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The Impact of Hosting Mega-Sporting Events on Urban Industrial Transformation: Evidence from a Staggered Multi-period Difference-in-Differences Design

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Abstract. Against the backdrop of mounting pressure on local public finances and continued efforts to stimulate domestic demand, rigorously assessing the economic consequences of mega-sporting events is essential for both event-bidding decisions and post-event urban development. Using panel data for 207 prefecture-level cities in China from 2000 to 2023, this study treats a city's first hosting of a national-level mega-sporting event—including the Olympic Games, Asian Games, and National Games—as a quasi-natural experiment with staggered treatment timing. A multi-period difference-in-differences (DID) framework with city and year fixed effects is employed to estimate the effect of hosting on two dimensions of industrial transformation: industrial structure upgrading, measured by the ratio of tertiary- to secondary-industry value added, and industrial structure rationalization, proxied by overall labor productivity. The regressions further control for key city-level economic and fiscal characteristics. The results show that hosting a mega-sporting event is associated with a statistically significant increase in the tertiary-to-secondary industry ratio, with the estimated upgrading effect becoming most pronounced two to four years after the event. Hosting is also associated with higher overall labor productivity, although this effect is comparatively modest. Event-study evidence supports the pre-treatment parallel-trends assumption, and placebo and alternative-specification tests indicate that the baseline results are robust to several sensitivity checks. By moving beyond single-city case studies and static before-and-after comparisons, this study provides multi-city evidence on the dynamic industrial consequences of mega-sporting events in China.

Keywords: Mega-Sporting Events, Industrial Transformation, Industrial Structure Upgrading, Multi-period Difference-in-Differences, Urban Economic Development

1. Introduction

Local governments have long regarded mega-sporting events as powerful tools to raise a city's profile, spur fixed-asset investment, and invigorate consumer markets. Since the 2008 Beijing Olympics, a number of Chinese cities—Guangzhou, Tianjin, Hangzhou, Jinan, and Xi'an, to name a few—have played host to either the Asian Games or the National Games. During the run-up to these events, host cities typically pour resources into transport networks, sports stadiums, convention

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centres, and cultural-tourism facilities. The expectation is twofold: a short-term boost to accommodation, catering, retail, and other services during the event itself, and a longer-term lift from improved infrastructure and heightened city brand recognition, which may continue to draw tourists and business travellers afterwards.

Yet the net economic payoff of such events is far from settled. Early feasibility studies, heavily reliant on input-output tables and multiplier models, often produced eye-catching estimates of economic stimulus. However, these approaches tend to count every dollar of event-related spending as new activity, while overlooking substitution effects—money that might have been spent elsewhere—and crowding-out of other public investments. On the fiscal side, massive outlays for stadiums and ancillary infrastructure can crowd out spending on education, health, or industrial subsidies. On the demand side, the surge in tourism and hospitality during the event may simply displace consumption from other periods or other destinations, rather than representing genuine new spending. Hence, gross expenditure figures alone cannot establish whether hosting actually adds net value.

A second, more stubborn problem is that host cities are not randomly selected. Those that win bids for the Olympics, Asian Games, or National Games tend to be larger, richer, better connected, and more politically favoured than the average prefecture-level city. A naive before-after comparison would therefore mix up the effect of the event with the city's own upward trajectory. A credible estimate therefore requires a plausible counterfactual—what would have happened to these cities had they not hosted—as well as explicit recognition that different cities staged their first events in different years.

This paper tackles these challenges with a staggered multi-period difference-in-differences design. Using a panel of 207 Chinese prefecture-level cities from 2000 to 2023, each city's first hosting of a qualifying mega-event is treated as an exogenous shock, with treatment timing allowed to vary across cities. The analysis focuses on two distinct dimensions of industrial transformation: structural upgrading (the shift from secondary to tertiary industry) and structural rationalisation (the efficiency with which factors are allocated, proxied by labour productivity). By tracking the dynamic evolution of treatment effects over several years before and after the event, the study provides a more nuanced and policy-relevant assessment than earlier single-city or static studies.

2. Literature review

Research on mega-events and urban economies falls into four broad camps, each with its own counterfactual logic, data coverage, and ability to pin down timing and persistence of impacts.

The first camp consists of ex-ante forecasting, widely used in the bidding phase. Mao, F. F., Zheng, F., & Zhu, S. Q. draw on 70 major Chinese cities and show that multiplier-based projections often imply large Gross Domestic Product (GDP) gains [1]. Yet these forecasts have two well-known weaknesses. First, they equate gross spending with net addition, ignoring fiscal displacement and consumption substitution. Second, they never construct a no-event baseline for the host city. Consequently, such forecasts reveal more about the scale of spending than about the causal effect. Boto-García, D., & Santana-Gallego, M. make a similar point in their recent review, calling for stronger identification in ex-post evaluations [2].

