Does Stadium Construction Drive Surrounding Urban Development? Evidence from Spatiotemporal Impacts of Large-Scale Stadiums in China

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Abstract (Academic)

Existing research on the urban impacts of stadium construction has been predominantly shaped by cost-benefit frameworks in Western contexts. In China, however, stadium construction is deployed as part of state-led development packages as strategic instruments for inter-city competition and spatial restructuring. Whether this approach generates sustained spatial effects in surrounding areas remains unclear. This study analyzes 153 large-scale stadiums (≥15,000 seats or ≥15 ha) completed between 2004 and 2019 across Chinese cities, using a spatiotemporal panel dataset and an interrupted time series (ITS) model to assess changes in urban development intensity within 5 km buffers. We find that development intensity rises sharply in the period immediately after stadium completion—plus a one-time bump in the year of the first major sporting event—but does not produce a sustained change in the longer-run post-completion growth trajectory. The effect is significantly stronger in sub-provincial and provincial capital cities, while distance to the city center and built environment quality do not significantly moderate the outcome. These results suggest that stadium-related development gains are shaped by the coordination capacity embedded in administrative hierarchy rather than by localized spatial conditions, highlighting a fundamental asymmetry between the replicability of development templates and the institutional capacity required to translate them into sustained spatial outcomes.

Does Stadium Construction Drive Surrounding Urban Development? Evidence from Spatiotemporal Impacts of Large-Scale Stadiums in China

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General Audience Abstract

In China, local governments have invested heavily in large sports stadiums as part of broader development packages that often include new transport infrastructure, commercial districts, and residential expansion. These projects are intended to enhance urban image, attract investment, and stimulate growth in surrounding areas. Do these investments lead to lasting development? This study examines 153 large stadiums built across Chinese cities between 2004 and 2019 to find out whether the areas around them became more developed after construction. Using satellite-based land cover data and population estimates, we tracked changes in development intensity within a 5-kilometer radius of each stadium over two decades. The results show a clear increase in development immediately after stadium completion, along with an additional boost when the stadium hosts its first major sporting event. However, these gains do not continue to grow over time—the long-term growth trajectory of surrounding areas does not change. Interestingly, the effect is significantly stronger in sub-provincial and provincial capital cities, while proximity to the city center and existing built environment conditions do not substantially alter outcomes. These patterns suggest that the effects of stadium-led development are shaped more by institutional coordination capacity embedded within administrative hierarchies than by localized spatial characteristics. Overall, these findings highlight the limits of using stadium construction as a tool for long-term urban development, especially in smaller cities that may lack the institutional capacity to sustain initial gains.

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CHAPTER 1 INTRODUCTION

Stadium Construction in China

Since the founding of the People's Republic of China, sports development has followed a state-led approach known as the Juguo Tizhi ("whole-nation system"), which positioned competitive sports as both a symbolic and political instrument for consolidating national unity and projecting power on the global stage (Li et al., 2024; Junior & Rodrigues, 2024). The successful bid for the 2008 Beijing Olympic Games marked a critical turning point, bringing sports infrastructure construction to a new level and triggering a nationwide wave of large-scale sports center development. This momentum was reinforced by a series of subsequent high-profile events, including the 2010 Guangzhou Asian Games, the 2011 Shenzhen Universiade, and the 2022 Beijing Winter Olympics, which helped intensify infrastructure investment and project delivery in multiple cities (Duan et al., 2016). The release of the "Opinions on Accelerating the Development of Sports Industry and Promoting Sports Consumption" by the State Council further embedded sports infrastructure within national economic strategy, prompting local governments to treat stadium projects as instruments of city branding, investment attraction, and territorial competition (Fang et al., 2023; Su et al., 2023).

The scale of this expansion is striking. According to the 2024 National Sports Venue Survey (GSASA, 2024), China now has 4.84 million sports venues with a combined area of 4.23 billion square meters, equivalent to approximately 3 square meters of sports facility space per capita. Compared with 2003, these figures represent increases of 469%, 88%, and 191%, respectively (GSASA, 2005).

Why Local Governments Build Stadiums

This expansion was not driven primarily by market demand or local sports participation needs. Unlike countries where stadium construction responds to professional sports team demands or private investment (Ma & Kurscheidt, 2019), stadiums in China are embedded within a distinct institutional logic that links infrastructure investment to political incentives and fiscal strategy.

China's governance system creates strong incentives for local officials to pursue visible, large-scale development projects. Under the cadre evaluation and promotion system, officials are assessed in part on the economic growth and visible achievements of their jurisdictions, generating intense inter-city competition for investment, policy resources, and higher-level recognition (Guo, 2020; Lei & Zhou, 2022). Stadium projects fit naturally within this competitive dynamic, as their high political visibility and concentrated construction timelines enable local governments to demonstrate governance performance through project delivery. At the same time, China's land-finance system provides the fiscal mechanism that makes such projects viable. Within China’s land system, municipal governments influence urban expansion largely through the management and leasing of land for development, and land-lease revenues have been a key source of local fiscal resources. Infrastructure investments such as stadiums, roads, and cultural facilities can raise surrounding land values and strengthen expected returns from land leasing (Theurillat, 2017). Within this system, a stadium does not need to generate revenue directly through ticket sales or event hosting. Its primary fiscal function is to anchor a development package that enhances surrounding land values, creating a self-reinforcing cycle of infrastructure investment and land-based revenue extraction. This helps explain why stadiums are rarely built as standalone facilities. Instead, they often form part of bundled development packages that combine transport infrastructure, cultural facilities, and residential projects, and are used as anchor projects for new-area development or urban expansion (Ren, 2008; Woodworth & Chein, 2022; Xue & Mason, 2019).

This highly institutionalized model raises a fundamental question: if stadium construction is primarily a mechanism for state-led resource mobilization and land value enhancement rather than a response to local market demand, does it generate sustained spatial effects in surrounding areas, or do the impacts remain confined to the construction and event-hosting cycle?

Uncertain Returns and Limited Evidence

Stadium construction is often framed as a catalyst for surrounding development, yet evidence of sustained returns remains mixed. Internationally, the effectiveness of stadium-led development has been widely debated. A substantial body of research in Western contexts has found that public investments in large stadiums rarely translate into measurable net economic gains and may impose long-term fiscal burdens (Bradbury et al., 2022; Siegfried & Zimbalist, 2000; Sepulveda, 2023). In the United Kingdom, stadium-linked urban regeneration has been associated with unintended consequences such as gentrification and spatial exclusion (Watt, 2013; Jakar & Philippou, 2025). While these findings are rooted in market-oriented institutional settings and may not directly apply to China's state-led context, they establish a broader pattern of uncertain returns from stadium investment.

In the context of China, the evidence that does exist points in a similar direction. The Sixth National Sports Venue Census (GSASA, 2015) reported that the combined operating deficit of large stadiums reached 578.17 million RMB (approximately 95.5 million USD) in 2013, and subsequent research has documented persistent challenges of low utilization, limited commercialization, and dependence on government subsidies (Ge & Feng, 2019; Gao et al., 2022). Studies on facility provision have revealed pronounced regional disparities, with sports infrastructure concentrated in coastal provinces and major urban centers while western and rural areas remain underserved (Zhang et al., 2023; Guo et al., 2025). Even within cities, inequalities persist: high-end venues tend to cluster in central business districts or newly developed zones, while older communities and low-income neighborhoods often lack adequate access (Chen et al., 2021; Shen et al., 2020; Xiao et al., 2022; Yang & Tang, 2025).

At the same time, an important limitation remains. Most Chinese studies evaluate stadium outcomes at the facility level, focusing on distribution, accessibility, and operational management, rather than on broader spatial and developmental impacts on surrounding areas. The research relies predominantly on descriptive statistics, national surveys, or single-city case studies, and has rarely employed high-resolution geospatial datasets or spatiotemporal analytical frameworks to examine stadium impacts systematically. This makes it difficult to identify where, when, and under what institutional conditions stadium construction produces measurable surrounding development, and whether any observed gains persist over time. As a result, it remains unclear whether stadium construction generates sustained changes in the development trajectories of surrounding areas.

Problem Statement and Research Objectives

This thesis provides an empirical assessment of the surrounding development effects of large-scale stadium construction in China. It asks whether stadium projects are associated with sustained shifts in urban development intensity around the site, or mainly with short-term intensification tied to construction and early event hosting. The analysis also examines how these effects vary across institutional and spatial conditions, focusing on administrative city level, distance to the city center, and micro-scale built environment quality.

The study is organized around three research questions:

1. **Post-completion dynamics:** After stadium completion, does surrounding urban development intensity exhibit a one-time level change, a change in growth trajectory, or both?
2. **Institutional heterogeneity:** How do post-completion patterns differ across China's administrative hierarchy?
3. **Spatial heterogeneity:** Do intra-urban location and local built conditions shape post-completion patterns, as reflected by distance to the city center and micro-scale built environment quality?

To answer these questions, the study analyzes a spatiotemporal panel of 153 large stadiums completed between 2004 and 2019, with yearly observations from 2000 to 2020. It uses an interrupted time series design to compare pre- and post-completion patterns in development intensity, and then estimates a set of moderation models to examine heterogeneity across institutional and spatial conditions. The analysis draws on multiple spatial datasets, including the China Land Cover Dataset, WorldPop, OpenStreetMap road networks, and Baidu Maps POI data, to track changes in the areas surrounding each stadium over time.

