76]. Core tourism cities with stronger brand recognition and resource advantages may continuously attract visitors, investment, and skilled labor from surrounding areas, thereby creating a siphoning effect [89]. In addition, excessive tourism agglomeration may increase the costs of land, labor, and other production factors [90]. Through regional economic linkages, these rising costs can spread to neighboring cities and constrain their development opportunities [6]. If such competitive pressures outweigh the benefits generated by tourism industry development, urban livability in surrounding areas may be adversely affected [71].

Taken together, tourism industry development may influence urban livability beyond local administrative boundaries through multiple channels, including diffusion, demonstration, factor mobility, and competition. The effects of tourism industry development may differ in different settings, but the existence of spatial interactions suggests that tourism industry development is likely to generate measurable spillover effects on urban livability in neighboring cities. Accordingly, the following hypothesis is proposed:

H2. *Tourism industry development is expected to generate spatial spillover effects on urban livability.*

3.3. Moderating Effects of Public Service Provision and Infrastructure Connectivity

The influence of tourism development on urban livability is unlikely to be homogeneous across cities. Rather, existing studies suggest that the magnitude of this relationship depends on local institutional and infrastructural conditions. Among these conditions, public service provision and infrastructure connectivity are particularly important because they influence both how efficiently tourism-related resources are allocated and how effectively cities convert tourism growth into broader social benefits.

3.3.1. The Moderating Effect of Public Service Provision

Public service provision significantly shapes the outcomes of tourism industry development. Existing studies suggest that this moderating role primarily operates through improvements in urban service capacity. High-quality public services, including education, healthcare, social security, and cultural services, enhance urban service capacity and provide a supportive social environment for tourism industry development [82]. When tourism expansion generates economic growth and fiscal revenues, cities with stronger public service systems are generally better positioned to convert these gains into tangible improvements in residents' quality of life, thereby strengthening tourism's positive contribution to urban livability [6]. This reflects the conversion capacity of economic gains into welfare outcomes.

In addition, public services perform important resource allocation and social coordination functions. Through investments in education, technological innovation, and public cultural facilities, local governments can facilitate industrial upgrading and promote the transition of tourism toward higher value-added and higher-quality development [28,88]. Effective public service provision may also alleviate social inequalities and resource competition that occasionally accompany tourism expansion, enabling a broader distribution of tourism-related benefits among local residents [91]. As a result, the impact of tourism industry development on urban livability is theoretically expected to be amplified in cities with higher levels of public service provision, as such cities possess stronger institutional capacity to transform tourism-driven economic gains into inclusive welfare improvements.

Accordingly, the following hypothesis is proposed:

H3a. *Public service provision is expected to positively moderate the relationship between tourism industry development and urban livability.*

3.3.2. The Moderating Effect of Infrastructure Connectivity

Infrastructure connectivity constitutes an important foundation for realizing both the economic benefits and spatial linkages associated with tourism industry development. Its moderating role mainly lies in facilitating factor mobility and regional integration. Well-developed transportation and communication networks improve accessibility, facilitate the movement of tourists, capital, information, and services, and strengthen interactions among tourism resources, commercial activities, cultural assets, and public services [71,91]. By reducing spatial barriers and expanding market accessibility, infrastructure connectivity enhances the capacity of the tourism industry development to generate broader economic and social benefits. Consequently, the gains associated with tourism industry development are more likely to translate into improvements in urban livability [88,92].

Infrastructure connectivity also serves as a key vehicle for regional integration and factor mobility. Improved transportation networks reduce travel time and transaction costs, enhance resource allocation efficiency, and facilitate the diffusion of tourism-related benefits across urban areas [29]. Moreover, high levels of connectivity help overcome administrative barriers, strengthen intercity interactions, and mitigate development constraints arising from geographical isolation [81]. These conditions contribute to higher living standards and enhanced happiness perception for urban residents. Therefore, infrastructure connectivity is theoretically expected to enhance the effectiveness of spatial spillovers and transmission of tourism-driven welfare gains, thereby strengthening the positive impact of tourism industry development on urban livability.

Accordingly, the following hypothesis is proposed:

H3b. *Infrastructure connectivity is expected to positively moderate the relationship between tourism industry development and urban livability.*

Based on the above hypotheses, a research framework is developed to illustrate the linkages between tourism industry development and urban livability, as well as spatial spillover effects and the proposed moderating mechanisms (Figure 1).

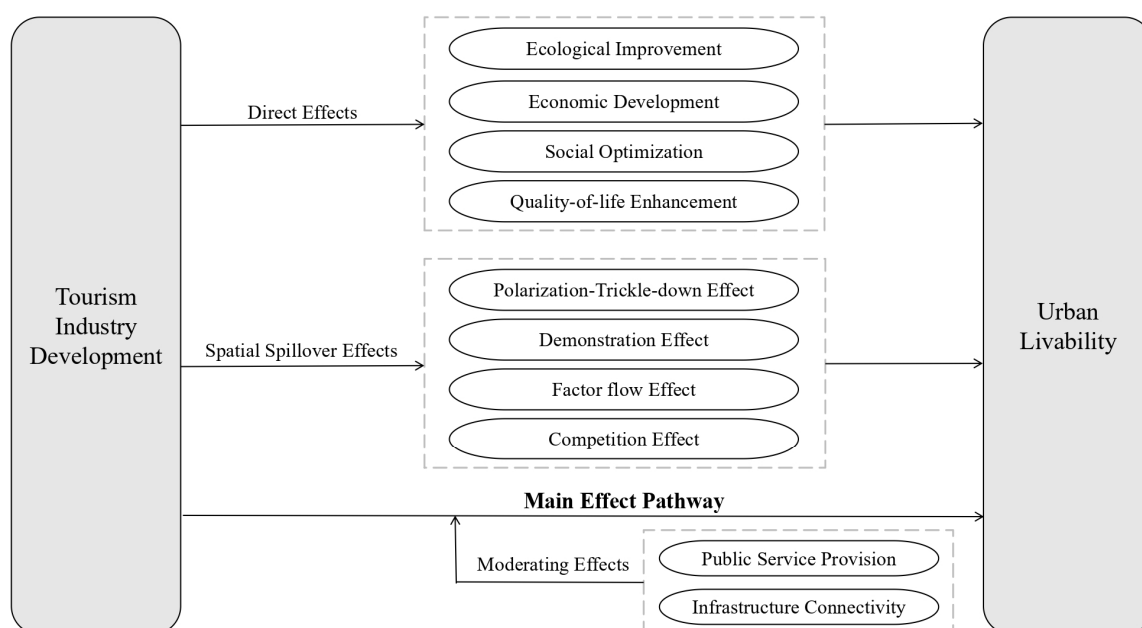


Figure 1. Research Framework of the Impact of Tourism Industry Development on Urban Livability.

4. Research Design

4.1. Research Area

The Middle Reaches of the Yangtze River Urban Agglomeration (MRYRUA), located in central China, comprises the Wuhan Metropolitan Area, the Urban Agglomeration around Changsha-Zhuzhou-Xiangtan, and the Urban Agglomeration around Poyang Lake (Figure 2). The region is endowed with abundant natural ecological resources, such as Dongting Lake, Poyang Lake, and Mount Lushan, as well as distinctive cultural resources, including Jingchu culture and revolutionary “red” culture, providing a solid foundation for tourism industry development [93,94]. In recent years, driven by cultural and tourism integration strategies, the tourism industry in the region has experienced rapid growth, with emerging forms such as all-for-one tourism, eco-tourism, and health and wellness tourism continuously developing. These rich tourism resource endowments support diversified tourism development and make the region a representative tourism-intensive urban agglomeration in central China.