The second strand uses Synthetic Control Method (SCM) to build a data-driven comparator for a single host city. Liu, C. Q., & Yan, Y. R. for instance, study Guangzhou after the 2010 Asian Games and report a short-lived expansion in services and tourism [3]. SCM is powerful for deep case studies, but it becomes cumbersome when many cities are treated at different times. Wang, Y. H., Hu, Z., Wang, J. H., & Gao, W. Also, its success hinges on a good pre-treatment fit, which is not

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always achievable [4]. Li, J. L., Lu, J. M., & Xu, Y. X. survey these methodological nuances, while caution that single-city findings may not travel well across different urban contexts [5]. Thus, SCM offers rigour for individual cases but less traction for average effects across a national sample.

Mao, F. F., Zheng, F., & Zhu, S. Q. The third camp employs panel DID [1]. use a PSM-DID (Propensity Score Matching–Difference-in-Differences) model and find that major events raise the tertiary sector's share. However, many of these studies impose a common treatment year on cities that actually hosted in different years, thereby losing information on timing and heterogeneity. Zhan, X. Y., Cheng, X., & Zhang, R. F. adopt a staggered DID for mass-participation events like marathons, but their outcomes are GDP and firm revenue, not industrial composition [6]. Moreover, marathons differ enormously from the Olympics or National Games in scale, financing, and infrastructure needs. Consequently, existing domestic DID work leaves room for a broader study that accommodates staggered timing, multiple event types, and multiple transformation indicators.

A fourth and more recent line of work stresses the importance of dynamic treatment timing and better counterfactuals. Baade, R. A., & Matheson, V. A. emphasise the difficulty of disentangling event effects from underlying urban trends [7]. Kobieck, M. M., & Pierzgalski, M. show the value of quasi-experimental methods for mega-events [8]. Still, most international studies concentrate on GDP or tourist arrivals, rarely splitting composition from efficiency. Zhan, X. Y., Cheng, X., & Zhang, R. F. Huang, H. Y. Moreover, evidence from advanced economies may not carry over to Chinese prefecture-level cities, given their distinct fiscal systems, industrial bases, and development stages [6, 9]. Liu, S. W., Zhang, J. S., Che, J. L., & Li, S. X. Study on effectiveness of China's national sports industry base policy: An empirical analysis based on multi-period DID with data from sports listed companies. Journal of Wuhan Sports University [10].

To summarise, four gaps persist: (i) weak counterfactual identification in multiplier-based or simple pre-post studies; (ii) over-reliance on a single outcome, mixing composition with efficiency; (iii) insufficient characterisation of the post-event time path; and (iv) limited generalisability from single cities, single event types, or non-Chinese settings.

This study addresses these gaps in three ways. First, the actual first-hosting year for each treated city is used to preserve staggered timing. Second, upgrading (sectoral shares) and rationalisation (labour productivity) are examined separately. Third, a long panel (2000–2023) is used to trace dynamic effects and conduct multiple robustness tests—placebo, alternative outcome, and sample restriction.

3. Theoretical mechanisms and research hypotheses

How might hosting a mega-event reshape a city's industrial structure? The influence can unfold through preparation, the event itself, and the post-event period. Three interrelated channels are considered: investment, demand, and factor reallocation.

Investment channel. Preparing for a large event typically spans several years, channelling public and private funds into stadiums, transport links, public spaces, and tourist infrastructure. In the short term, this construction boom lifts building materials and related manufacturing. Over the longer haul, the new or upgraded assets—roads, convention centres, hotels—can reduce operating costs for service industries and provide a physical platform for tourism, conventions, entertainment, and business services. The Hangzhou Asian Games infrastructure programme is a recent case in point, illustrating how preparation can leave a lasting stock of productive assets.

Demand and population flows. During the event, the temporary influx of spectators, athletes, officials, and media drives up demand for accommodation, food, retail, transport, and entertainment. If the event also boosts the city's profile and improves its amenities, some of that demand may

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persist afterwards, attracting more tourists and business visitors. Sustained service demand, in turn, raises the relative weight of the tertiary sector in the local economy.

Structural adjustment and factor reallocation. Shifts in investment and demand can coax labour and capital away from manufacturing towards services, altering the sectoral composition. However, improvements in productive efficiency are not automatic. They require that venues be effectively reused after the event, that production factors integrate more deeply, and that service industries achieve greater specialisation. For these reasons, labour productivity is expected to respond more slowly and modestly than sectoral shares.

Based on these mechanisms, the following hypotheses are proposed:

H1: Hosting significantly promotes industrial structure upgrading, as measured by the tertiary-to-secondary output ratio.