The following chapter (Chapter 2) presents a manuscript that has been published and constitutes the core empirical component of this thesis. The manuscript is reproduced here in its published form with minor formatting adjustments for consistency with Graduate School requirements. Chapter 3 provides a summary of the key findings and their broader implications.

CHAPTER 2 MANUSCRIPT

Does Stadium Construction Drive Surrounding Urban Development? Evidence from Spatiotemporal Impacts of Large-Scale Stadiums in China[1]

Shuqi Jin, Yang Shao, Robert Oliver, Fangzheng Lyu

Abstract: Existing research on the urban impacts of stadium construction has been predominantly shaped by cost-benefit frameworks in Western contexts. In China, however, stadium construction is deployed as part of state-led development packages as strategic instruments for inter-city competition and spatial restructuring. Whether this approach generates sustained spatial effects in surrounding areas remains unclear. This study analyzes 153 large-scale stadiums (≥15,000 seats or ≥15 hectares) completed between 2004 and 2019 across Chinese cities, using a spatiotemporal panel dataset and an interrupted time series (ITS) model to assess changes in urban development intensity within 5 km buffers. We find that development intensity rises sharply in the period immediately after stadium completion—plus a one-time bump in the year of the first major sporting event—but does not produce a sustained change in the longer-run post-completion growth trajectory. The effect is significantly stronger in sub-provincial and provincial capital cities,

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while distance to the city center and built environment quality do not significantly moderate the outcome. These results suggest that stadium-related development gains are shaped by the coordination capacity embedded in administrative hierarchy rather than by localized spatial conditions, highlighting a fundamental asymmetry between the replicability of development templates and the institutional capacity required to translate them into sustained spatial outcomes.

Key words: entrepreneurial city, urban catalyst, urban development, sports stadiums, multi-source data, China

1. Introduction

The 2008 Beijing Olympic Games marked a critical turning point in China's sports development. The successful Olympic bid strengthened public interest in sports and brought sports infrastructure construction to a new level, triggering a nationwide wave of large-scale sports center development. The release of the "Opinions on Accelerating the Development of Sports Industry and Promoting Sports Consumption" issued by the General Office of the State Council of China further reinforced the strategic importance of the sports industry. In response, local governments increasingly treated stadium projects as instruments of image-building, investment attraction, and regional development, committing substantial public resources to their construction (Fang et al., 2023; Su et al., 2023; Zhao et al., 2023). According to the 2024 National Sports Venue Survey (GSASA, 2024), China now has 4.84 million sports facilities with a combined area of 4.23 billion square meters, equivalent to approximately 3 square meters of sports facility space per capita. Compared with 2003, these figures represent increases of 469%, 88%, and 191%, respectively (GSASA, 2005).

Unlike countries where stadium construction is primarily driven by market forces (Ma & Kurscheidt, 2019), stadium construction in China is deeply embedded within the national sports governance system and local development strategies, serving both political-symbolic and developmental purposes (Wei, 2015). Sports centers are rarely built as standalone facilities for hosting events. Instead, they frequently serve as core components of bundled development packages combined with transport infrastructure, cultural centers, and residential projects as anchors for new-area development or urban expansion (Ren, 2008; Woodworth & Chein, 2022; Xue & Mason, 2019). These projects are typically characterized by large-scale capital investment, high political visibility, concentrated land supply, and strong administrative support. Within the logic of project-based urban governance, they function as strategic tools for securing policy resources and signaling governance performance (Fang et al., 2023; Wu et al., 2016).

This highly institutionalized model of stadium construction raises a question that remains insufficiently addressed: does stadium construction generate sustained changes in development trajectories within its surrounding area? If the sustained spatial and economic effects of stadiums remain uncertain, why do local governments continue to invest in them? In many Western contexts, the effectiveness of stadium-led development has long been debated. A significant number of empirical studies suggest that stadiums often fail to deliver net economic gains and may impose fiscal burdens, spatial exclusion, or resource misallocation (Bradbury et al., 2023; Sepulveda, 2023). Even so, these findings are rooted in market-oriented institutional settings and may not readily apply to China, where the political economy and urban governance structures operate under different logics.

In response, this study examines 153 large-scale stadiums completed between 2004 and 2019 across China. Using a spatiotemporal panel dataset spanning 2000 to 2020, we employ an interrupted time series (ITS) model to assess changes in urban development intensity within 5 km buffers around each stadium before and after completion. We further conduct moderation analyses to test whether stadium effects vary by administrative city level, distance to the city center, and micro-scale built environment conditions.

2. Literature Review

2.1 Entrepreneurial Urbanism: General Logic and Chinese Practice

Entrepreneurial urbanism is intimately linked to a shift in urban governance from public service provision to a more growth-driven, entrepreneurial mode (Harvey, 1989; Jessop & Sum, 2000; Wu & Zhang, 2007). Compared with managerial approaches that prioritize service provision and welfare administration, entrepreneurial governance focuses on securing growth opportunities through inter-urban competition (Harvey, 1989). It often relies on public–private partnerships and highly visible development projects to reshape place image and attract capital and economic activity (Shin, 2014; Wu, 2016; Xue & Mason, 2019). At the same time, these strategies are highly speculative and outcomes are uncertain. In many cases, risks and up-front costs are borne by the public sector (Harvey, 1989). In this case, the entrepreneurial city is not simply the result of marketization, but a competition-driven logic of governance anchored in project-based interventions (Xue & Mason, 2019).

Within this framework, cities are treated as strategic actors. In practice, these strategies are pursued primarily by local governments within a state-led governance framework, rather than by the "city" as a unitary actor (Wang & Yeh, 2019; Wu, 2018; Wu & Zhang, 2007). While stadium development may involve land developers and property interests, the central and local governments retain strategic guidance and planning authority, and the private sector tends to play a subordinate role under strong state control (He & Wu, 2005; Wu & Zhang, 2007). This governance structure means that stadiums are often delivered as development projects tied to growth objectives, rather than as facilities planned primarily for local service needs (Guo, 2020). From this perspective, large sports venues are framed less as service facilities but more as high-visibility development projects mobilized within inter-urban competition and state-led entrepreneurial agendas (He et al., 2018; Xue & Mason, 2019).

2.2 New Area Expansion and the Bundling Mechanism

Project-based governance in China is closely tied to the repeated establishment and expansion of new areas and development zones (Li & Chiu, 2019). From national new areas to provincial development zones, and from high-tech zones to industrial parks, local governments repeatedly open-up new growth spaces under competitive pressure and performance incentives (Jiang & Waley, 2022; Zhang, 2011). This dynamic has been described as "zone fever" and "project fever" (Wei, 2015). More importantly, new-area development often follows a modular template. Similar planning blueprints, standardized investment-promotion packages, and replicable infrastructure provision are deployed across cities with only limited adaptation (Chien & Woodworth, 2022).

However, modularity does not imply replicable success. A template that consolidates quickly in large metropolitan economies can remain underused for years in smaller cities. Differences in industrial structure, fiscal capacity, and demand mean that similar development policies and project strategies often produce sharply different outcomes (Chien & Woodworth, 2022; Wei, 2015). This unevenness highlights a basic point. Projects do not generate growth by default. Instead, outcomes depend on how development templates interact with local conditions.

In this context, stadiums are frequently positioned as anchor projects within integrated new-area development packages. Stadium investment is commonly articulated as a high-visibility flagship that advances place branding and provides political and financial legitimation for adjacent infrastructure provision, land assembly and redevelopment, and associated commercial investment (Ren, 2008; Shin, 2014; Xue & Mason, 2019). As Xue and Mason (2019) argue, large stadiums in China are better understood as "state projects".

They are closely tied to inter-urban positioning, place branding, and local development strategies, rather than simply expanding sport service provision. This framing also shifts the payoff logic accordingly. Stadiums do not necessarily need to "make money" if they help make surrounding land and districts investable. This logic is closely tied to China's land-finance system, in which municipal governments fund development through land leasing revenues and property-linked fiscal extraction (Theurillat, 2017).

Mega-event hosting often intensifies this bundling dynamic. Major events open a policy window for accelerated infrastructure investment, cross-sector mobilization, and spatial restructuring (Ma & Ma, 2024). They enable local governments to concentrate resources and fast-track complementary investments (Wu et al., 2016; Shin, 2014). This compressed timelines, however, can also generate longer-term fiscal exposure and operating pressures, especially when day-to-day demand after the event is insufficient to sustain venue use and management (Duan et al., 2016).

2.3 Stadium effects: international debates and evidence from China

Internationally, whether sports stadiums can stimulate urban development remains a subject of intense scrutiny. A large body of evaluation research has found that public investments in large stadiums rarely translate into measurable net economic gains and may even impose long-term fiscal burdens on local governments (Bradbury et al., 2022; Siegfried & Zimbalist, 2000). While proponents often cite intangible benefits such as enhanced city branding, civic pride, or increased tourism, these effects are difficult to quantify and insufficient to justify the substantial public costs involved (Jakar & Philippou, 2025; Santo, 2007; Sepulveda, 2023) Moreover, stadium projects are often embedded within wider urban regeneration initiatives, complicating efforts to identify a discrete "stadium-only" effect separate from the impacts of the broader development package (Baumann & Bradbury, 2023; Davies, 2012). Subsequent evaluations further indicate that any benefits that do accrue are frequently uneven in their spatial and social distribution

(Jakar & Philippou, 2025; Watt, 2013). Taken together, research from Western contexts suggests that stadium-related outcomes are conditioned less by the venue itself than by the surrounding development logic, governance arrangements, and market conditions within which it is situated.