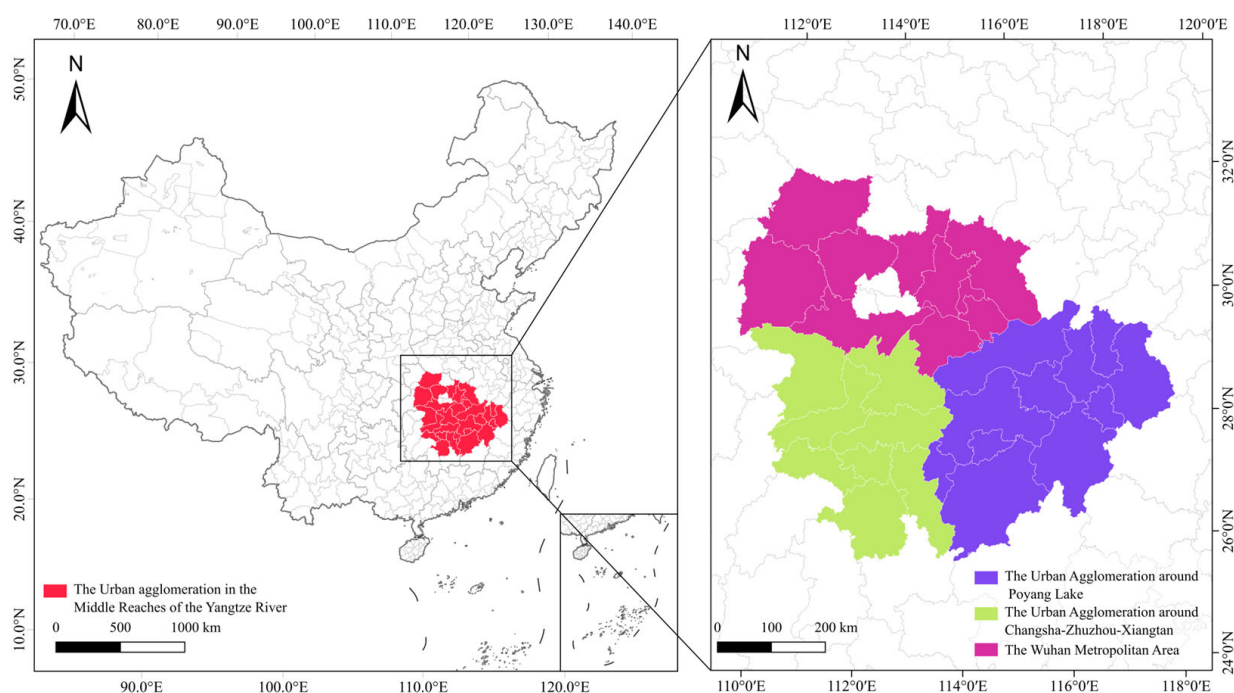


Figure 2. Map of Research Area.

At the same time, the region exhibits pronounced urban hierarchy differences, with significant disparities in economic development, public service provision, transportation accessibility, and tourism resource allocation between core capital cities and surrounding medium- and small-sized cities, forming a typical core–periphery structure [34]. In addition, although regional coordinated development strategies have been implemented, persistent regional collaboration dilemmas remain in terms of administrative coordination, cross-city resource allocation, and policy alignment, which constrain the effectiveness of regional integration [94]. Meanwhile, substantial spatial differentiation is observed across cities in tourism development patterns, infrastructure conditions, and urban livability levels, while increasing intercity connectivity further strengthens factor mobility, tourism flows, and economic interactions, thereby intensifying spatial dependence and spillover effects within the region. These characteristics make the region a typical and representative case for examining tourism–livability interactions under conditions of strong spatial heterogeneity, core–periphery structure, and coordination constraints within an emerging urban agglomeration system.

Based on data availability and the completeness of long-term statistical records, this study selected 28 prefecture-level cities within the study area from 2000 to 2024 for investigation. Because the key variable data required for constructing tourism development and urban livability indicators in Tianmen, Xiantao, and Qianjiang are incomplete and structurally inconsistent, including these three cities would lead to an imbalance in the panel data structure and may affect the comparability and reliability of the empirical results. Therefore, these three cities were excluded from the sample.

4.2. Methods

4.2.1. Entropy Weight Method

To comprehensively measure the development level of the tourism industry and urban livability, this study adopts the entropy method to reduce the bias caused by subjective weighting and improve the objectivity of the evaluation results. First, the indicators are standardized for both positive and negative values to make them comparable. Then, the weight of each indicator is calculated, and information entropy and redundancy are measured accordingly. Finally, the indicator weights are determined based on redundancy, and a weighted sum is obtained to obtain a comprehensive index. The detailed calculation procedure is reported in Ref. [48].

4.2.2. Kernel Density Estimation

To examine the spatiotemporal evolution of tourism industry development and urban livability, kernel density estimation (KDE) was used to characterize the distributional patterns and dynamic changes in the two variables over time [49]. The KDE model is specified as follows:

$$f_n(x) = \frac{1}{nh} \sum_{i=1}^n k\left(\frac{x - x_i}{h}\right) \quad (1)$$

where n denotes the sample size, h is the bandwidth parameter, and $k(\cdot)$ represents the kernel function. A Gaussian kernel function was adopted in this study.

4.2.3. Global Moran's I

Global Moran's I was used to assess the spatial autocorrelation of tourism industry development and urban livability [88]. The index is calculated as follows:

$$\text{Moran's } I = \frac{\sum_{i=1}^n \sum_{j=1}^n W_{ij} (x_i - \bar{x})(x_j - \bar{x})}{S^2 \sum_{i=1}^n \sum_{j=1}^n W_{ij}} \quad (2)$$

where n denotes the number of observations, x_i represents the observed value for city i , $\bar{x}$ is the sample mean, S^2 denotes the sample variance, and W_{ij} represents the spatial weight matrix. Following previous studies, an economic-geographic weight matrix (W_{eg}) combining geographic proximity and economic distance was constructed to capture both spatial and economic interdependencies among cities. The matrix was row-standardized to ensure comparability across observations. A significantly positive (negative) Moran's I indicates positive spatial clustering (spatial dispersion). Statistical significance was evaluated using the Z-test.

4.2.4. Econometric Models

1. Baseline Regression Models

To estimate the direct effect of tourism industry development on urban livability, a two-way fixed-effects model was constructed [95]:

$$UL_{it} = \alpha_0 + \alpha_1 TIDL_{it} + \alpha_2 C_{it} + \mu_i + \gamma_t + \varepsilon_{it} \quad (3)$$

where UL_{it} denotes the level of urban livability of city i at time t ; $TIDL_{it}$ represents tourism industry development; C_{it} denotes the vector of control variables; α_0 is the intercept term; α_1 and α_2 are the coefficients of the explanatory and control variables, respectively; y_t represents time-fixed effects; μ_i denotes city-fixed effects; and ε_{it} is the error term.

2. Spatial Durbin Model

Given the potential spatial dependence among cities, a Spatial Durbin Model (SDM) was further used to capture the spatial spillover effects of tourism industry development. The SDM incorporates spatially lagged terms of the dependent variable, explanatory variable, and control variables, and is specified as follows:

$$UL_{it} = \alpha_0 + \rho W_{it} UL_{it} + \alpha_1 TIDL_{it} + \beta_1 W_{it} TIDL_{it} + \alpha_2 C_{it} + \beta_2 W_{it} C_{it} + \mu_i + y_t + \varepsilon_{it} \quad (4)$$

where ρ denotes the spatial autoregressive coefficient; β_1 and β_2 represent the coefficients associated with the spatially lagged explanatory and control variables, respectively; and W_{ij} denotes the spatial weight matrix. To check robustness, both the economic-geographic weight matrix (W_{eg}) and the inverse-distance weight matrix (W_{id}) were employed.

3. Moderating Effect Model

To examine whether public service provision and infrastructure connectivity moderate the relationship between tourism industry development and urban livability, interaction terms between tourism industry development and the moderating variables were incorporated into the baseline regression model:

$$UL_{it} = \delta_0 + \delta_1 TIDL_{it} + \delta_2 T_{it} + \delta_3 TIDL_{it} \times T_{it} + \delta_4 C_{it} + \mu_i + y_t + \varepsilon_{it} \quad (5)$$

where T_{it} denotes the moderating variable, including public service provision (*pub*) and infrastructure connectivity (*infras*); δ_0 is the intercept term; and δ_1 , δ_2 , δ_3 , and δ_4 represent the estimated coefficients.

4.3. Variables Measurement

4.3.1. Core Independent Variable

Tourism industry development (*TIDL*) is the core independent variable in this study. To capture the multidimensional nature of tourism industry development, a comprehensive evaluation system was constructed based on four dimensions: tourism scale, tourism performance, tourism structure, and tourism quality.

Specifically, tourism industry scale reflects the development foundation and market size; tourism industry benefits capture its contributions to economic growth and social development; tourism industry structure characterizes the degree of industrial coordination and agglomeration within and across related sectors; and tourism industry quality reflects improvements in industrial development and service provision capacity. The specific indicators are presented in Table 1.

4.3.2. Dependent Variable

Urban livability (*UL*) is the dependent variable of this study. Drawing on the Sustainable Development Goals (SDGs) framework and previous research on urban livability assessment [42], a multidimensional evaluation system was constructed from four dimensions: environmental livability, economic livability, social livability, and living livability.

Table 1. The index system of *TIDL*.

Criterion	Indicators	Indicator Attribute and Indicator Weight	Indicator Interpretation
Tourism Industry Scale	Total number of tourists	0.1522 (+)	This indicator reflects the scale of the regional tourism market and its tourism attraction capacity.
	Growth rate of total tourism	0.0099 (+)	This indicator reflects the dynamic expansion trend of the regional tourism market and the level of tourism industry development activity.
	Tourism brand resource endowment	0.0616 (+)	This indicator reflects the attractiveness of urban tourism resources and the ability of tourism brand building.
Tourism Industry Benefits	Total tourism revenue	0.1923 (+)	This indicator reflects the contribution of the tourism industry to the regional economy.
	Per capita consumption level in the tourism market	0.0187 (+)	This indicator reflects the tourism consumption capacity and the efficiency of service value transformation of the regional tourism market.
	Number of tourism employees	0.1092 (+)	This indicator reflects the employment absorption ability of the tourism industry and the social driving effect.
Tourism Industry Structure	Elasticity coefficient of tourism industry growth	0.0012 (+)	This indicator is the ratio of the growth rate of tourism total revenue to the GDP growth rate, reflecting the response ability and driving effect of the tourism industry on regional economic growth.
	Location entropy of the tourism industry	0.0693 (+)	This indicator is the ratio of the proportion of the tourism industry in the regional economy of a prefecture-level city to the average level of the entire urban agglomeration, reflecting the comparative advantages and cluster effect of the tourism industry in the regional spatial layout.
Tourism Industry Quality	Number of tourism enterprises	0.1997 (+)	This indicator reflects the scale of the tourism industry market entities and the vitality of industry development.
	Urban nighttime light index	0.1305 (+)	This indicator reflects the vitality of the night economy and the efficiency of urban space utilization, embodying the ability of tourism services to cover all time periods and all days.
	Number of star-rated hotels	0.0554 (+)	This indicator reflects the tourism reception capacity and the quality level of tourism services.

