The Impact of China's "Stadium Diplomacy" on Local Economic Development in Sub-Saharan Africa*

Valentin Lindlacher† Gustav Pirich‡

January 10, 2024

Abstract

This study investigates the economic impact of China's "stadium diplomacy" in Sub-Saharan Africa. Exploiting the staggered timing of the construction in a difference-in-differences framework, we analyze the effect of Chinese-built and financed stadiums on local economic development. Employing nighttime light satellite data, we provide both an aggregate and spatially disaggregated assessment of these investments. We find that a stadium's city nighttime light intensity increases by 25 percent, on average, after stadium completion. The stadium's direct surrounding increases by 34 percent, on average, in its nighttime light activity. The effects can be attributed to the stadiums but are not only visible close to the stadium's location. The effect remains strong when controlling for other local Chinese investments. Thus, we find evidence for beneficial effects of Chinese-built and financed stadiums on local economic development in Sub-Saharan Africa, contrasting with the widely held notion that China's development finance projects constitute "white elephants".

Keywords: stadium diplomacy, regional development, nighttime light, local public infrastructure, Sub-Saharan Africa

JEL-Codes: O18, R11, O55, R53, Z20

---

*We thank participants of the ifo Dresden Workshop on Regional Economics, the Geoffrey J.D. Hewing Regional Economics Workshop at the Austrian Institute of Economic Research, the Development Economics Network of Berlin (DENeB) PhD Workshop, the Annual Meeting of the Royal Economic Society (RES), and the German Development Economics Conference (GDEC) for valuable comments. Declarations of interest: none.

†Corresponding author. Helmholtzstr. 10, 01069 Dresden (Germany). TUD Dresden University of Technology, ifo Institute for Economic Research, and CESifo, valentin.lindlacher@tu-dresden.de.

‡WU Wien, gustav.pirich@s.wu.ac.at

1 Introduction

China's growing presence in Sub-Sahara Africa is a highly debated issue among academics, policymakers, and the broader public. During the period of 2000 to 2019, China emerged as the largest bilateral financier to Africa, committing 153 billion US dollars (Acker and Brautigam, 2021). Since 2013, with the announcement of the Belt and Road initiative, China has invested globally in a portfolio of infrastructure projects such as roads, airports, and power plants. But Chinese overseas development finance funds a different set of projects than traditional Western countries and institutions. Stadiums, especially soccer venues, stand out as a unique type of investment project in international development finance. This form of cultural diplomacy has been termed "stadium diplomacy". China gains diplomatic leverage over African policymakers and valuable access to natural resources. Moreover, African countries take on substantial amounts of debt to finance these loans.

The opportunity costs of these investments in the form of health, education, or housing are high in light of widespread poverty. In addition, African countries give up their diplomatic sovereignty and rights to mining natural resources to obtain concessional terms on their loans. Both aspects highlight the importance of the question of whether this type of development policy is capable of lifting economic prospects. There is no literature that systematically investigates the legacy of stadiums built in developing countries. Although the literature on the effects of foreign aid is large (see, e.g., Burnside and Dollar, 2000; Rajan and Subramanian, 2008; Wright and Winters, 2010; Dreher et al., 2021b), and despite the large investments in stadiums, this particular type of development policy has received little academic interest.[1]

This paper estimates the causal effect of the Chinese "stadium diplomacy" on local economic development in Sub-Saharan Africa in a quasi-experimental framework. To this end, we exploit plausibly exogenous variation in the timing of stadiums' completion. We evaluate in total 56 stadiums built and financed by China in Sub-Saharan Africa since 1992. We investigate the local economic impact of stadiums in a difference-in-differences (DiD) framework with staggered treatment adoption. We estimate the effect both at the city level to estimate the aggregate effect, which might be more

[1] The case of Angola, which hosted the Africa Cup of Nations, the continent's most popular sports event, in 2010, demonstrates the enormous financial resources that are committed. The country invested an estimated 600 million US dollars for a total number of four stadiums, which were built and financed by China. 227 million US dollars have solely been dedicated to the main stadium, the "Estadio 11 Novembro" in Luanda.

economically relevant, and at the stadium level by drawing buffers around the stadiums with radii of 1, 5, and 10km to investigate the spatial extension of the treatment effect.

In high-income countries, sports venues seem to provide little economic benefit to host regions (Baade and Matheson, 2016). There is no evidence that stadiums increase local employment, especially when taking into account the high upfront cost of these investments. Our paper provides evidence that sports venue construction in developing countries can lead to a substantial increase in local economic development. Furthermore, this contrasts with the widely held notion that China's development finance projects constitute "white elephants" yielding no benefit to the local economy. Therefore, our results are in line with the literature finding positive effects on local economic development from Chinese development finance (Dreher et al., 2021b).