In China, existing studies have developed a relatively systematic evidence base on facility provision, service equity, and operational governance. At the inter-city and regional scales, studies document pronounced disparities in the distribution of sports facilities, with resources concentrating in more developed regions and larger cities (Zhang et al., 2023; Guo et al., 2025). At the intra-urban scale, research further shows unequal access across neighborhoods and social groups. Accessibility and service quality vary markedly across communities, indicating persistent spatial and social inequities in provision (Chen et al., 2021; Shen et al., 2020; Xiao et al., 2022; Yang & Tang, 2025). Other research has highlights challenges in post-construction operation and governance. Large venues often face limited commercialization, low utilization, and dependence on subsidies. In some cases, stadiums evolve into long-term operational burdens and fiscal pressures (Ge & Feng, 2019; Gao et al., 2022).

Although existing research has revealed patterns of unequal provision and operational challenges, much of this work evaluates stadium legacy effects primarily at the facility level, focusing on operational performance and adaptive reuse rather than broader spatial influence. Systematic assessments of how stadium construction shapes the development trajectories of surrounding areas remain limited. More specifically, as capital-intensive, project-based interventions, do stadiums generate observable and sustained changes in nearby areas, or are their impacts limited to short-term construction activity and event-driven fluctuations? To address this gap, this study examines dynamic changes in surrounding areas before and after stadium completion.

3. Study Area and Data

This study collected data on 153 large-scale sports stadiums completed between 2004 and 2019 in China (details in Appendix A). The analysis spans from 2000 to 2020, which provides a sufficiently long pre-construction baseline to capture underlying trends before stadium completion. The stadium sample is restricted to projects completed by 2019, so that each stadium has at least one post-completion year observed within the study window while avoiding the post-2020 period when Covid-19 introduced broad disruptions to population activity and urban consumption that would confound the evaluation of post-completion development dynamics. This temporal span also aligns with China's accelerated sports infrastructure development following the successful bid for the 2008 Beijing Olympics.

To enhance comparability across samples, stadiums were selected based on explicit size threshold: seating capacity ≥ 15,000 or a footprint ≥ 15 hectares. The 15,000-seat cutoff follows "Design Code for Sports Buildings" (JGJ 31-2003), which classifies stadiums by seating capacity as Class A (≥ 25,000), Class B (15,000 - 25,000), Class C (5,000 -15,000), and Class D (< 5,000). By focusing on Class B and above, we reduce heterogeneity from smaller, single-purpose facilities and ensure the sample consists of venues with comparable scale and urban influence.

The sample spans diverse geographic and administrative contexts, from municipalities to county-level cities, which enables assessment of stadium impacts under varying levels of urbanization and economic development.

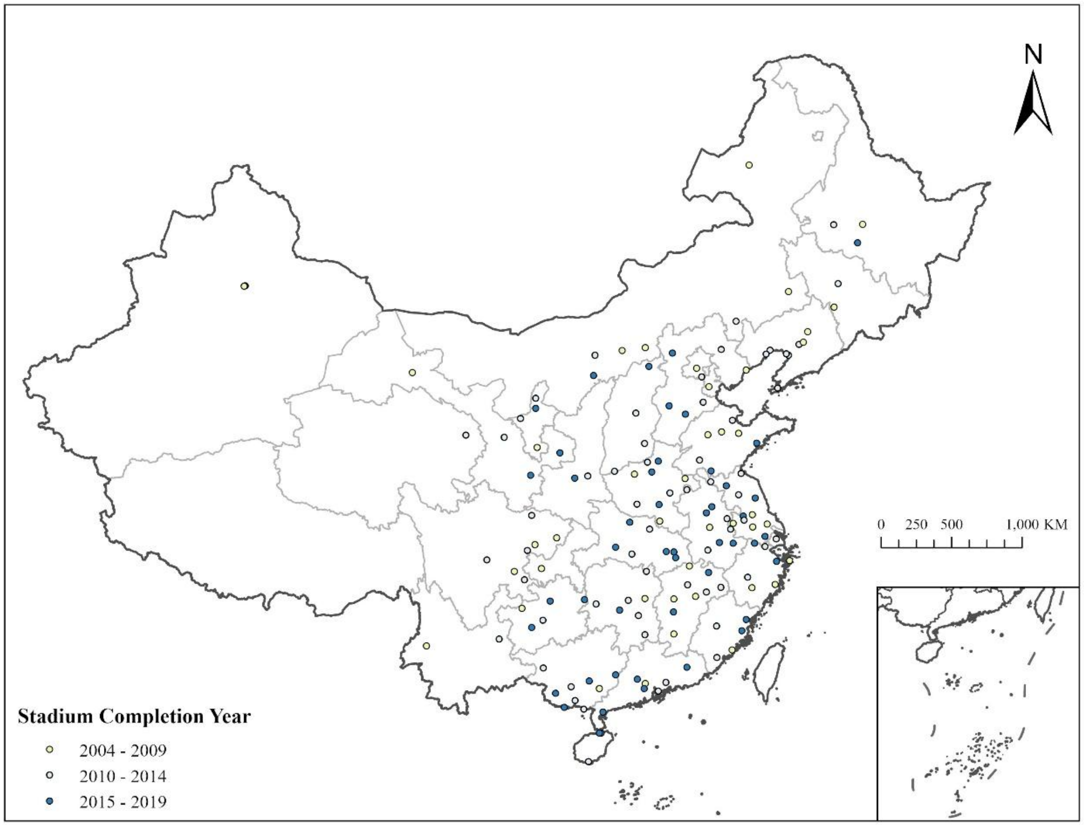

Fig. 1. Spatial distribution of samples.

Annual land cover data were obtained from the China Land Cover Dataset (CLCD), which provides 30-meter resolution land cover information from 2000 to 2020. Gridded population data (2000–2020) from WorldPop, with 100-meter spatial resolution, allow us to assess annual population distribution around stadium neighborhood. Road network data from 2014–2020 were retrieved from OpenStreetMap and simplified using ArcGIS Pro 3.4.0 to avoid redundancy caused by multi-line representations of major roads. Additionally, Points-of-Interest (POI) data, including detailed coordinates, names, and addresses, were collected from Baidu Maps. To ensure temporal consistency with the OSM road data, POIs from 2014 to 2020 were used, covering 13 categories grouped into five core dimensions: commercial activity, recreational facilities, infrastructure, public services, and financial institutions (see Appendix B for full category list). These data provide a fine-grained representation of urban development and vitality.

4. Methods

4.1 Indicator construction

The core dependent variable in this study is urban development intensity, constructed as a composite of land-use intensity and population density. This measure reflects both the physical expansion of built-up areas and the demographic concentration of residents, providing a proxy for local development dynamics. Formally, urban development intensity was calculated as the average of min–max normalized land-use intensity and population density:

$$Y_{it} = \frac{S_{it}^{land} + S_{it}^{pop}}{2}, \qquad where\ S_{it}^{x} = \frac{x_{it} - \min(x)}{\max(x) - \min(x)} \tag{1}$$

Here, Y_{it} denotes the composite index for stadium i in year *t*; S_{it}^{land} and S_{it}^{pop} are the min-max normalized values of land-use intensity and population density within 5 km buffer of stadium i in each year. x_{it} is the raw value of land use intensity or population density, $\min(x)$ and $\max(x)$ are the minimum and maximum of that indicator across all stadiums and all years in the sample. This normalization rescales each component to the [0,1] range, allowing us to track annual changes each stadium across the study period (2000-2020).

We also include two contextual moderators that are available for the full sample: stadium distance to the city center and administrative city level. Distance is measured as the straight-line (Euclidean) distance between each stadium and the location of the municipal government, which serves as a proxy for the city center. For cities with multiple government sites, we use the original government office location as the reference point to ensure comparability over time. City level is defined by administrative hierarchy (provincial-level, sub-provincial level, provincial capital city, and prefecture-level city). We adopt this classification instead of population-based city size to avoid potential mechanical correlation, because population density is a component of the urban development intensity index.

We further examine whether the post-completion shift varies with micro-scale built-environment conditions around the stadium. To do so, we construct a Built Environment Index (BEI) based on five indicators: land-use entropy, road density, road integration, POI density, and POI entropy (details see Table 1). Each indicator was standardized using z-scores across the mechanism sample to place them on a comparable scale. The BEI was then defined as the unweighted mean of the five standardized components and mean-centered for use in the regression models. Higher BEI values indicate locations with denser service provision, a more connected street network, and a more mixed land-use pattern around the stadium.

Given that the BEI inputs are only available for 2014-2020, the BEI-based moderation analysis is conducted as an additional exploratory analysis on stadiums completed between 2015 and 2019. This restriction ensures that both pre- and post-completion observations fall within a consistent data window.

All indicators were calculated within circular buffers centered on each stadium. A 5 km buffer was selected as the primary unit of analysis, consistent with prior studies on public infrastructure impacts (e.g., Zhan et al., 2021), while additional robustness tests were conducted using 3 km and 7 km buffers (see Section 5.2).