Notes: “+” represents a positive effect.

Specifically, environmental livability reflects ecological quality and environmental carrying capacity; economic livability captures economic performance as well as residents’ income and welfare conditions; social livability represents social services, social equity, and public safety; and living livability reflects the convenience of daily life and overall living quality. The selection of indicators within each dimension follows existing literature on urban livability measurement and is intended to capture key aspects of urban living conditions, as detailed in Table 2.

Table 2. The index system of *UL*.

Criterion	Indicators	Indicator Attribute and Indicator Weight	Indicator Interpretation
Environmental Livability	Green coverage rate of the built-up area	0.0096 (+)	This indicator represents the ratio of the green area within the built-up area of a city to the total area of the built-up area, reflecting the ecological quality of the city and the level of green space construction.
	Annual average PM2.5 concentration	0.0155 (−)	This indicator reflects urban air pollution levels and overall ecological conditions.
	Per capita water resource volume	0.0455 (+)	This indicator reflects the capacity of urban water resources to guarantee and the ecological carrying capacity.
	Rate of harmless treatment of domestic waste	0.0077 (+)	This indicator reflects the urban environmental governance capacity and the level of ecological civilization construction.
	Urban sewage treatment rate	0.0152 (+)	This indicator reflects the water environment governance level of the city and the construction capacity of environmental infrastructure.
Economic Livability	Local fiscal revenue	0.2336 (+)	This indicator reflects the city's fiscal capacity to provide public services and support urban infrastructure development, which constitutes an important material foundation for urban livability.
	Proportion of the tertiary industry in GDP	0.0733 (+)	This indicator reflects the level of service-oriented economic development and industrial upgrading, which is closely associated with the availability and diversity of urban services that support residents' quality of life.
	Per capita disposable income of urban residents	0.0944 (+)	This indicator reflects residents' consumption capacity and living standards, which directly influence access to housing, healthcare, education, and other essential urban services.
	Urban registered unemployment rate	0.0106 (−)	This indicator reflects labor market stability and employment security, which are important components of social stability and urban livability.
	Per capita retail sales of social goods	0.1944 (+)	This indicator reflects the vitality of urban consumption and the richness of local market activity, which contribute to the convenience and diversity of residents' daily life.
Social Livability	Number of traffic accidents per 100,000 people	0.0161 (−)	This indicator reflects the level of urban traffic safety and public security conditions.
	Number of fire accidents per 100,000 people	0.0056 (−)	This indicator reflects the fire safety level of the city and the governance capacity of society.
	Proportion of education expenditure in GDP	0.0426 (+)	This indicator reflects the educational guarantee capability of the city and the level of human capital investment.
	Number of primary and secondary schools	0.0538 (+)	This indicator reflects the supply capacity of basic educational resources.
	Number of practicing physicians per 100,000 people	0.0358 (+)	This indicator reflects the allocation level of urban medical resources and the public health service capability.

Table 2. Cont.

Criterion	Indicators	Indicator Attribute and Indicator Weight	Indicator Interpretation
Living Livability	Number of public transportation operating vehicles per 100,000 people	0.0882 (+)	This indicator reflects the service capacity and convenience of urban public transportation.
	Per capita living area	0.0309 (+)	This indicator reflects the living conditions and comfort level of residents.
	Housing price-to-income ratio	0.0089 (−)	This indicator is the ratio of residents' housing prices to their income levels, reflecting the pressure of housing affordability.
	Per capita park green area	0.0237 (+)	This indicator reflects the supply level of urban leisure and ecological spaces and the quality of residents' leisure environment.
	Communication index	0.0607 (+)	This indicator is the ratio of total communication users (fixed-line, mobile, broadband) to population in that year, reflecting communication penetration and digital infrastructure development.

Notes: “+” represents a positive effect and “−” represents a negative effect.

4.3.3. Moderating Variables

Two moderating variables were incorporated into the analysis.

Public service provision (*pub*) was measured as the proportion of expenditures on education, science and technology, social security and employment, and healthcare within total general public budget expenditures, following Ref. [96]. Infrastructure connectivity (*infras*) was measured by the logarithm of urban road network density.

4.3.4. Control Variables

Four control variables are included to capture factors that may influence urban livability.

Economic development (*pgdp*) was measured by the logarithm of GDP per capita. Human capital (*edu*) was measured by the ratio of university students to the resident population, following Ref. [1]. Urbanization (*urban*) was measured by the urbanization rate of the resident population. Transportation development (*trans*) was measured by the logarithm of total passenger traffic volume, following Ref. [34].

4.4. Data Sources

The data utilized in this study spanned the period from 2000 to 2024. Most variables are sourced from the China Statistical Yearbook, the China City Statistical Yearbook, statistical yearbooks of Hubei Province, Hunan Province, and Jiangxi Province, as well as the Statistical Communiqué on National Economic and Social Development issued by prefecture-level cities. Missing values were handled using a linear interpolation method along the time dimension to fill isolated missing observations. This approach is commonly used in panel data processing to maintain data continuity and avoid sample loss.

Special attention has been paid to the construction of tourism-related indicators. Based on the official directories issued by the National Cultural Heritage Administration and the Ministry of Culture and Tourism of China, the author compiled data on the tourism brand resource endowment. These data encompass World Heritage sites, national scenic spots, national nature reserves, and national key historical and cultural protection sites.

Data on tourism enterprises were obtained from the official database of Tianyancha. Tourism-related firms were identified according to enterprise names and registered business scopes, and the annual number of tourism enterprises in each city was manually compiled.

Nighttime light data were derived from the DMSP-OLS and NPP-VIIRS datasets. To improve temporal consistency and spatial comparability, a corrected and integrated global NPP-VIIRS nighttime light dataset at 500 m spatial resolution was adopted.

5. Results

5.1. Spatiotemporal Evolution of Tourism Industry Development and Urban Livability

5.1.1. Temporal Evolution

Figure 3 illustrates the temporal evolution of tourism industry development and urban livability in the research area from 2000 to 2024. Both indicators exhibited a sustained upward trend over the study period, although their growth patterns differed substantially.

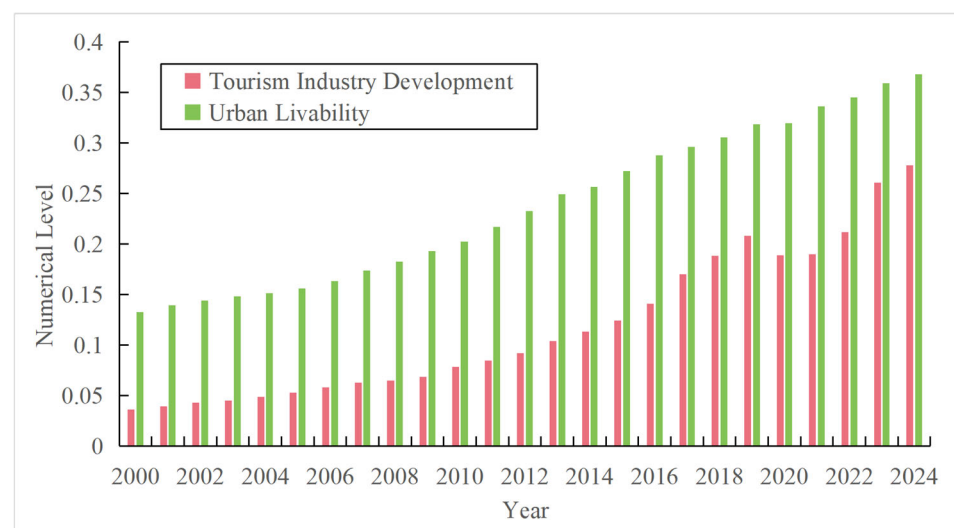


Figure 3. Temporal Evolution of Tourism Industry Development and Urban Livability in the Research Area.

Tourism industry development increased from 0.0362 in 2000 to 0.2776 in 2024, representing a marked improvement over time. Growth remained relatively moderate before 2013 but accelerated thereafter, reflecting the rapid expansion of the tourism economy. Nevertheless, temporary fluctuations were observed in several years, particularly under changing market conditions and the impacts of the COVID-19 pandemic. Urban livability increased from 0.1327 to 0.3681 during the same period and followed a more stable growth path. The upward trend became more pronounced after 2012, coinciding with continued improvements in infrastructure provision, public services, and environmental governance in the region.