We tap two main data sources. As a proxy for GDP, we use nighttime light satellite data. Since Henderson et al. (2012) and Nordhaus and Chen (2015), a growing literature has established the validity of nighttime lights to proxy economic development (see e.g., Storeygard, 2016; Bruederle and Hodler, 2018). One of the main advantages of nighttime light satellite data is its spatial granularity, which allows to investigate the local and regional effects of specific policy interventions. Numerous studies explore the economic effects, not only of foreign aid (Dreher et al., 2021a) or infrastructure projects (Mitnik et al., 2018), or how aid affects inequality (Lessmann and Seidel, 2017), using this data. We use the top-coded adjusted version of this data from Bluhm and Krause (2022). Our second data source is derived from reports of Chinese-financed and constructed stadiums in Africa from 1958 onwards. We collect them from Vondracek (2021), Dreher et al. (2021b), and additional media reports, and restrict the sample to stadiums constructed after 1992 as this is the first year nighttime light satellite data is available.

The panel data allows us to control for time- and stadium-specific effects. We estimate a static two-way fixed effects (TWFE) model to obtain the average treatment effect on the treated (ATT). The treatment is defined as the year of completion of a stadium. Additionally, we estimate event study estimates to test the credibility of the parallel trends assumption and examine the dynamic effects of stadium construction on local economic development. As a robustness test, we uncover the extent of bias through the decomposition proposed by Goodman-Bacon (2021) and subsequently apply the newly proposed event study estimators by Callaway and Sant'Anna (2021) and Sun and Abraham (2021) to account for "forbidden comparison" between early and late treated units and heterogeneous treatment effects.

We find that stadiums have a large and persistent effect on the growth of nighttime light emissions. On average, a stadium increases local economic development proxied by nightlights by 25 percent over the whole post-treatment period at the city level. Our second set of results concerns the spatial extension of the effect. The effect is largest with 35 percent in the direct proximity of a stadium (1km buffer), and decreases to half this figure with a larger buffer size of 10km around the stadium location, as one would expect. Identification relies on exogenous variation in the timing of the stadium construction. A balancing exercise provides evidence that city characteristics are not correlated with the construction year. Event study estimates at the city level do not show statistically significant deviations from zero in the pre-treatment periods. Moreover, in the post-treatment periods, we can see a persistent and gradual increase in local economic development.

We can show that the effect remains when subtracting light emissions in the direct surroundings of the stadiums, indicating that the effect is not coming from the direct light emissions of the stadiums. Moreover, this indicates that what is measured at the city level comes from locations besides the direct stadium surroundings. We also test the effect against other Chinese aid coming from *AidData* (Dreher et al., 2022). We find that the main effect remains even when controlling for alternative treatments coming from different sectoral programs or for the amount spent on other sectors.

The remainder of this paper is structured as follows. Section 2 gives an overview of the related literature on Chinese overseas development finance and the effects of sports venues on regional development. Section 3 describes China's "stadium diplomacy". Section 4 describes the data sources and Section 5 lays out the empirical strategy. Section 6 presents our regression results, while Section 7 discusses potential mechanisms. Section 8 concludes.

2 Related Literature

This paper contributes to two strands of literature. Firstly, it extends the growing literature on the impact of China's overseas development finance. The field of research has gained traction in recent years due to the emergence of China as a global creditor with the announcement of high-profile projects of the "Belt and Road Initiative". Rising geopolitical tensions have contributed to increased interest in China's involvement in Africa. Data collection efforts by research initiatives like *AidData* and *Sais-Cari* contribute to growing academic interest in Chinese overseas development finance. Moreover, these new data sources, also including nighttime light satellite data, are opening up avenues to evaluate the spatial and economic impact of a wide array of projects.