Table 1. Definitions and Measurement of Spatial Indicators.

Indicator	Illustration	Interpretation
Land Development Intensity (LDI)	Impervious surface area (built-up area) within the buffer/Buffer area	Represents intensity of urban construction activities
Land Entropy	$$Entropy = -\sum_{i=1}^{N} p_i log p_i$$ where N denotes the number of land cover types, p_i is the proportion of land cover type i within buffer	Indicates diversity of different land cover types
Road Density	Total road length within the buffer/Buffer area	Indicates road infrastructure accessibility and connectivity
Road Integration	$$I_i = \frac{N^2}{\sum(d, j)}$$ where N represents total nodes in the network, $d(i, j)$ denotes the shortest path distance (weighted by angular deviation) from node i to	Quantifies the potential accessibility of road network based on topological connectivity

	node j, and $\sum(d,j)$ is the total sum of these shortest path distances for all nodes.	
Population Density	Total population within the buffer/Buffer area	Captures intensity of population clustering
POI Density	Total POI count within the buffer/Buffer area	Proxy for functional density of urban amenities
POI Entropy	$Entropy = -\sum_{i=1}^{N} p_i log p_i$ where N denotes the number of different POI categories, p_i is the proportion of POI categories i.	Measures functional diversity and evenness of urban facilities
City Scale	City classification is defined by administrative hierarchy	
Distance	Euclidean distance between the stadium location and the municipal government office (administrative city center)	Reflects relative location within urban spatial structure

Note: The algorithm of road integration in this study adopts an improved segment-based model incorporating angular deviation weights to better simulate pedestrian preferences for straight-line paths and vehicular turning constraints. This refinement enhances the estimation of accessibility around sports stadiums (Tao et al., 2017).

4.2 Interrupted Time Series (ITS)

This study employs an Interrupted Time Series (ITS) to analyze the impact of sports stadium construction on local urban development intensity. The ITS model is particularly appropriate for evaluating interventions when a clear interruption point exists. Given that the completion year of stadiums differ across cities, this study allows the interruption point to vary across individuals rather than assuming a single fixed intervention time. The model is specified as follows:

$$Y_{it} = \alpha_i + \beta_1 Post_{it} + \beta_2 Time_{it} + \beta_3 Post \times Time_{it} + \beta_4 GDP_{ct} + \beta_5 Event_{it} + \varepsilon_{it} \quad (2)$$

where Y_{it} denotes local development intensity as defined in Section 3.1. $Post_{it}$ is a binary variable equals 1 if year t falls after the construction of the stadium in location i, and 0 otherwise. $Time_{it}$ measures the number of years since the beginning of the study period (2000). The interaction term $Post \times Time_{it}$ captures changes in the post-completion growth trend of development intensity. Additionally, we include city-level GDP (GDP_{ct}) as a control variable to isolate stadium effects from broader macroeconomic influences that may affect local development patterns. α_{it} represents stadium fixed effect that absorb time-invariant characteristics such as pre-existing infrastructure, geographic features, and socioeconomic conditions, and ε_{it} is the error term. To account for short-term pulses associated with high-profile sports events, we further add a dummy variable $Event_{it}$, which equals 1 in the year when stadium i first hosts a major sports event after completion (and 0 otherwise). Here, "major events" are restricted to comprehensive multi-sport events at the National Games level or above. Standard errors are clustered at the city level to account for shared conditions among stadiums within the same city.

In this study, the "short-term" effects refers to a one-time step increase in the year following construction, captured by the Post coefficient. The interaction term (Post × Time) captures whether stadium construction produces a sustained shift in the post-construction growth trajectory, that is, whether the growth slope of development intensity changes after completion. This distinction is defined not by a fixed number of years, but by whether stadium construction alters the rate of growth over the observation period.

4.3 Moderation Analysis

To further examine whether the relationship between sports stadium construction and urban development intensity varies under different conditions, we estimate a set of moderation models that build on the ITS model. We consider three moderators: (1) administrative city level; (2) proximity to the city center (intra-urban location); and (3) micro-scale built environment conditions, captured by the BEI introduced above. The moderated ITS model is specified as follows:

$$Y_{it} = \delta_t + \lambda_p + \beta_1 Post_{it} + \beta_2 M_{it} + \beta_3 (Post_{it} \times M_{it}) + \beta_4 GDP_{ct} + \beta_5 Event_{it} + \varepsilon_{it} \quad (3)$$

Where Y_{it} represents urban development intensity within a 5 km buffer of stadium i in year t. $Post_{it}$ is a post-construction indicator that equals 1 from the year after completion onward and 0 otherwise, which means the completion year itself is treated as part of pre-period. M_{it} denotes the moderators, and the interaction term ($Post \times M_{it}$) tests the significance of moderation effect. Time fixed effect (δ_t) and province fixed effect (λ_p) are included to capture common shocks in year *t* and time-invariant provincial characteristics.

5. Results

5.1 ITS (Interrupted Time Series)

All ITS analyses were conducted using urban development intensity measured within a 5 km buffer around each stadium. This buffer was selected because it provided the most stable and interpretable results across different buffer sizes (see Section 5.2 for buffer sensitivity analysis). Table 2 compares two ITS models of stadium completion effects on urban development intensity. Model (1) provides a baseline for comparison, while Model (2) adds controls for city-level GDP and an event indicator to absorb citywide growth and event-related influences on development intensity.

In Model (1), the Post coefficient is positive and statistically significant (0.0078, $p < 0.01$), indicating a one-time boost in urban development intensity after the stadium completion. The Time coefficient is also positive and highly significant (0.0062, $p < 0.001$), which points out a general increasing trend throughout the study period. In contrast, the interaction term (Post × Time) is not statistically significant. This provides limited evidence of a sustained change in vitality growth after the construction.

The same pattern is observed after introducing GDP and Event controls in Model (2). The Post coefficient stays positive and statistically significant (0.0068, $p < 0.01$), while Post × Time continues to be small and insignificant. This consistency reinforces that the baseline effect is not driven by differences in city size or event-related shocks. While GDP is statistically significant (5.37e–7, $p < 0.01$), the coefficient is close to zero, illustrating that overall economic conditions has limited influence on localized spatial development. The Event variable is also positive and significant (0.0095, $p < 0.05$), pointing to an additional short-term boost in the year when the stadium first hosts a major event.

Model fit improves slightly in Model (2), with within R^2 increasing from 0.776 to

0.799. The significance of the Event variable aligns with existing findings that large-scale sports events in China often acts as a deadline-driven implementation push, enabling governments to mobilize resources, accelerate construction, and facilitate bundled upgrades in infrastructure and land use (Duan et al., 2016; Ren, 2008). However, such event-led restructuring tends to be short-lived unless supported by sustained governance mechanisms and local demand (Shin, 2014), which may explain why the interaction term remains insignificant across both models.

Overall, the ITS results support a short-term intensification pattern: both stadium completion and the first event year are associated with significant discrete gains in urban development intensity, but these shocks do not appear to translate into sustained changes in development trajectories.

These patterns remain robust across a series of alternative specifications. Appendix Tables C1–C3 test the sensitivity of results to surrounding-area spillovers (donut-ring controls), alternative event-year definitions, and balanced event-time windows. Across all models, the main estimates remain consistent in sign and significance, reinforcing the credibility of the observed effects.

Table 2. Interrupted Time Series Estimates of Stadium Effects on Urban Development

Variable	**Baseline ITS (1)**	**ITS Adjusted for Concurrent Events (2)**
Post	0.0078**	0.0068**
	(0.0024)	(0.0024)
Time	0.0062***	0.0043***
	(0.0004)	(0.00049)
Post x Time	0.0010	0.0008
	(0.0007)	(0.0006)
GDP		5.37e-7**
		(1.43e-7)
Event		0.0095*
		(0.0044)

Observations	3,211	3,211
Within R^2	0.776	0.799

Note: Standard errors clustered at the city level are reported in parentheses. All models control for stadium-level fixed effects.
**p < .05, **p < .01, ***p < .001.*

5.2 Impacts of buffer sizes on ITS estimates

To test whether our results depend on the spatial definition of the outcome, we reconstruct urban development intensity using 3 km and 7 km buffers and re-estimate the same main ITS model used in Table 2.

The Post coefficient is positive across all three buffer sizes and decreases with distance. Post × Time remains insignificant in all specifications, indicating that the core finding of a one-time level shift without a lasting trajectory change holds regardless of buffer choice.

The scale dependence of the controls further clarifies the mechanisms captured at different spatial extents. The Event coefficient is positive but insignificant at 3 km, and becomes significant at 5 km and 7 km, consistent with event-related development extending beyond the immediate stadium surroundings. Similarly, the GDP effect strengthens as the buffer expands, suggesting that macroeconomic conditions are more visible when the outcome measure includes a broader portion of the urban fabric. Taken together, these patterns indicate that smaller buffers emphasize stadium-adjacent changes, whereas larger buffers increasingly reflect citywide dynamics that can dilute stadium-specific signals.

Overall, the sensitivity results support the robustness of our findings. Stadium completion is associated with a one-time increase in surrounding development intensity, with limited evidence of a sustained shift in the subsequent growth path. They also provide additional justification for using the 5 km buffer as the primary spatial unit, as it preserves a statistically meaningful Post effect while capturing broader event and economic influences and delivering the strongest model fit (within R^2 = 0.799).