Overall, the tourism industry development grew more rapidly and displayed greater volatility than urban livability. The comparatively gradual improvement in urban livability suggests that the welfare benefits generated by tourism industry development may require time to materialize and accumulate.

5.1.2. Spatial Distribution

Figures 4 and 5 present the spatial distribution of tourism industry development and urban livability in 2000, 2008, 2016, and 2024.

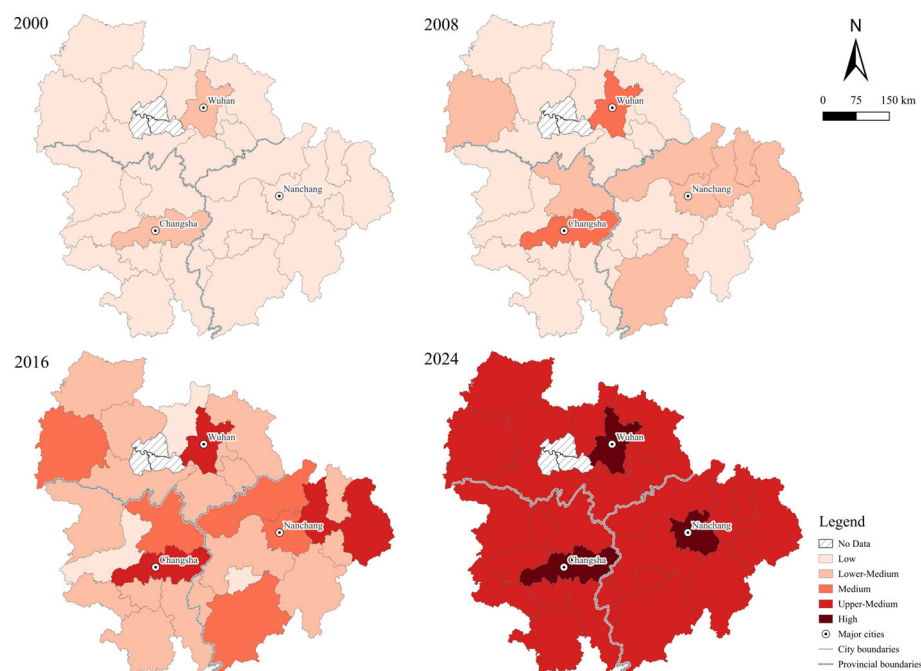


Figure 4. Spatial Distribution of Tourism Industry Development in the Research Area.

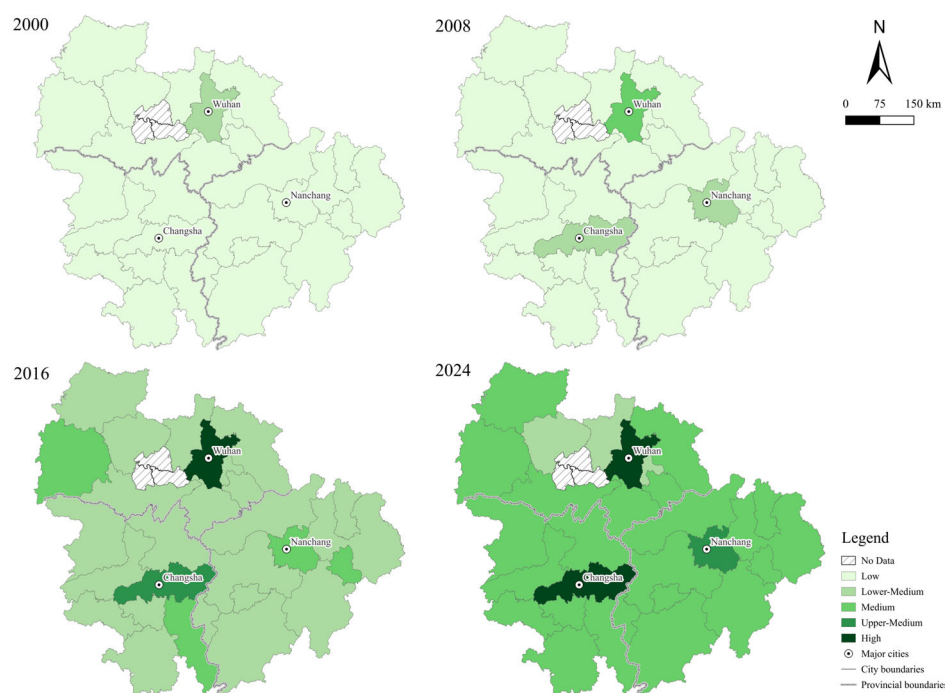


Figure 5. Spatial Distribution of Urban Livability in the Research Area.

Tourism industry development displayed a clear pattern of spatial expansion during the study period (Figure 4). In 2000, high-value areas were predominantly observed in the provincial capitals of Wuhan, Changsha, and Nanchang, while most other cities remained at relatively low development levels. By 2008, improvements in regional transportation networks facilitated the outward diffusion of tourism activities along major transport corridors. The expansion continued after 2016, with secondary cities such as Yichang and Yueyang emerging as new growth poles. By 2024, high-value areas formed a more continuous spatial pattern along the Yangtze River Economic Belt and major transportation networks, although several peripheral cities still lagged behind.

Urban livability exhibited a similar diffusion process but with a more gradual pattern (Figure 5). High livability levels were initially concentrated in the three provincial capitals, reflecting their advantages in economic development and public service provision. Over time, the spatial concentration weakened as improvements spread to surrounding cities. By 2016, several cities located along the Yangtze River and within metropolitan areas had experienced substantial gains in livability. In 2024, high-value areas extended along major transportation corridors, while regional disparities narrowed and inter-city coordination became increasingly evident.

Taken together, both tourism industry development and urban livability evolved from a core-periphery structure toward a more networked spatial configuration, indicating strengthened regional integration within the research area.

5.1.3. Dynamic Evolution

The kernel density estimation results further reveal the dynamic evolution of tourism industry development and urban livability (Figure 6).

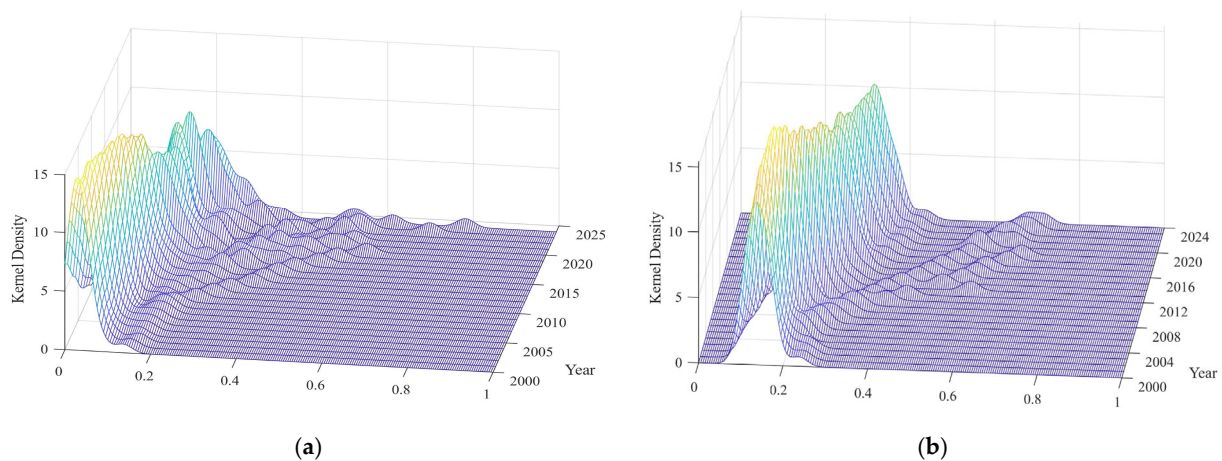


Figure 6. Dynamic Evolution of Tourism Industry Development and Urban Livability in the Research Area. (a) Tourism Industry Development; (b) Urban Livability. The color gradient represents variations in kernel density values.

As shown in Figure 6a, the distribution of tourism industry development shifted progressively to the right over time, indicating an overall improvement across the research area. The declining height of the main peak suggests increasing inter-city disparities. Meanwhile, the emergence of secondary peaks and an extended right tail indicates growing polarization, with a rising number of cities reaching relatively high levels of tourism industry development. These patterns imply that tourism industry development gradually evolved from concentration in a few core cities toward a multi-polar spatial structure.

Figure 6b shows that the kernel density curve for urban livability also shifted steadily to the right, reflecting continuous improvements in overall livability. The widening distribution and declining peak height indicate a temporary expansion of regional disparities. However, unlike tourism industry development, the distribution remained predominantly unimodal throughout the study period. Although the right tail became more pronounced, suggesting an increasing number of highly livable cities, no clear multi-polar pattern emerged.

Overall, both indicators experienced substantial improvement over time, while urban livability exhibited a more balanced spatial evolution than tourism industry development.