H2: Hosting also exerts a positive but smaller effect on industrial structure rationalisation, captured by overall labour productivity.

H3: The effect is dynamic—it emerges around the event year, strengthens in the subsequent two to four years, and then gradually fades.

4. Findings and policy implications

4.1. Main findings

Drawing on a panel of 207 prefecture-level Chinese cities from 2000 to 2023, this study uses a staggered multi-period DID framework to estimate how first-time hosting of a national-level mega-sporting event relates to urban industrial transformation. The baseline estimates, event-study plots, and robustness checks yield three principal findings.

First, hosting is linked to a statistically significant rise in the tertiary-to-secondary output ratio—a clear sign of industrial upgrading. The effect peaks roughly two to four years after the event, implying that the economic repercussions extend well beyond the event week itself.

Second, hosting also correlates with higher labour productivity, suggesting some improvement in structural rationalisation. However, this productivity gain is relatively modest. This finding should not be interpreted as a fixed proportion of the upgrading effect, since the two indicators are measured on different scales. The lagged and gradual nature of the productivity response aligns with the view that post-event utilisation of venues, factor deepening, and service-sector specialisation take time to bear fruit.

Third, the results highlight the value of respecting actual treatment timing. A multi-period design that allows for staggered entry delivers a richer picture of the temporal trajectory than a simple pre-post comparison, and it provides a more credible counterfactual from non-host cities.

4.2. Policy implications

4.2.1. Tie bidding decisions to fiscal capacity and industrial base

Cities should not base their bids solely on rosy multiplier projections. Decision-makers need to weigh fiscal headroom, the existing service-sector footprint, likely post-event demand for facilities, and the opportunity cost of public funds. Financially weaker cities, or those with thin service sectors, might be better off pursuing smaller-scale events that require less investment and offer steadier post-event utilisation, thus lowering the risk of crowding out essential social spending.

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4.2.2. Push for active post-event venue management and sports-service chain integration

The moderate and gradual productivity response suggests that long-run value depends not just on building infrastructure but on using it well after the event. Local authorities should explore diverse operating models for venues—conventions, concerts, mass fitness, sports tourism, training camps, and event services. Tying these activities together can raise asset utilisation and deepen the allocation of labour and capital along the sports-service value chain.

4.2.3. Expand the performance-evaluation framework for urban event economies

Evaluation systems should move beyond short-term GDP or tourist spending. Industrial upgrading and labour productivity capture two complementary facets of longer-term transformation—compositional change versus efficiency gains. Including both can help shift policy focus from one-off event consumption to the sustained development of the sports-service economy.

4.3. Limitations and future research

This study has several limitations. First, the DID estimates rely on the parallel-trends assumption, which cannot be fully tested beyond the pre-event window. Second, all mega-events are treated as homogeneous; in reality, the Olympics, Asian Games, and National Games differ enormously in scale and legacy. Third, detailed data on venue utilisation and sector-specific employment are unavailable, limiting more direct investigation of the underlying mechanisms. Future work could use firm-level or micro-survey data to disentangle the investment, demand, and reallocation channels and explore spatial spillovers to neighbouring cities.

5. Empirical results

5.1. Descriptive statistics and parallel-trends test

Table 1 reports descriptive statistics for the main outcome variables and selected controls. The figures reveal substantial heterogeneity across cities in both industrial structure and underlying economic conditions.

Table 1. Descriptive statistics of main variables

Variable	Mean	Std. Dev.	Min	Max
Industrial structure upgrading (tertiary/secondary industry ratio)	1.152	0.487	0.312	4.826
Industrial structure rationalization (labor productivity, 10,000/person)	18.634	14.271	1.203	98.452
Log per capita GDP	10.284	0.682	8.115	12.736
Fiscal expenditure/GDP	0.156	0.058	0.041	0.421

Table 1 presents summary statistics for the key variables. The figures point to substantial cross-city variation. For the upgrading measure—the ratio of tertiary to secondary output—the minimum sits at 0.312 while the maximum reaches 4.826, a spread of more than fifteen-fold. Labour productivity is no less dispersed, ranging from 12,000 yuan per worker to nearly 1 million yuan per

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worker across the sample. Such wide dispersion underscores the importance of including both city fixed effects and year fixed effects, as unobserved city-specific traits and common macroeconomic shocks could easily confound a simpler comparison.

Next, the parallel-trends assumption is assessed using an event-study framework. The estimated coefficients for the three pre-event periods are all small in magnitude and statistically indistinguishable from zero. This provides evidence that, absent the event, host and non-host cities would have followed broadly similar trends in industrial upgrading. From the event year onwards, however, the coefficients turn positive and, in most post-event periods, statistically significant. Notably, the point estimates hover around 0.06 to 0.09 in the second through fourth years after the event, suggesting that the structural shift takes a couple of years to materialise and then peaks in that window. This timing pattern is consistent with H3 regarding the dynamic post-event trajectory.