Table 3. Comparison of ITS Results Based on Different Buffer Size

Variable	**3 KM**	**5 KM**	**7 KM**
Post	0.0131***	0.0068**	0.0036
	(0.0029)	(0.0024)	(0.0020)
Time	0.0061***	0.0043***	0.0033***
	(0.0006)	(0.00049)	(0.0005)
Post x Time	0.0005	0.0008	0.0009
	(0.0008)	(0.0006)	(0.0006)
GDP	3.82e-7*	5.37e-7***	6.25e-7***
	(1.67e-7)	(1.43e-7)	(1.43e-7)
Event	0.087	0.0095*	0.0099*
	(0.0059)	(0.0044)	(0.0039)
Observations	3,211	3,211	3,211
Within R^2	0.783	0.799	0.793

Note: Standard errors clustered at the city level are reported in parentheses. The dependent variable is constructed using 3 km, 5 km, and 7 km buffers, and the same model is estimated in each column with stadium fixed effects, city-level GDP, and an event dummy to account for event-related shocks.

*$p < .05$, **$p < .01$, ***$p < .001$.*

5.3 Moderation Analysis

Table 4 reports the moderation results using city level as a moderator. The post-completion effect is positive and statistically significant in the baseline group (prefecture-level cities), indicating an overall increase in the outcome following stadium completion. Notably, the interaction term suggest clear heterogeneity across city tiers. Compared with prefecture-level cities, the post effect is more significant in sub-provincial cities (Post × L2 = 0.0827, $p < 0.01$) and provincial capitals (Post × L3 = 0.0540, $p < 0.05$), whereas the change for provincial-level cities is not statistically significant (Post × L1 = 0.0130, $p = 0.537$). We return to potential explanations for this heterogeneity in Section 6.2.

Table 4. Results of Moderation Analysis (City Level as Moderator).

Variable	**Coefficient**	**Std. error**	***t*-value**	**95% Confidence Interval**
Post	0.0643***	0.012	5.245	[0.040, 0.088]
L2	0.0429	0.036	1.206	[-0.027, 0.113]
L3	0.0586	0.033	1.785	[-0.006, 0.123]
GDP	0.0000	0.000	0.957	[-0.000, 0.000]
Event	0.0453**	0.014	3.255	[0.018, 0.073]
Interaction (Post × L1)	0.0130	0.021	0.619	[-0.029, 0.055]
Interaction Post × L2	0.0827**	0.027	3.044	[0.029, 0.136]
Interaction Post × L3	0.0540*	0.026	2.046	[0.002, 0.106]
Model Summary				
Within R^2	0.149			
Adjusted R^2	0.648			
F-statistic	5.05			

Note: City level is coded as L1–L4, where L1 = provincial-level, L2 = sub-provincial, L3 = provincial capital, and L4 = prefecture-level. L4 (prefecture-level) serves as the baseline category. *$p < .05$, **$p < .01$, ***$p < .001$.*

The results in Table 5 show that the stadium's distance from the administrative city center does not significantly moderate its effect on urban development intensity, as indicated by the insignificant interaction term (Post × Distance = -0.0008, p = 0.647). In other words, the strength and direction of stadium effects appear unrelated to their proximity to the traditional city center.

Table 5. Results of Moderation Analysis (Distance as Moderator)

Variable	Coefficient	Std. error	*t*-value	95% Confidence Interval
Post	0.0591***	0.012	4.792	[0.035, 0.084]
Distance	-0.0043**	0.016	-2.748	[0.007, -0.001]
GDP	9.3441e-7*	3.755e-07	2.488	[0.000, 0.000]
Event	0.0539**	0.016	3.310	[0.022, 0.086]
Interaction (Post × Distance)	-0.0008	0.002	-0.458	[-0.004, 0.000]
Model Summary				
Within R^2	0.144			
Adjusted R^2	0.646			
F-statistic	5.28			

Note: **p < .05, **p < .01, ***p < .001.*

Estimates based on micro-scale built-environment conditions (BEI) also offer additional perspectives on heterogeneity in the post-completion pattern (Table 6). A positive and statistically significant Post estimate (0.0489, $p < 0.05$) remains evident in this subsample, consistent with a modest level increase in urban development intensity after completion. *BEI* is also positively associated with the overall level of development intensity (0.1236, $p < 0.01$), showing that stadium areas with higher built-environment quality tend to exhibit higher overall urban development intensity throughout the study period.

The interaction term (Post × BEI) is negative but not statistically significant ($p = 0.064$). This implies that, although BEI is related to the local development level, it provides limited evidence that BEI moderated the post-completion shift. One reason is that the observed change is driven more by infrastructure upgrading implemented along with the stadium project than by pre-existing built environments alone.

Table 6. Results of Moderation Analysis (BEI as Moderator)

Variable	**Coefficient**	**Std. error**	***t*-value**	**95% Confidence Interval**
Post	0.0489*	0.021	2.294	[0.006, 0.092]
BEI	0.1236**	0.036	3.400	[0.051, 0.197]
GDP	0.0000	0.000	1.132	[-0.000, 0.000]
Event	0.0779	0.070	1.113	[-0.063, 0.218]
Interaction (Post × BEI)	-0.0592	0.031	-1.896	[-0.122, 0.004]
Model Summary				
Within R^2	0.232			
Adjusted R^2	0.624			
F-statistic	3.38			

Note: $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

6. Discussion

This study examined the impact of large-scale stadium construction on surrounding urban development intensity across 153 stadiums in China (2004-2019). The core finding is a significant post-completion increase in development intensity (Post = 0.0068, $p < 0.01$) with no corresponding change in the post-completion growth trend (Post × Time, insignificant). Moderation analysis further shows that this effect varies by administrative level but not by distance to city center or built environment quality. These results point to a pattern of concentrated, one-time development that do not translate into sustained trajectory shifts.

We argue that this pattern reflects a structural feature of China's project-based governance rather than a simple lack of market demand or poor facility planning. Stadium projects in China function primarily as mechanisms of coordinated resource mobilization within the hierarchical planning system. This coordination produces measurable short-term development outcomes, but it is organized around project delivery and does not extend beyond the construction cycle.

6.1 Stadium Construction as Project-Based Resource Mobilization

The Post coefficient is significant while Post × Time is not, indicating that stadium construction is associated with a one-time increase in development intensity rather than a sustained shift in the subsequent growth trajectory. This pattern is difficult to explain through market-driven mechanisms such as amenity effects or agglomeration economies, which would imply continued growth after the initial investment. Instead, we interpret this result through the institutional logic of project-based coordination in China.

When a stadium project receives formal approval, it can open a policy window that enables multiple resource streams to be mobilized in parallel. Central funding flows through sports system channels, municipal governments allocate land and commit to supporting infrastructure, and provincial governments provide event-hosting support and policy endorsement. Taken together, these arrangements can produce synchronized mobilization across both vertical (sports bureaucracy) and horizontal (municipal development) institutional channels (Wu et al., 2016; Xue & Mason, 2019).

Critically, this mobilization is organized around project delivery rather than long-term operational outcomes. Roads are upgraded, land is rezoned, and commercial development is fast-tracked because the project provides institutional authorization for bundled investment. After major-event preparations and hosting end, the cross-sector coordination mechanism typically winds down. Venue management shifts back to the routine administration of local sports authorities, with weaker linkage to urban development planning. Resources that were temporarily pooled around delivery are reallocated through regular departmental budgets.

This institutional logic helps explain the insignificant Post × Time interaction. The mechanisms producing the observed effects are designed for time-bound project completion, not for sustaining the cross-sectoral coordination or generating the market demand required to alter long-term trajectories. As Xue and Mason (2019) argue, stadium development in China is pursued less for long-run local demand and more for sustaining growth-oriented urban competition and symbolically positioning the city to secure higher-level recognition and support. Once these objectives are met within the project cycle, the coordination that enabled delivery is unlikely to persist. The significant Event coefficient (Table 2, Model 2) is consistent with this interpretation, as it represents an additional pulse of coordinated investment rather than a sustained governance arrangement.

6.2 Coordination Capacity and the Limits of Modular Replication

Administrative level in China is not merely a proxy for city size. It structures governance capacity, fiscal autonomy, and position within hierarchical resource allocation networks (Ma, 2005; Wang & Yeh, 2019). Higher-tier cities maintain direct institutional links with provincial and central authorities, enabling preferential access to funding and policy support (Gao et al., 2022). Their governments command greater administrative authority and institutional capacity to organize complex development projects (Kennedy, 2017; Zhao & Wang, 2022), while their larger and more diversified local economies provide a broader demand base that helps sustain post-construction activity beyond the initial state-led investment. These institutional advantages enable higher-tier cities to translate stadium approval into a more integrated development, where venue construction, surrounding spatial development, and supporting commercial projects proceed as a coordinated package.

The competitive dynamics of China's governance system reinforce this capacity. Performance assessment and promotion systems create strong incentives for officials in higher-tier cities to demonstrate visible achievements through large-scale coordinated action (Guo, 2020; Lei & Zhou, 2022). These cities possess both the institutional authority to execute coordination and the competitive motivation to do so effectively.