5.2. Benchmark Regression Results

5.2.1. Statistical Characteristics of Variables

Table 3 presents the descriptive statistics of all variables. Considerable variation within variables is observed, indicating substantial regional heterogeneity in tourism industry development, urban livability, and other socioeconomic characteristics. Several variables were logarithmically transformed to reduce skewness and mitigate potential heteroscedasticity.

Table 3. Descriptive Statistics.

Variable Type	Variable Name	Indicator Attribute and Indicator Weight	Sample Size	Mean Value	Standard Deviation	Minimum Value	Maximum Value	VIF
Core Independent Variable	Tourism Industry Development	<i>TIDL</i>	700	0.1180	0.1081	0.0051	0.7874	1.95
Dependent Variable	Urban Livability	<i>UL</i>	700	0.2380	0.1043	0.0999	0.7603	/
Moderating Variable	Public Service Provision	<i>pub</i>	700	0.3890	0.0651	0.2039	0.5683	2.37
	Infrastructure Connectivity	<i>lninfras</i>	700	0.0080	0.5414	−1.5906	0.9441	5.73
Control Variable	Economic Development	<i>lnpgdp</i>	700	10.2211	0.9606	8.0198	11.9683	1.24
	Human Capital	<i>edu</i>	700	0.0194	0.0242	0.0004	0.1230	1.11
	Urbanization	<i>urban</i>	700	0.5106	0.1347	0.2036	0.8500	1.17
	Transportation Development	<i>lntrans</i>	700	8.4590	0.8752	5.5342	10.5433	2.81

Multicollinearity was examined using the variance inflation factor (VIF) diagnostics. As shown in Table 3, all explanatory variables have VIF values below the threshold of 10, with a mean VIF of 2.34, indicating that multicollinearity is not a concern.

5.2.2. Baseline Regression

Table 4 presents the baseline regression results. The F-test and Hausman test indicated that a two-way fixed-effects model is appropriate.

Table 4. Baseline Regression Results.

Variable	(1)	(2)
<i>TIDL</i>	0.390 *** (11.15)	0.402 *** (11.51)
<i>lnpgdp</i>		−0.080 (−1.78)
<i>edu</i>		−0.023 (−0.61)
<i>urban</i>		0.145 * (3.13)
<i>lntrans</i>		0.108 * (3.03)
_cons	0.597 *** (17.26)	0.428 *** (4.73)
R ²	0.156	0.188
N	700	700
City-fixed Effects	YES	YES
Time-fixed Effects	YES	YES

Note: The values in parentheses are *t*-values; * and *** indicate significance at the 10% and 1% levels, respectively.

Column (1) presents the estimation results without control variables. Tourism industry development (*TIDL*) exhibits a significantly positive coefficient (0.3903, $p < 0.01$), indicating that tourism industry development contributes to improvements in urban livability. After introducing the control variables in Column (2), the coefficient of *TIDL* remains significantly positive and increases slightly from 0.3903 to 0.4015, providing support for Hypothesis 1 (H1).

Among the control variables, urbanization (*urban*) and transportation development (*trans*) exert significantly positive effects on urban livability, whereas the coefficients of economic development (*pgdp*) and human capital (*edu*) are statistically insignificant. Overall, the results suggest that tourism industry development is an important driver of urban livability in the study area.

5.2.3. Robustness and Endogeneity Tests

Several robustness tests were performed to verify the reliability of the baseline results (Table 5).

Table 5. Robustness and Endogeneity Test Results.

	Recalculate TIDL (1)	Recalculate UL (2)	Winsorization (3)	Exclude Provincial Capitals (4)	Instrumental Variable Approach	
	(5)	(6)				
<i>TIDL</i>		0.208 *** (3.27)		0.005 ** (2.02)		0.069 *** (6.17)
<i>lnpgdp</i>	−0.003 * (−1.69)	−0.065 *** (−3.17)		−0.000 (−0.041)	−0.197 *** (−7.08)	−0.019 *** (−4.31)
<i>edu</i>	−0.000 (−0.26)	0.005 (0.37)		−0.000 (−1.14)	−0.144 *** (−4.59)	−0.006 ** (−2.39)
<i>urban</i>	0.000 (0.48)	0.003 (0.23)		−0.000 (−0.78)	−0.129 *** (−4.07)	−0.009 *** (−3.19)
<i>lntrans</i>	0.012 *** (3.77)	0.126 *** (3.79)		0.004 *** (2.85)	0.086 *** (2.96)	0.007 * (1.79)
<i>TIDL_pca</i>	0.024 *** (13.34)					
<i>TIDL_w5</i>			0.018 *** (5.47)			
<i>lnpgdp_w5</i>			−0.002 * (−1.75)			
<i>edu_w5</i>			−0.001 (−1.21)			
<i>urban_w5</i>			−0.001 (0.79)			
<i>lntrans_w5</i>			−0.003 ** (−2.04)			
IV					0.189 *** (9.00)	
Kleibergen-Paap rk LM statistic						42.205 (0.000)
Cragg-Donald Wald F statistic						46.825 {16.38}
_cons	0.164 *** (27.49)	−1.192 *** (−5.12)	0.198 *** (17.23)	0.143 *** (15.58)	−2.465 *** (−9.28)	0.408 *** (13.66)
R ²	0.890	0.952	0.958	0.973	0.214	0.673
F					81.07 ***	112.01 ***
N	700	700	700	625	700	700
City-fixed Effects	YES	YES	YES	YES	YES	YES
Year-fixed Effects	YES	YES	YES	YES	YES	YES

Note: The values in parentheses are *t*-values; *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. The values within {} represent the critical values of the Stock-Yogo weak identification test at the 10% significance level.

First, the tourism industry development and urban livability indices were recalculated using the Analytic Hierarchy Process (AHP) instead of the entropy-weight method. The estimated coefficients remain significantly positive (Columns (1), (2)). Second, all variables

were winsorized at the 5% level to mitigate the influence of outliers, and the results remain robust (Column (3)). Third, the three provincial capitals of Wuhan, Changsha, and Nanchang were excluded from the sample. The positive effect of tourism industry development on urban livability persists (Column (4)).

To mitigate potential endogeneity concerns related to reverse causality and omitted variables, an instrumental variable (IV) approach was employed, mainly following two considerations. It satisfies the relevance as terrain relief, and railway connectivity jointly affect tourism development through accessibility and transportation costs. It also satisfies the exclusion restriction, as terrain is a time-invariant geographic factor and railway mileage is a macro-level variable that does not directly affect urban livability except through tourism development. The first-stage F-statistic was 81.07, well above 10, suggesting no weak instrument problem. The second-stage estimates indicated a significantly positive effect of tourism industry development at the 1% level (Columns (5)–(6)), consistent with the baseline findings.

5.3. Spatial Spillover Effects

5.3.1. Spatial Dependence and Model Specification

Table 6 reports the Global Moran's I statistics for tourism industry development (TIDL) and urban livability (UL) under the economic–geographic weight matrix. Most of Moran's I values are significantly negative during the study period, indicating that the spatial distributions of TIDL and UL exhibit spatial differentiation rather than random patterns. These results suggest the presence of significant spatial dependence and justify the application of spatial econometric models.

Table 6. Global Moran's I Index Results.

Year	TIDL	UL	Year	TIDL	UL
2000	−0.034	−0.108 **	2013	−0.118 ***	−0.140 ***
2001	−0.047	−0.119 ***	2014	−0.116 ***	−0.143 ***
2002	−0.046	−0.116 ***	2015	−0.115 ***	−0.150 ***
2003	−0.062	−0.127 ***	2016	−0.111 **	−0.151 ***
2004	−0.066	−0.127 ***	2017	−0.096 **	−0.150 ***
2005	−0.083 *	−0.117 ***	2018	−0.089 *	−0.148 ***
2006	−0.098 **	−0.115 ***	2019	−0.088 *	−0.148 ***
2007	−0.097 **	−0.125 ***	2020	−0.102 **	−0.148 ***
2008	−0.100 **	−0.124 ***	2021	−0.105 **	−0.149 ***
2009	−0.106 **	−0.121 ***	2022	−0.105 **	−0.148 ***
2010	−0.093 **	−0.131 ***	2023	−0.121 ***	−0.147 ***
2011	−0.110 **	−0.127 ***	2024	−0.134 ***	−0.146 ***
2012	−0.105 **	−0.143 ***			

Note: The values are z-score; *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

To identify the appropriate model specification, both the economic–geographic and inverse-distance weight matrix were employed. As shown in Table 7, the LM and Robust LM tests are significant at the 1% level, indicating the coexistence of spatial lag and spatial error dependence. Furthermore, the LR and Wald tests reject the simplification of the Spatial Durbin Model (SDM) into the Spatial Autoregressive Model (SAR) or the Spatial Error Model (SEM). The Hausman, LR-individual, and LR-time tests indicate that a two-way fixed-effects specification is appropriate. Accordingly, a two-way fixed-effects SDM is employed in the subsequent analysis.

Table 7. Spatial Econometric Model Test Results.