Table 2 reports the main DID estimates. Column (1) provides a baseline that includes only the treatment interaction along with city and year fixed effects, yielding a coefficient of 0.094. Column (2) shows that after adding controls, the treatment coefficient is 0.071 and significant at 1%. In Model (3), the corresponding coefficient for labour productivity is 0.038 and significant at 5%. Given the different scales of the two outcomes, these magnitudes are not directly comparable. Among the controls, log per capita GDP enters positively and significantly in both specifications, while population size shows only a weak association with rationalisation and none with upgrading.

5.2. Benchmark regression results

Table 2 presents the benchmark multi-period DID estimates. Model (1) includes the event treatment interaction together with city and year fixed effects but excludes the full set of city-level controls. Models (2) and (3) add the complete control vector and use industrial structure upgrading and industrial structure rationalization, respectively, as dependent variables.0.071

Table 2. Benchmark multi-period DID regression results

Variable	(1) Upgrading No controls	(2) Upgrading Full controls	(3) Rationalization Full controls
Event treatment interaction	0.094***(0.021)	0.071***(0.018)	0.038**(0.015)
Log per capita GDP	—	0.112***(0.009)	0.206***(0.014)
Log population size	—	0.008(0.006)	0.011*(0.006)
City fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	4,968	4,968	4,912

Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors are reported in parentheses.

Column (2) shows that the treatment coefficient is 0.071, which is interpreted as an average increase of 0.071 in the ratio rather than a percentage change. The result supports H1 and indicates that hosting is associated with a measurable shift toward a more service-oriented industrial structure.

In Model (3), the coefficient on the event treatment interaction is 0.038 and is positive and statistically significant at the 5% level. This finding indicates that hosting is also associated with

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higher overall labor productivity, supporting the directional prediction in H2. Because the two dependent variables are measured on different scales, the numerical magnitudes of the two coefficients should not be interpreted as directly comparable treatment-effect sizes.

Among the control variables, the logarithm of per capita GDP is positive and statistically significant in both fully controlled specifications, suggesting that cities with higher levels of economic development tend to exhibit both greater service-sector orientation and higher labor productivity. Population size is weakly positively associated with industrial structure rationalization but shows no pronounced association with the upgrading indicator.

5.3. Robustness checks

Three additional tests are conducted to assess whether the baseline findings are sensitive to the treatment definition, the upgrading measure, or the sample window.

First, treatment status and event years are randomly reassigned across cities while keeping the number of treated cities and the distribution of treatment timing unchanged. This process is repeated 500 times to generate a distribution of placebo coefficients. The pseudo-estimates cluster around zero, while the actual coefficient sits far in the right tail of that distribution, with a p-value below 0.02. This pattern indicates that the result is unlikely to be a product of random chance.

Second, the upgrading measure is replaced with the share of tertiary-industry value added in city GDP. The coefficient remains positive and statistically significant, indicating that the main finding does not hinge on the specific ratio selected.

Third, the sample is restricted to 2004–2019 by dropping the early years and the post-2020 period. Re-estimation on this restricted window still yields a significant treatment effect, confirming that the result is not an artifact of the full 2000–2023 sample.

6. Conclusion

Using panel data from 207 prefecture-level cities between 2000 and 2023 and a staggered multi-period difference-in-differences framework, this study investigates the effects of hosting mega-sporting events on urban industrial development in China. The results show that holding such events greatly encourages upgrading of the industrial structure, as evidenced by a larger tertiary-to-secondary industry ratio, with the largest impacts appearing two to four years following the event. Increased work productivity is also linked to hosting, however this effect is more gradual and rather mild.Using panel data from 207 prefecture-level cities between 2000 and 2023 and a staggered multi-period difference-in-differences framework, this study investigates the effects of hosting mega-sporting events on urban industrial development in China. The results show that holding such events greatly encourages upgrading of the industrial structure, as evidenced by a larger tertiary-to-secondary industry ratio, with the largest impacts appearing two to four years following the event. Increased work productivity is also linked to hosting, however this effect is more gradual and rather mild.

These findings imply that by promoting the growth of the service sector, the use of infrastructure, and the reallocation of factors, mega-sporting events can have long-term economic consequences that go beyond immediate consumption. Further evidence that the primary conclusions are not influenced by random treatment assignment, sample periods, or alternative variable definitions comes from robustness testing. In order to improve post-event venue usage and service-sector integration, communities should assess event bids based on their financial capability and industrial

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underpinnings. Future studies should look more closely at underlying mechanisms, potential regional spillover effects, and variations among event types.

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