Although constrained in administrative authority and resource access, lower-tier cities participate in the same hierarchical system and face comparable pressure to demonstrate development achievements. They can build stadiums using replicable modular templates, but cannot replicate the coordination capacity required to generate spillover effects.

The case of Kangbashi in Ordos clearly illustrate this structural constraint. It was developed as a new district with large-scale public investment in infrastructure, cultural centers, and the Ordos Sports Center as part of a bundled development package (Yin et al., 2024). However, the area initially experienced low occupancy and limited economic activity, and became widely labeled as a "ghost city". Although conditions have improved in subsequent years, this transformation has depended on continuous government intervention over an extended period, including heavy fiscal commitment to education, administrative relocation of residents, and strict controls on new housing supply (Yin et al., 2024). The case demonstrates that while project-based investment can deliver immediate and visible outcomes, sustained urban development depends on continued institutional coordination that extends beyond project delivery. Although Kangbashi represents a broader new-area development strategy rather than a single stadium project, the same logic applies: stadium construction may generate a short-term increase in development intensity, but it does not produce sustained changes in surrounding growth trajectories without additional and sustained policy support.

The null results for distance and BEI further support the primacy of institutional over spatial factors. If market mechanisms drove stadium effects, spatial positioning and built environment quality should matter substantially. Well-located stadiums in areas with established infrastructure should outperform peripheral stadiums in underdeveloped areas. Our findings point in the opposite direction: the strength of stadium effects depends on institutional coordination capacity, not on physical context.

This finding is consistent with the polycentric restructuring of Chinese cities over the past two decades (Liu & Wang, 2016). As newly designated sub-centers become priorities for state investment, distance from the historic urban core is no longer a reliable indicator of development potential. The Nanjing Olympic Sports Center offers a clear example: although located in the peripheral Jianye District, far from Xinjiekou (the traditional center), it emerged as a focal point of urban development (Chen et al., 2022).

Similarly, the non-significant BEI moderation shows that stadium-related development shaped more by state-led intervention and less by pre-existing urban conditions. As Shin (2014) observes, mega-event-led development in China follows an expansionary logic based on concentrated fixed asset investment, which is distinct from the market-driven processes that characterize stadium impacts in Western contexts.

6.3 Theoretical Implications

The findings provide new insights into three key debates.

First, they reframe the question of stadium impact in the context of China. The dominant approach in Western literature evaluates stadium value based on market-driven outcomes such as local spending, employment growth, and amenity value (Bradbury et al., 2023; Sepulveda, 2023). Our results indicate that in China, stadium-led development is driven less by market demand and more by state-led planning. What generates visible impact is not the stadium itself, but the government's ability to mobilize supporting investments. Therefore, evaluating Chinese stadiums against Western market-driven criteria will overlook their institutional function.

Second, the temporal pattern (one-time boost without sustained trajectory change) offers large-sample quantitative evidence for a limitation of project-based governance that has been extensively discussed but rarely tested empirically. This short-lived effect mirrors the challenges observed in new-area and project-based development across China, where the physical expansion of projects often exceeds the institutional capacity required to maintain long-term vitality (Wei, 2015; Woodworth & Chien, 2022).

Third, the heterogeneity results highlight a fundamental asymmetry in China's project-based development model. Although the physical templates of stadium construction are standardized and replicable, the institutional capacity required to translate them into sustained outcomes remains uneven across administrative tiers. This limits the effectiveness of replication strategies and highlights the structural barriers to policy transfer across different urban contexts. Policy mobilities research emphasizes that development models circulate through global knowledge circuits and are reassembled locally rather than simply copied (McCann, 2011; Ward, 2024); our findings highlight that in China's case, what travels is the physical template, not the coordination capacity behind it.

6.4 Limitations and Future Research

Several limitations should be noted. First, the dependent variable captures urban development intensity through a composite of land-use change and population density. While this provides a consistent measure across all sample sites, it does not capture economic output, employment, or other dimensions of urban vitality that may respond differently to stadium construction. Future research could incorporate night-time light (NTL), firm-level registration data, or household survey data to provide a more comprehensive assessment of stadium impacts.

Second, the temporal scope of the study (2000-2020) constrains both pre-construction baselines and post-completion observation windows. For stadiums completed in the late 2010s, the short time frame after completion may reduce the ability to assess post-completion development trajectories. Extending the observation window in future research could improve the robustness of results.

Third, due to sample restrictions based on facility size, the distribution of stadiums across different administrative tiers is not fully balanced. The subsample used for BEI analysis is further constrained by data availability, since built environment indicators are only computed for stadiums completed between 2015 and 2019. As a result, the reduced sample size may reduce statistical power, which could lead to the non-significance BEI moderation effect.

Fourth, the ITS design captures pre-post changes around a clearly defined intervention point but cannot fully eliminate confounding from concurrent development initiatives that coincide with stadium construction. Although we control for city-level GDP and event hosting, and robustness tests using donut-ring specifications help address spatial spillover concerns, unobserved policy shocks or concurrent investment programs remain potential confounders. Quasi-experimental approaches such as difference-in-differences with matched control areas could provide stronger causal identification in future work.

Finally, potential data biases may exist: for example, Baidu POI records and OpenStreetMap road data tend to be more complete and up-to-date in large cities than in smaller or less-developed areas, which could affect the comparability of results across contexts. We also acknowledge that WorldPop data may involve smoothing effects at sub-city scales, which could attenuate localized variation in population estimates.

7. Conclusion

This study assessed the impact of 153 large-scale sports stadiums constructed in Chinese cities over the past two decades, using multi-source time-series spatial data to capture changes in urban development. The results show a statistically significant immediate boost in development intensity following stadium completion, but no evidence of a sustained change in growth trajectory. The observed significance of the event variable should not be interpreted as direct outcomes of the events themselves. Instead, this result is driven more by deadline-oriented administrative mobilization.

Additional analyses reveal notable variation across cities. Greater effects observed in sub-provincial and provincial capitals can be attributed to privileged access to resources and greater capacity of policy coordination. In contrast, the lack of significance for distance to the city center implies that stadium-led development in China is shaped more by institutional context than by spatial proximity.

Overall, these findings contribute to ongoing debates on the limits of project-based governance. They provide empirical support for the idea that visible infrastructure projects often deliver short-term outputs without sustained structural impact. These findings call for more careful evaluation of stadium-led development initiatives. Planners and policymakers should be cautious in expecting replicable success from such interventions across diverse urban settings.

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Appendix A. Stadium information

Table A.1 Summary of large sports stadiums included in this study.

ID	Province	City	Stadium Name	Year Built	Land Area (hectares)	Seating Capacity (people)
1	Beijing	Beijing	National Stadium (Bird's Nest)	2008	20.4	80000
2	Shanghai	Shanghai	Oriental Sports Center	2010	34.75	18000
3	Tianjin	Tianjin	Tianjin Olympic Center	2007	96.6	80000
4	Chongqing	Chongqing	Chongqing Olympic Sports Center	2004	90	60000
5	Hebei	Shijiazhuang	Hebei Olympic Sports Center	2017	74.53	60000
6	Hebei	Qinhuangdao	Qinhuangdao Olympic Sports Center	2004	36.67	33000
7	Hebei	Zhangjiakou	Zhangjiakou Olympic Sports Center	2019	50	50000
8	Hebei	Chengde	Chengde Olympic Sports Center	2010	15.33	20000
9	Hebei	Cangzhou	Cangzhou Stadium	2013	19.88	31800
10	Hebei	Langfang	Langfang Stadium	2010	11.33	30000
11	Hebei	Hengshui	Hengshui Olympic Sports Center	2018	22.67	30000
12	Shanxi	Taiyuan	Shanxi Sports Center	2012	82.53	60000
13	Shanxi	Datong	Datong Sports Center	2019	43.07	30000
14	Shanxi	Changzhi	Changzhi Sports Center	2010	38.67	30000
15	Inner Mongolia	Hohhot	Hohhot Stadium	2007	12.2	51600
16	Inner Mongolia	Baotou	Baotou Olympic Sports Center	2010	40	40000
17	Inner Mongolia	Chifeng	Chifeng Sports Center	2013	22.31	32000
18	Inner Mongolia	Tongliao	Tongliao Olympic Sports Center	2005	40	18000
19	Inner Mongolia	Ordos	Ordos Sports Center	2015	70.88	60000
20	Inner Mongolia	Hulunbuir	Hulunbuir Gymnasium	2008	10.99	29000
21	Inner Mongolia	Ulanqab	Ulanqab Stadium	2009	12.7	30000
22	Liaoning	Shenyang	Shenyang Olympic Sports Center	2007	54.59	60000
23	Liaoning	Dalian	Dalian Sports Center	2013	82	61000