	Economic-Geographic Weight Matrix (W_{eg})	Inverse-Distance Weight Matrix (W_{id})
Moran's I	31.478 **	34.300 ***
LM-error	928.253 ***	1102.722 ***
Robust LM-error	629.367 ***	787.001 ***
LM-lag	316.069 ***	325.640 ***
Robust LM-lag	17.183 ***	9.919 ***
Hausman	12.71 **	10.13 ***
LR-ind	15.91 ***	204.84 ***
LR-time	585.37 ***	740.91 ***
LR-error	109.60 ***	104.20 ***
LR-lag	105.56 ***	47.47 ***
Wald-error	31.93 **	32.22 ***
Wald-lag	23.81 **	26.95 ***

Note: The values are t -values; **, and *** indicate significance at the 5%, and 1% levels, respectively. “lag” and “error” represent spatial lag and spatial error, respectively; “ind” and “time” represent spatial effect and temporal effect, respectively.

5.3.2. Spatial Spillover Estimation Results

Table 8 presents the SDM estimation results. Under both the economic–geographic and inverse-distance weight matrices, tourism industry development ($TIDL$) remains statistically significant and positive at the 1% level, indicating robust results across alternative spatial specifications. The model based on the economic–geographic matrix exhibits a better fit and is therefore used for further interpretation.

The spatial autoregressive coefficient (ρ) is significantly negative under both weight matrices, and the coefficient of the spatially lagged tourism variable ($W \times TIDL$) is also significantly negative. These findings indicate a negative spatial spillover effect of tourism industry development on urban livability in neighboring cities. The results are consistent with the pattern of polarization effects across cities, characterized by a “local promotion–neighboring inhibition” pattern. In other words, tourism-related resources, capital, and visitor flows tend to concentrate in core cities, potentially producing a siphoning effect on surrounding areas.

To further examine the transmission mechanism, the effects were decomposed into direct, indirect, and total effects based on a partial-derivative approach (Table 9). The direct effect of tourism industry development is significantly positive (0.059, $p < 0.01$), indicating that tourism industry development contributes to local improvements in urban livability. By contrast, the indirect effect is significantly negative (−0.024, $p < 0.01$), suggesting that tourism growth in one city may reduce livability in neighboring cities. This finding aligns with the concentration of tourism resources and development opportunities in regional core cities, including Wuhan, Changsha, and Nanchang. Nevertheless, the total effect remains significantly positive (0.035, $p < 0.01$), implying that tourism industry development contributes positively to overall livability across the urban agglomeration despite its uneven spatial distribution.

Among the control variables, economic development ($\ln pgdp$) and transportation development ($\ln trans$) exhibit significant spatial heterogeneity in their effects, whereas the spillover effects of human capital (edu) and urbanization ($urban$) are relatively limited. Overall, the results indicate that tourism industry development enhances local livability while simultaneously generating negative spillover effects on neighboring cities, thereby supporting Hypothesis 2 (H2).

Table 8. Regression Results of SDM Model.

	Economic-Geographic Weight Matrix (W_{eg})	Inverse-Distance Weight Matrix (W_{id})
<i>TIDL</i>	0.056 *** (12.32)	0.060 *** (13.33)
<i>lnpgdp</i>	−0.009 *** (−3.15)	−0.008 *** (−2.86)
<i>edu</i>	−0.003 (−1.55)	−0.003 (−1.29)
<i>urban</i>	−0.006 *** (−2.96)	−0.004 ** (−2.36)
<i>lntrans</i>	0.007 *** (2.85)	0.006 *** (2.41)
$W \times TIDL$	−0.221 *** (−7.08)	−0.142 *** (−4.24)
$W \times lnpgdp$	0.046 *** (2.70)	0.055 *** (2.91)
$W \times edu$	−0.037 ** (−2.16)	−0.026 (−1.56)
$W \times urban$	−0.002 (−0.12)	0.012 (0.85)
$W \times lntrans$	−0.050 *** (−3.65)	−0.053 *** (−3.68)
ρ	−0.306 ** (−2.18)	−1.693 *** (−8.40)
σ^2	0.002 *** (19.71)	0.002 *** (17.61)
Log-Likelihood	1142.839	1145.274
R^2	0.093	0.026

Note: The values in parentheses are *t*-values; **, and *** indicate significance at the 5%, and 1% levels, respectively.

Table 9. The Decomposition Result of the Spatial Spillover Effect.

	Direct Effect	Indirect Effect	Total Effect
<i>TIDL</i>	0.059 *** (12.76)	−0.024 *** (3.26)	0.035 *** (6.31)
<i>lnpgdp</i>	−0.010 *** (−4.14)	0.038 *** (2.92)	0.028 *** (2.12)
<i>edu</i>	−0.002 (−1.15)	−0.030 ** (−2.44)	−0.033 ** (−2.52)
<i>urban</i>	−0.005 *** (−2.64)	−0.000 (−0.02)	−0.006 (−0.51)
<i>lntrans</i>	0.007 *** (2.51)	−0.041 *** (−3.58)	−0.034 *** (−2.96)

Note: The values in parentheses are *t*-values; **, and *** indicate significance at the 5%, and 1% levels, respectively.

5.4. Moderating Effects

Table 10 reports the moderating effect estimates. The interaction effects between tourism industry development and the two moderating variables are significantly positive, indicating that public service provision and infrastructure connectivity strengthen the positive effect of tourism industry development on urban livability.

Table 10. Moderating Effect Test Results.

	Public Service Provision (<i>pub</i>)	Infrastructure Connectivity (<i>lninfrs</i>)
<i>TIDL</i>	0.099 *** (32.12)	0.075 *** (20.93)
<i>pub</i>	0.107 ** (3.01)	
<i>lninfrs</i>		0.076 *** (15.76)
<i>TIDL</i> × <i>pub</i>	0.237 *** (7.34)	
<i>TIDL</i> × <i>lninfrs</i>		0.070 *** (21.38)
<i>lnpgdp</i>	−0.008 *** (−4.57)	−0.005 *** (−3.78)
<i>edu</i>	−0.002 (−1.52)	0.001 (0.90)
<i>urban</i>	−0.002 (−1.03)	−0.001 (−0.83)
<i>lntrans</i>	0.001 (0.21)	0.002 (0.97)
_cons	0.233 *** (144.80)	0.220 *** (155.64)
R ²	0.7865	0.8726
F	22.86 ***	30.37 ***

Note: The values in parentheses are *t*-values; **, and *** indicate significance at the 5%, and 1% levels, respectively.

Specifically, the interaction term of tourism industry development and public service provision (*TIDL* × *pub*) is statistically positive and significant at the 1% level ($\beta = 0.237$), suggesting that a higher level of public services enhances the conversion of tourism industry development benefits into improvements in urban livability. This finding supports Hypothesis 3a (H3a).

Similarly, the interaction term between tourism industry development and infrastructure connectivity (*TIDL* × *lninfrs*) is significantly positive ($\beta = 0.070$, $p < 0.01$), indicating that well-connected infrastructure networks amplify the livability benefits generated by tourism industry development. Improved connectivity facilitates the movement of tourists, capital, and information, thereby strengthening the contribution of tourism industry development to urban livability. Therefore, Hypothesis 3b (H3b) is also supported.

5.5. Heterogeneity Analysis

5.5.1. Development Stage Heterogeneity

To examine whether the implementation of the national urban agglomeration strategy altered the livability effects of tourism industry development, the sample period was divided into two stages using the 2015 approval of the Development Plan for the research area as the breakpoint.

As shown in Table 11, tourism industry development has no significant effect on urban livability during 2000–2014. In contrast, the coefficient becomes significantly positive during 2015–2024 ($\beta = 0.018$, $p < 0.05$). This result suggests that the livability benefits of tourism industry development became more pronounced after the implementation of regional integration and coordinated development policies.

Table 11. Heterogeneity Test Results.

	Development Stage		Tourism Brand		Economic Development Level		City Size	
	Before 2015	After 2015	Yes	No	Low	High	Small and Medium	Large
<i>TIDL</i>	−0.001 (−0.25)	0.018 ** (2.81)	0.012 ** (2.48)	0.022 *** (4.08)	0.013 *** (3.57)	0.028 *** (5.80)	0.011 ** (2.70)	0.025 *** (5.16)
<i>lnpgdp</i>	−0.003 ** (−2.29)	0.000 (0.07)	−0.001 (−1.32)	−0.003 * (−1.67)	−0.000 (−0.79)	−0.003 * (−1.70)	−0.000 (−0.71)	−0.004 ** (−2.08)
<i>edu</i>	−0.001 (−1.09)	−0.001 (−0.81)	−0.001 (−1.25)	−0.001 (−0.55)	0.000 (0.81)	−0.002 (−1.00)	−0.000 (−0.17)	−0.002 (−1.18)
<i>urban</i>	0.000 (0.37)	0.001 (0.57)	0.001 (0.69)	0.002 (1.10)	0.002 (1.24)	0.002 (1.22)	0.003 * (1.81)	0.001 (0.072)
<i>lntrans</i>	0.005 ** (2.03)	−0.004 ** (−1.97)	−0.004 ** (−2.24)	−0.002 (−0.72)	0.003 (1.52)	−0.007 ** (−3.00)	−0.002 (−0.84)	−0.007 ** (−2.56)
<i>_cons</i>	0.134 *** (8.26)	0.314 *** (22.78)	0.171 *** (10.34)	0.213 *** (11.99)	0.176 *** (13.26)	0.235 *** (15.09)	0.170 *** (11.11)	0.227 *** (13.93)
<i>R²</i>	0.922	0.816	0.965	0.954	0.976	0.963	0.970	0.955
<i>F</i>	71.89 ***	30.61 ***	80.66 ***	47.02 ***	52.72 ***	60.07 ***	62.67 ***	44.76 ***
<i>N</i>	448	252	375	325	350	350	350	350
City-fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Year-fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES

Note: The values in parentheses are *t*-values; *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

5.5.2. Tourism Brand Effect Heterogeneity

To assess whether tourism brands affect the impact of tourism industry development on urban livability, the sample was divided into National All-for-One Tourism Demonstration Zones and non-demonstration zones. The classification follows the official list released by the former China National Tourism Administration in 2016.