24	Liaoning	Anshan	Anshan Olympic Sports Center	2013	44	40000
25	Liaoning	Jinzhou	Jinzhou Coastal Sports Center	2014	33.4	43000
26	Liaoning	Yingkou	Yingkou Olympic Sports Center	2011	14	35000
27	Liaoning	Liaoyang	Liaoyang Stadium	2008	34	26400
28	Liaoning	Panjin	Panjin Red Beach Sports Center	2013	48.3	46000
29	Liaoning	Huludao	Huludao Sports Center	2013	10	30000
30	Jilin	Changchun	Changchun Olympic Park	2012	52.76	30000
31	Jilin	Liaoyuan	Liaoyuan Stadium	2007	10	20000
32	Heilongjiang	Harbin	Harbin Olympic Sports Center	2018	98	15000
33	Heilongjiang	Daqing	Daqing Olympic Park	2013	42.73	30000
34	Heilongjiang	Suihua	Suihua Sports Park	2004	6.8	22000
35	Jiangsu	Nanjing	Nanjing Olympic Sports Center	2005	89.7	62000
36	Jiangsu	Xuzhou	Xuzhou Olympic Sports Center	2013	47.2	35000
37	Jiangsu	Changzhou	Changzhou Olympic Sports Center	2008	28.5	41000
38	Jiangsu	Suzhou	Suzhou Olympic Sports Center	2018	60	45000
39	Jiangsu	Nantong	Nantong Sports Convention Center	2006	40	30000
40	Jiangsu	Lianyungang	Lianyungang Sports Center	2010	48	30000
41	Jiangsu	Huaian	Huaian Sports Center	2014	43.3	33000
42	Jiangsu	Yancheng	Yancheng Sports Center	2015	40	37000
43	Jiangsu	Yangzhou	Yangzhou Sports Park Stadium	2015	11.866	30000
44	Jiangsu	Zhenjiang	Zhenjiang Sports Convention Center	2013	46	31500
45	Jiangsu	Taizhou	Taizhou Sports Center	2005	8.67	30000
46	Jiangsu	Suqian	Suqian Olympic Sports Center	2019	32.25	30000
47	Zhejiang	Ningbo	Ningbo Olympic Sports Center	2019	54	60000
48	Zhejiang	Jiaxing	Jiaxing Sports Center	2010	18.4	33000
49	Zhejiang	Huzhou	Huzhou Olympic Sports Center Stadium	2017	31.3	40000
50	Zhejiang	Jinhua	Jinhua Sports Center	2012	26.67	30000
51	Zhejiang	Zhoushan	Zhoushan Sports Center	2009	23.73	12000
52	Zhejiang	Taizhou	Taizhou Sports Center	2004	34.87	40000

53	Zhejiang	Lishui	Lishui Sports Center	2009	56.22	19000
54	Anhui	Hefei	Hefei Sports Center Gymnasium	2006	53	60000
55	Anhui	Bengbu	Bengbu Olympic Sports Center	2018	34.27	42000
56	Anhui	Huainan	Huainan Olympic Park	2016	56	40000
57	Anhui	Maanshan	Maanshan Sports Convention Center	2013	50	36000
58	Anhui	Tongling	Tongling Sports Center	2015	23.3	30000
59	Anhui	Anqing	Anqing Sports Center	2014	56.62	40000
60	Anhui	Chuzhou	Chuzhou Sports Center	2012	21.27	35000
61	Anhui	Xuancheng	Xuancheng Sports Center	2019	15.7	25000
62	Anhui	Bozhou	Bozhou Stadium	2010	21	17000
63	Fujian	Fuzhou	Fuzhou Straits Olympic Sports Center	2015	73.3	60000
64	Fujian	Sanming	Sanming Sports Center	2011	20	20000
65	Fujian	Quanzhou	Quanzhou Straits Sports Center	2008	49	34000
66	Fujian	Zhangzhou	Zhangzhou Olympic Sports Center	2014	23.33	18000
67	Fujian	Ningde	Ningde Sports Center	2017	20	20000
68	Jiangxi	Nanchang	Nanchang International Sports Center	2011	21	60000
69	Jiangxi	Jingdezhen	Jingdezhen Sports Center	2015	66.67	19000
70	Jiangxi	Jiujiang	Jiujiang Sports Center	2008	46.67	31700
71	Jiangxi	Fuzhou	Fuzhou Gymnasium	2008	25.33	20000
72	Jiangxi	Yingtan	Yingtan Sports Center	2010	27.54	21300
73	Jiangxi	Ganzhou	Ganzhou Sports Center	2008	14.67	22000
74	Jiangxi	Jian	Jian National Fitness Center	2016	71.47	20000
75	Jiangxi	Xinyu	Xinyu Sports Center	2006	32.93	18800
76	Jiangxi	Shangrao	Shangrao Olympic Center	2011	37.27	21000
77	Shandong	Jinan	Jinan Olympic Sports Center	2009	81	56800
78	Shandong	Qingdao	Qingdao Public Fitness Center	2018	36	60000
79	Shandong	Zibo	Zibo Sports Center	2009	46.67	45000
80	Shandong	Zaozhuang	Zaozhuang Sports Center	2017	52.3	31300
81	Shandong	Dongying	Dongying Olympic Sports Center	2014	43.93	45000

82	Shandong	Weifang	Weifang Olympic Sports Center	2009	28.7	50000
83	Shandong	Jining	Jining Olympic Sports Center	2012	56	30000
84	Henan	Zhengzhou	Zhengzhou Olympic Sports Center	2019	32.2	58800
85	Henan	Luoyang	Luoyang Sports Center	2005	86.67	45000
86	Henan	Xinxiang	Xinxiang Pingyuan Sports Center	2019	25.1	6700
87	Henan	Jiaozuo	Jiaozuo Sports Center	2014	11.73	20000
88	Henan	Sanmenxia	Sanmenxia Culture and Sports Center	2011	33.33	30000
89	Henan	Nanyang	Nanyang Stadium	2011	27.07	35000
90	Henan	Shangqiu	Shangqiu Olympic Sports Center	2005	25.33	30000
91	Henan	Xinyang	Xinyang Sports Center	2004	22.28	23000
92	Henan	Zhoukou	Zhoukou Sports Center	2010	53.73	35000
93	Henan	Zhumadian	Zhumadian Sports Center	2015	24	35000
94	Hubei	Wuhan	Hubei Olympic Sports Center	2019	66.67	35000
95	Hubei	Huangshi	Huangshi Olympic Sports Center	2018	58	32000
96	Hubei	Yichang	Yichang Olympic Sports Center	2019	95	40000
97	Hubei	Xiangyang	Xiangyang Public Fitness Center	2018	13.33	30000
98	Hubei	Jingzhou	Jingzhou Sports Center	2014	30	6100
99	Hubei	Huanggang	Huanggang Sports Center	2015	66.67	20000
100	Hubei	Suizhou	Suizhou Binhu Stadium	2014	7.05	19700
101	Hunan	Zhuzhou	Zhuzhou Sports Center	2006	56	42700
102	Hunan	Hengyang	Hengyang Sports Center	2010	45.93	35800
103	Hunan	Shaoyang	Shaoyang Sports Center	2018	117	30000
104	Hunan	Yueyang	Yueyang Sports Center	2012	40.4	40000
105	Hunan	Chenzhou	Chenzhou Sports Center	2010	20.33	28000
106	Hunan	Huaihua	Huaihua Sports Center	2010	15.33	20000
107	Hunan	Loudi	Loudi Sports Center	2011	33.33	42800
108	Guangdong	Shenzhen	Shenzhen Bay Sports Center	2011	33.6	33000
109	Guangdong	Foshan	Foshan Century Lotus Sports Center	2006	42	36700
110	Guangdong	Jiangmen	Jiangmen Sports Center	2017	40	25000

111	Guangdong	Zhanjiang	Zhanjiang Olympic Sports Center	2015	44.3	40000
112	Guangdong	Zhaoqing	Zhaoqing New District Sports Center	2018	33	20000
113	Guangdong	Huizhou	Huizhou Olympic Stadium	2010	42	40000
114	Guangdong	Meizhou	Wuhua Olympic Sports Center	2019	17.54	30000
115	Guangxi	Nanning	Guangxi Sports Center	2010	133.33	60000
116	Guangxi	Wuzhou	Wuzhou Sports Center	2015	40	30000
117	Guangxi	Beihai	Beibu Gulf Sports Center	2011	33.33	25000
118	Guangxi	Qinzhou	Qinzhou Sports Center	2011	26	22000
119	Guangxi	Guigang	Guigang Sports Center	2016	31.34	30000
120	Guangxi	Yulin	Yulin Sports Center	2007	20	20000
121	Guangxi	Baise	Baise Sports Center	2013	23.6	5000
122	Guangxi	Chongzuo	Chongzuo Sports Center	2018	52.2	28000
123	Hainan	Haikou	Hainan Sports Center	2015	11	60000
124	Hainan	Haikou	Wuyuan River Culture and Sports Center	2018	19.18	40000
125	Hainan	Sanya	Sanya Sports Center	2011	12.2	16000
126	Sichuan	Zigong	Zigong Sports Center	2008	21.17	20000
127	Sichuan	Luzhou	Luzhou Olympic Sports Park	2013	21.33	21000
128	Sichuan	Guangyuan	Guangyuan Aoyuan Sports Center	2011	25.11	20000
129	Sichuan	Suining	Suining Sports Center	2014	26	30000
130	Sichuan	Nanchong	Nanchong Sports Center	2004	14.67	32000
131	Sichuan	Dazhou	Dazhou Sports Center	2006	14.69	30000
132	Sichuan	Yaan	Yaan Sports Center	2010	9.67	20000
133	Guizhou	Guiyang	Guiyang Olympic Sports Center	2011	114.33	51600
134	Guizhou	Zunyi	Zunyi Olympic Sports Center	2018	41	35600
135	Guizhou	Anshun	Anshun Olympic Sports Center	2016	31.87	25000
136	Guizhou	Bijie	Bijie Olympic Stadium	2008	11.74	23000
137	Guizhou	Tongren	Tongren Olympic Sports Center	2018	33.87	45000
138	Yunnan	Qujing	Qujing Culture and Sports Park	2014	39.93	34000
139	Yunnan	Baoshan	Baoshan Olympic Sports Center	2008	12.15	20000

140	Shaanxi	Xianyang	Xianyang Olympic Sports Center	2018	21.2	38000
141	Shaanxi	Weinan	Weinan Sports Center	2014	30.87	32000
142	Gansu	Jiayuguan	Jiayuguan Sports Center	2006	11.47	20000
143	Gansu	Baiyin	Baiyin Sports Center	2011	13.33	20000
144	Gansu	Tianshui	Tianshui Sports Center	2019	29.07	20000
145	Gansu	Jiuquan	Jiuquan Gymnasium	2018	8.67	5630
146	Gansu	Qingyang	Qingyang Stadium	2016	8.4	20000
147	Qinghai	Xining	Xining Haihu Sports Center	2013	24.47	40000
148	Ningxia	Yinchuan	Helan Mountain Stadium	2012	29.54	40000
149	Ningxia	Wuzhong	Wuzhong Yellow River Olympic Sports Center	2018	43.93	30000
150	Ningxia	Guyuan	Guyuan Gymnasium	2006	15.33	6000
151	Ningxia	Zhongwei	Zhongwei Gymnasium	2011	15.47	4000
152	Xinjiang	Urumqi	Urumqi Olympic Sports Center	2019	32	30000
153	Xinjiang	Urumqi	Xinjiang Sports Center	2005	25.67	50000

Appendix B

Table B.1 Classification of POI categories and their descriptions.

Categories	Factor	Description
Commercial	Restaurants	Places offering food and beverage services, including restaurants and cafe.
	Life services	Facilities providing daily convenience services such as laundry, repair, or printing.
	Shopping	Locations for retail and consumer goods, including malls and stores.
	Business housing,	Mixed-use buildings combining commercial and residential functions.
	Accommodation services	Facilities offering lodging services such as hotels and inns.
Recreation	Sports and leisure services	Venues for fitness, sports, and recreational activities.
	Scenic spots	Tourist attractions and cultural or natural sites like parks and museums.
Infrastructure	Public facilities	Basic urban infrastructure such as utilities, toilets, and squares.
	Transportation facilities	Nodes of urban mobility, including stations, parking lots, and gas stations.
Public Services	Health care services	Institutions providing medical and health-related services.
	Scientific, educational and cultural services	Educational and cultural facilities including schools, libraries, and museums.
	Government agencies or social organizations	Locations of administrative bodies or nonprofit social organizations.
Finance & Business	Financial and insurance services	Institutions offering banking, insurance, and financial services.
	Business	Offices and buildings for private companies or corporate entities.

Note: The POI classification is based on the taxonomy provided by Baidu Map Open Platform (2024).
Source: https://lbsyun.baidu.com/index.php?title=open/poitags

Appendix C Robustness Test

Appendix Table C1. Robustness Test: Controlling for Donut-Ring Trends

Variable	**Main ITS (1)**	**ITS + Surrounding-Area Control (2)**
Post	0.0068***	0.0076***
	(0.0024)	(0.0017)
Time	0.0043***	0.0030***
	(0.0005)	(0.0003)
Post × Time	0.0008	-0.0003
	(0.0006)	(0.0005)
GDP	5.37e-7***	-6.84e-8
	(1.43e-7)	(6.33e-8)
Event	0.0095*	0.0026
	(0.0044)	(0.0040)
Donut_ring_control		0.8784***
		(0.0645)
Observations	3,211	3,211
Within R^2	0.799	0.899

Note: The additional control variable measures development intensity in the 5–10 km ring around each stadium (the donut ring) and is used to capture broader citywide growth and spatial spillovers outside the study area. Model (1) is the main ITS specification with GDP control and Event dummy. Model (2) adds the donut-ring control. Standard errors clustered at the city level are reported in parentheses. All models control for stadium-level fixed effects.
**p < .05, **p < .01, ***p < .001.*

Appendix Table C2. Robustness Test: Alternative Definitions of Event-Year Shocks

Variable	**Main ITS (Event-Year Pulse)** **(1)**	**Main ITS (Event-Year ±1 Window)** **(2)**
Post	0.0068***	0.0066***
	(0.0024)	(0.0024)
Time	0.0043***	0.0043***
	(0.0005)	(0.0005)
Post × Time	0.0008	0.0009
	(0.0006)	(0.0006)
GDP	5.37e-7***	5.3e-7**
	(1.43e-7)	(1.43e-7)
Event	0.0095*	
	(0.0044)	
Event (±1)		0.0012*
		(0.0047)
Observations	3,211	3,211
Within R^2	0.799	0.806

Note: *Event* is a one-time dummy that equals 1 in the year when a stadium first hosts a major event after its completion. Model (2) replaces the event-year pulse with a ±1-year window to allow for potential lead–lag effects of major events. Standard errors clustered at the city level are reported in parentheses. All models include stadium and year fixed effects.

**p < .05, **p < .01, ***p < .001.*

Appendix Table C3. Robustness Check: Balanced Event-Time Window (−4, +4)

Variable	Main ITS (Full Sample) (1)	Main ITS (Balanced Window −4,+4) (2)
Post	0.0068***	-0.0008
	(0.0024)	(0.0005)
Time	0.0043***	0.0066***
	(0.0005)	(0.0005)
Post × Time	0.0008	-0.00001
	(0.0006)	(0.0005)
GDP	5.37e-7***	3.41e-7**
	(1.43e-7)	(1.02e-7)
Event	0.0095*	0.0026
	(0.0044)	(0.0015)
Observations	3,211	1,302
Within R^2	0.799	0.753

Note: Model (1) reports the main ITS specification estimated on the full sample of stadium–year observations, allowing the length of pre- and post-completion periods to vary across stadiums. Model (2) restricts the estimation to a symmetric event-time window to ensure comparable pre- and post-construction observation periods. Standard errors clustered at the city level are reported in parentheses. All models include stadium and year fixed effects.

*$p < .05$, **$p < .01$, ***$p < .001$.*

CHAPTER 3 SUMMARY AND CONCLUSIONS

This study examined the impact of 153 large-scale sports stadiums constructed across Chinese cities between 2004 and 2019 on surrounding urban development intensity, using multi-source spatiotemporal data spanning 2000 to 2020. The analysis employed an interrupted time series (ITS) model to assess whether stadium completion produced measurable changes in development intensity within 5 km buffer zones, and further tested whether these effects were moderated by administrative city level, distance to city center, and micro-scale built environment conditions.

The key findings of this study can be summarized as follows. First, stadium completion is associated with a statistically significant one-time increase in urban development intensity, but this effect does not translate into a sustained shift in post-completion growth trajectories. The interaction of the post-completion indicator with time was not statistically significant across multiple model specifications, indicating that the initial boost does not accumulate over time. Second, the first hosting of a major sporting event generates an additional but similarly short-lived pulse in development intensity, consistent with deadline-driven administrative mobilization rather than market-generated demand. Third, the post-completion effect is significantly stronger in sub-provincial and provincial capital cities compared with prefecture-level cities, while provincial-level municipalities show no significant difference from the baseline. This pattern highlights the importance of administrative hierarchy and coordination capacity in shaping the translation of stadium investment into observable spatial outcomes. Fourth, neither distance to the city center nor micro-scale built environment quality significantly moderates the post-completion effect, suggesting that stadium-related development in China is shaped more by institutional coordination than by localized market conditions or spatial positioning.

These findings carry several implications for urban geography and planning scholarship. They demonstrate that the developmental logic of stadium construction in China fundamentally differs from the market-driven model assumed in most Western evaluations, requiring analytical frameworks attuned to the institutional mechanisms of state-led, project-based governance. The temporal pattern of a discrete boost without sustained trajectory change provides large-sample quantitative evidence for a limitation of project-based governance that has been extensively theorized but rarely tested empirically. The heterogeneity across administrative tiers highlights a structural asymmetry in China's development model: while the physical templates of stadium projects are standardized and replicable, the institutional capacity required to convert them into sustained outcomes is unevenly distributed across the urban hierarchy.

Several limitations should be acknowledged. The dependent variable captures urban development intensity through a composite of land-use change and population density but does not capture economic output, employment, or other dimensions of urban vitality. The temporal scope constrains post-completion observation windows for recently built stadiums. The ITS design, while appropriate for identifying pre-post changes, cannot fully eliminate confounding from concurrent development initiatives. Future research could extend the observation window, incorporate additional outcome measures such as nighttime light data or firm-level registration records, and employ quasi-experimental designs with matched control areas for stronger causal identification.

Taken together, the evidence from 153 stadium projects suggests that stadium construction in China functions primarily as a mechanism for time-bound resource mobilization within project-based governance, rather than a reliable driver of long-run surrounding development. The developmental effects observed in surrounding areas appear to be contingent on institutional coordination capacity and administrative positioning, which condition the assembly of bundled investments and their continuity after completion. This finding highlights a key asymmetry in stadium-led development: physical templates may be standardized, but the capacity to translate them into sustained spatial outcomes remains uneven across the urban hierarchy.

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