The regression results indicate significantly positive effects in both groups, but the effect is substantially stronger in demonstration areas ($\beta = 0.022$, $p < 0.01$) than in non-demonstration areas ($\beta = 0.012$, $p < 0.05$). This finding suggests that tourism branding enhances the ability of tourism industry development to generate improvements in urban livability, likely through better infrastructure, public services, and tourism governance.

5.5.3. Economic Development Level Heterogeneity

Considering that the urban economic foundation may affect the transformation ability of tourism industry development benefits, this paper divides samples into ‘high economic development level’ and ‘low economic development level’ based on the median of the average GDP of prefecture-level cities during the sample period, and conducts regression analysis separately for each group.

Tourism industry development exerts a significantly positive effect on urban livability in both groups, although the effect is stronger in economically developed cities ($\beta = 0.028$, $p < 0.01$) compared with less developed cities ($\beta = 0.013$, $p < 0.01$). This result indicates that a stronger economic foundation facilitates the transformation of tourism growth into livability improvements.

5.5.4. City Size Heterogeneity

Due to significant differences in tourism industry agglomeration capacity and resource allocation efficiency associated with city size, cities are classified into large-sized cities and small- and medium-sized cities based on China’s official urban size classification criteria and the permanent resident population of prefecture-level cities. Grouped regression analysis is then conducted.

The positive effect of tourism industry development on urban livability remains significant across both groups but is more pronounced in large cities ($\beta = 0.025, p < 0.01$) than in small and medium-sized cities ($\beta = 0.011, p < 0.05$). This finding implies that larger cities are better positioned to convert tourism advantages into improvements in urban livability due to their stronger infrastructure, service capacity, and resource agglomeration effects.

Overall, the results of the heterogeneity analysis suggest that the effects of tourism industry development on urban livability depend on regional development conditions. The positive impact is more evident in cities with stronger institutional support, higher economic development levels, and greater urban capacity.

6. Discussions

6.1. Tourism Industry Development and Urban Livability: From Economic Growth to Broader Welfare Gains

The positive association identified in this study supports a growing body of literature suggesting that tourism contributes not only to economic development but also to broader improvements in urban renewal, infrastructure improvement, and resident well-being [97,98]. For example, studies in European and North American cities have shown that cultural tourism can revitalize historic districts and participate in urban regeneration [66]. Existing research has generally emphasized the economic contributions of tourism through employment creation, industrial upgrading, and investment stimulation [58,81,91]. Most of these studies, however, focus on individual cities or specific tourism destinations. The present findings extend this line of research by demonstrating that these benefits are not confined to individual cities or tourism destinations but can also be observed at the urban agglomeration scale, where tourism industry development is associated with broader improvements in urban livability.

Compared with studies that primarily focus on the tourism-led growth hypothesis, the present research demonstrates that the influence of tourism extends beyond economic performance. Tourism industry development can improve urban livability through multiple channels, including enhanced public services, environmental improvement, and the upgrading of urban spaces. These findings imply that tourism increasingly functions as a component of urban development and governance rather than merely as a sector generating economic output. In the context of China's transition toward high-quality development, tourism has become more closely integrated with broader objectives of sustainability and quality of life.

The results also show that the benefits of tourism industry development are conditional rather than automatic. The positive effect of tourism on urban livability is significantly strengthened by higher levels of public service provision and infrastructure connectivity. This finding aligns with prior studies emphasizing that tourism industry development is highly dependent on the broader urban environment and supporting public resources [3]. In other words, tourism-generated economic gains do not necessarily translate into welfare improvements unless they are accompanied by effective public governance and adequate infrastructure provision. Well-developed public services and transport networks enhance the capacity of cities to transform tourism growth into tangible improvements in residents' daily lives, thereby facilitating the realization of a more inclusive and shared development model.

6.2. Spatial Spillover and Regional Inequality: Tourism Industry Development Does Not Necessarily Generate Shared Regional Benefits

A notable finding of the present study is that tourism industry development generates a significant negative spatial spillover effect on urban livability. This result contrasts with

studies reporting positive tourism spillovers across cities. For example, Wang et al. [76], using data from the Yangtze River Delta Urban Agglomeration, found that higher levels of tourism investment significantly strengthened intercity tourism linkages and generated positive spillover effects on neighboring cities by promoting the mobility of tourism-related production factors. By contrast, the present study reveals that rather than promoting balanced regional development, tourism growth in the research area appears to reinforce spatial inequality, with the observed spatial pattern being more consistent with polarization and resource concentration than with widespread diffusion. This finding should also be interpreted in light of the regional context of the research area, where a pronounced urban hierarchy, persistent core–periphery disparities, and ongoing regional integration create conditions under which the benefits of tourism development may remain concentrated in leading cities rather than diffuse evenly across the region. However, the present analysis does not directly identify the underlying mechanisms responsible for this pattern.

This pattern reflects the uneven development structure that characterizes many Chinese urban agglomerations. This interpretation is closely related to the asymmetric development structure of Chinese urban agglomerations. An alternative interpretation is that the observed negative spatial spillover may not arise solely from tourism industry development itself but may also reflect the broader dominance of stronger central cities within the urban agglomeration. Large metropolitan centers such as Wuhan, Changsha, and Nanchang possess long-established advantages in economic strength, administrative status, transportation accessibility, public service provision, and innovation capacity. These structural advantages enable them to attract population, capital, investment, and high-value economic activities even in the absence of tourism growth, thereby creating persistent core–periphery disparities. From this perspective, the negative spatial spillover identified in the present evidence should not necessarily be interpreted as an effect generated exclusively by tourism development. Rather, tourism development may interact with these pre-existing urban advantages by further concentrating tourism-related investment, visitors, skilled labor, and supporting industries in already advantaged cities. In this sense, tourism is likely to function as an amplifying factor that reinforces existing spatial inequalities rather than the sole source of the observed negative spillover. Consequently, the negative spillover identified in this study is more plausibly interpreted as the outcome of tourism interacting with pre-existing regional disparities rather than tourism alone.

The findings are consistent with studies reporting polarization and siphoning effects associated with tourism industry development in China [35,76], and they also echo recent evidence indicating that provincial capital cities may exert a shadowing effect on neighboring areas [34]. Similar conclusions have been reported for the research area, where negative neighboring effects have been observed in ecological, production, and living functions [92]. These results are consistent with the possibility that tourism industry development may generate competitive rather than complementary spatial relationships under conditions of substantial regional disparities.

More broadly, the findings highlight the context-dependent nature of tourism spillovers. Evidence from international metropolitan regions implies that, under conditions of coordinated governance and high regional integration, the development advantages of core cities can gradually diffuse to surrounding areas through infrastructure connectivity, institutional coordination, and functional complementarity. For example, research on the Greater Iași Metropolitan Area in Romania indicates that the spatial advantages of the core city can, over time, help transform the vulnerabilities of surrounding areas into opportunities for regional recovery and coordinated development, thereby mitigating spatial polarization [99]. By contrast, urban agglomerations in developing countries often remain in a stage characterized by rapid agglomeration and uneven growth, where regional

coordination mechanisms are still evolving, and substantial disparities persist between core and peripheral cities, whose spatial effects are shaped not only by tourism expansion itself but also by broader urban hierarchy, regional development conditions, and institutional arrangements. Therefore, the spatial consequences of tourism industry development should not be assumed to be inherently positive. Instead, their direction and magnitude are likely to depend on regional development stages, institutional arrangements, and the degree of spatial integration.

By identifying a negative spillover effect of tourism industry development on urban livability, the present findings contribute to the tourism spillover literature. The results further demonstrate that tourism-induced regional benefits are conditional rather than automatic. Tourism industry development is associated with a pattern characterized by local gains and neighboring losses. The underlying mechanisms producing this spatial pattern require further empirical investigation using data on intercity factor mobility, tourism flows, or resource allocation.

6.3. Implications for Sustainable Urban Agglomeration Governance

The findings have implications for ongoing debates on sustainable urban development and regional governance. Sustainable Development Goal 11 highlights the importance of inclusive, safe, resilient, and sustainable cities. In this context, tourism is increasingly viewed as a strategic tool for urban regeneration, economic diversification, and regional transformation [1,71]. Tourism should be evaluated not only by its economic contribution but also by its capacity to promote inclusive and sustainable urban development. Against this background, the present findings suggest that the contribution of tourism to sustainability is more complex than commonly assumed.

Although tourism industry development significantly improves local urban livability, its benefits are not necessarily distributed evenly across space. The negative spillover effects identified in this study indicate that tourism growth may be associated with stronger development advantages in leading cities and comparatively weaker development outcomes in neighboring areas. The specific mechanisms underlying this spatial pattern cannot be directly inferred from the present analysis. Consequently, tourism expansion alone cannot guarantee balanced regional development, and the results prove that its benefits may not be evenly distributed across cities within urban agglomerations.

These findings imply that sustainable tourism governance should extend beyond the pursuit of tourism growth and place greater emphasis on the spatial distribution of development benefits. From a regional perspective, the effectiveness of tourism as a development strategy depends not only on its capacity to generate economic value but also on its ability to support coordinated development across interconnected cities. This is particularly relevant for urban agglomerations in developing countries, where disparities in infrastructure provision, public services, and economic opportunities remain substantial.

The moderating effects identified in current research further highlight the importance of governance capacity in shaping tourism outcomes. Public service provision and infrastructure connectivity significantly enhance the positive effects of tourism industry development on urban livability, demonstrating that tourism benefits are more likely to be translated into welfare improvements when supported by effective institutions and adequate public investment. In this sense, the long-term sustainability of tourism is shaped not only by market expansion but also by its integration with public service improvement, infrastructure development, and broader quality-of-life objectives.

Taken together, the findings suggest that tourism should be understood as part of a wider urban and regional development system rather than as an isolated economic sector. Achieving sustainable and inclusive tourism industry development therefore requires

greater attention to regional coordination, equitable resource allocation, and the capacity of local governments to transform tourism growth into broader social welfare gains. These insights may offer useful lessons for urban agglomerations across the Global South that are seeking to balance tourism expansion with sustainable development objectives.

7. Conclusions and Implications

7.1. Conclusions

Using panel data for 28 prefecture-level cities in the Middle Reaches of the Yangtze River Urban Agglomeration (MRYRUA) from 2000 to 2024, this study employed kernel density estimation, two-way fixed-effects models, and spatial Durbin models to examine the impacts of tourism industry development on urban livability. Three main conclusions can be drawn.

First, both tourism industry development and urban livability exhibited a clear upward trend during the study period, although their spatiotemporal evolution patterns differed. Tourism industry development evolved from a core-centered concentration pattern toward corridor-based diffusion, while urban livability gradually expanded from core cities to surrounding areas, reflecting an overall improvement in regional coordination. Kernel density results further indicate increasing polarization in tourism industry development, whereas disparities in urban livability tended to narrow over time.

Second, tourism industry development significantly improved urban livability, but its effects were spatially heterogeneous. While tourism industry development generated substantial positive effects on local urban livability, it also produced significant negative spillover effects on neighboring cities, revealing a spatial pattern characterized by “local gains but neighboring constraints.” In addition, both public service provision and infrastructure connectivity positively strengthen the relationship between tourism industry development and urban livability.

Third, the effects of tourism industry development on urban livability varied across different contexts. The positive impact was stronger following the introduction of the national urban agglomeration development strategy, in National All-for-One Tourism Demonstration Zones, in economically developed cities, and in large-sized cities. These results argue that the livability benefits of tourism industry development depend not only on tourism growth itself but also on broader institutional, economic, and urban development conditions.

7.2. Theoretical Implications

The present findings contribute to the literature on tourism development and urban livability from a theoretical perspective in three ways.

First, it extends spatial interaction theory in the context of tourism by revealing an asymmetric spatial pattern characterized by a “local promotion–neighboring inhibition” effect, suggesting that the benefits of tourism development are not evenly distributed across space but instead exhibit structured spatial polarization within urban agglomerations. This finding refines existing assumptions that tourism development uniformly promotes regional welfare improvement.

Second, it enriches urban agglomeration coordination theory by demonstrating that spatial interdependence in tourism–livability relationships is shaped by cross-city disparities rather than purely by geographic proximity. The results indicate that spatial spillovers could be conditioned by the hierarchical urban structure and regional development imbalance, thereby highlighting the importance of internal heterogeneity in urban agglomeration theory.

Third, by incorporating public service provision and infrastructure connectivity as moderating factors, the present findings further advance the understanding of how institutional and infrastructural conditions shape the translation of tourism development into urban welfare outcomes. This provides a more nuanced theoretical mechanism linking tourism-driven economic activities to multidimensional urban livability.

7.3. Practical Implications

This study provides several practical implications for urban agglomeration governance and tourism planning.

First, tourism industry development should be integrated into broader livability-oriented urban development strategies. The results indicate that tourism industry development contributes not only to economic growth but also to improvements in urban livability. Policymakers should therefore move beyond a growth-centered tourism agenda and place greater emphasis on the welfare outcomes of tourism industry development. Investments generated by tourism should be directed toward public services, environmental improvement, and urban regeneration projects to ensure that tourism benefits are shared by both residents and visitors. Municipal governments can play a central role by prioritizing tourism-related fiscal revenues for neighborhood renewal, public transportation, healthcare, cultural facilities, and other livability-oriented investments.

Second, regional tourism policies should pay greater attention to spatial spillover effects and inter-city coordination. The negative spillover effect identified in this study reveals that tourism growth in one city does not automatically generate benefits for neighboring cities. In urban agglomerations characterized by strong core–periphery structures, excessive concentration of tourism resources and visitors may reinforce regional inequalities. Strengthening cross-jurisdictional cooperation, improving transportation integration, and promoting joint tourism products and marketing initiatives may help diffuse tourism benefits more evenly across the region. Provincial governments and regional tourism authorities should establish coordinated tourism planning mechanisms, integrate transportation and destination branding strategies, and support intercity tourism corridors that connect core and peripheral cities.

Third, differentiated development strategies are needed to address varying local conditions. The heterogeneity analysis shows that the livability effects of tourism industry development are stronger in economically advanced cities, large cities, and nationally recognized tourism destinations. This implies that less-developed and peripheral cities may face greater constraints in converting tourism growth into welfare gains. Rather than pursuing homogeneous tourism expansion, these cities should capitalize on their unique ecological, cultural, and historical resources while improving public services and infrastructure capacity. Such place-based approaches can enhance local competitiveness and support more balanced regional development. For less-developed and peripheral cities, provincial agencies, national tourism authorities, and planning institutions can provide targeted financial support, infrastructure investment, technical assistance, and destination planning guidance to enhance local service capacity and improve the conversion of tourism growth into long-term livability gains.

Overall, tourism should be viewed not merely as an engine of economic growth but as a policy instrument for promoting livability and sustainable urban development. Realizing this potential requires coordinated governance arrangements among municipal governments, provincial agencies, regional tourism authorities, planning institutions, and national policymakers to balance economic efficiency, social welfare, and regional equity.

7.4. Limitations and Future Research

Despite the contributions of this study, several avenues remain open for future research.

First, this study primarily employed linear spatial econometric models to examine the impact of tourism industry development on urban livability. While this approach effectively captures average effects and spatial interactions, the relationship may vary across different stages of tourism industry development and urbanization. Future research could explore potential nonlinearities and threshold effects by applying dynamic spatial models or threshold regression techniques.

Second, the empirical analysis relies primarily on statistical indicators at the city level. Although this allows for a comprehensive assessment of regional patterns and spatial spillover effects, it provides limited insight into how tourism industry development influences residents' subjective well-being. Future studies could integrate survey data, interviews, and other micro-level datasets to explore how tourism industry development influences life satisfaction, place attachment, and perceived quality of life.

Third, although this study identifies significant spatial spillover effects of tourism industry development on urban livability, the empirical analysis does not directly distinguish the specific mechanisms through which these spillovers occur. The theoretical framework considers multiple potential pathways, including factor mobility, demonstration effects, polarization, and trickle-down effects, while the empirical analysis evaluates the overall spillover outcome. Future research could incorporate micro-level data, intercity flow data, or structural models to empirically identify and compare the relative importance of different spillover mechanisms, thereby enabling a more rigorous assessment of the mechanisms underlying tourism-induced spatial spillover effects.

Fourth, this study primarily focuses on the causal effect of tourism industry development on urban livability, while the potential reverse relationship between the two remains worthy of further investigation. Although the present evidence addresses possible endogeneity concerns through instrumental variable estimation, urban livability may also influence tourism industry development by shaping destination attractiveness, investment conditions, and tourism competitiveness. Future research could further explore the bidirectional and dynamic interactions between tourism development and urban livability by employing dynamic panel models, simultaneous equation models, or other causal identification approaches.

Despite these limitations, this study provides new evidence on the direct, spatial spillover, and moderating effects of tourism industry development on urban livability from an urban agglomeration perspective. The findings contribute to the growing literature on tourism-led urban development and offer insights for promoting more livable and sustainable urban regions.

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