A large body of literature examines the impact of Chinese overseas development finance and foreign aid on growth, employment, inequality, corruption, and education and health (see e.g., Mandon and Woldemichael, 2022; Dreher et al., 2018; Bluhm et al., 2020). Martorano et al. (2020) investigate the impact of Chinese aid on household welfare in Sub-Saharan Africa using DHS data. They find that Chinese aid projects improve education and health but do not improve nutrition.[2] Dreher et al. (2021b) evaluate Chinese development finance projects in 138 developing countries between 2000 and 2014 by using Chinese steel production interacted with a recipient-specific probability of receiving Chinese aid as an instrumental variable to estimate the causal effect of Chinese overseas development finance. They find an average increase in economic growth of 0.41 to 1.49 percent two years after commitment for an additional project.[3] Dreher et al. (2019) evaluate the correlation between the allocation of Chinese development aid and the birthplace of African leaders. Their findings suggest that Chinese aid does improve local development outcomes inside and outside of the birth regions of political leaders. Empirical research by Isaksson and Kotsadam (2018) indicates that Chinese aid projects fuel local corruption but have no observable impact on short-term local economic activity. Their work builds upon a geo-referenced data set on the sub-national allocation of finance projects to Africa over the 2000—2012 period, with 98,449 respondents from surveys across 29 African countries. Dreher et al. (2021a) who find that Chinese development finance improves public opinion of China in receiving countries, demonstrating gains in soft power.

A meta-regression analysis of 473 estimates taken from 15 studies evaluates the effectiveness of Chinese aid (Mandon and Woldemichael, 2022). After accounting for publication selection bias, the authors find a positive impact on social and economic outcomes, while governance is negatively impacted. The negative impact on governance capabilities is in line with Isaksson and Kotsadam (2020), who showed that Chinese aid projects fuel local corruption. Further negative externalities are associated

2 Cruzatti et al. (2023) evaluate the impact of Chinese development finance on infant mortality in 55,000 sub-national African locations. Their findings suggest that Chinese aid decreases infant mortality and the country level and increases it at sub-national scales relative to the country's average.

3 However, while research by Busse et al. (2016) using a Solow-type growth model indicates that African countries exporting resources have benefited from trade with China, they could not find any significant impact on African growth by Chinese foreign aid and investments between 1991 and 2010.

with Chinese development finance. It has been shown to degrade the environment and instigate ethnic tensions (Isaksson and Kotsadam, 2020). Additional negative effects include the discouragement of the bargaining power of trade unions and a higher acceptance of authoritarian thought. Furthermore, there is a growing concern over countries taking on substantial amounts of debt to finance infrastructure projects, which could lead to strategic dependence on China. China has been accused of deliberately pushing countries into unsustainable amounts of public debt in order to seize assets. Brautigam (2020) and Dreher and Fuchs (2015) have criticized the story of China as a rogue donor. Brautigam (2020) highlights that contracts do not contain mischief clauses, nor does seizing sovereign assets constitute a major objective of China's development finance.

Most closely related to our study are Dreher et al. (2021a) and Dreher et al. (2021b), investigating Chinese aid at the sub-national level, with nighttime light satellite data, and at the country level, respectively. We differ by investigating a specific infrastructure investment (stadiums) over a longer time span and on a more fine-grained spatial level. Later allows us to examine spillover effects from the stadium location to the whole city and detect specifically the spatial extension of the Chinese aid. We find larger effects as we only investigate a specific investment, which is also larger than the average of their projects. Bluhm et al. (2020) is similar to our work in the sense that a particular investment is investigated using nighttime light satellite data. They geo-locate and investigate Chinese transportation projects and find a reduction in inequality within and between sub-national localities. By analyzing Chinese government projects in 138 countries between 2000 and 2014, they observe a positive economic spillover effect of Chinese investments. While our study focuses on Sub-Saharan Africa and there are fewer Chinese stadium projects than infrastructure projects generally, we are able to investigate growth in cities and track Chinese investments over a longer period, starting in the early 1990s.

Second, this paper contributes to the literature examining the effects of sports venues on regional development. (Bartik and Zimbalist, 1998) give a generally skeptical view on the economic benefits of sports teams and stadiums and question the return on investment for the public. The largest strand within this literature investigates the impact of stadiums in the US or other developed countries, like the UK or Germany, or focuses on single large events like the Olympic Games or soccer tournaments, like the FIFA World Cup. Feddersen et al. (2008) conduct an evaluation of the preparation made for the World Cup in Germany in 2006 in a difference-in-differences framework. They fail to find evidence for positive effects of stadium infrastructure on income and employment. In the US, Coates and Humphreys (1999) find no significant effect of sports stadiums on local economic growth. Some metropolitan statistical areas even saw a reduction in per capita income due to the presence of professional sports franchises. According to Coates and Humphreys (2008), economists have reached a consensus that sports stadiums provide little to no economic benefit and thereby invalidate the case for sports subsidies. However, other studies find contradictory evidence: Santo (2005) estimates a positive effect of stadiums on economic development when taking into account local heterogeneities in the US.

For developing countries, this literature is rather scares. The only relevant study is Pfeifer et al. (2018), who analyze the effect of infrastructure investments made in preparation for the FIFA World Cup in 2010 in South Africa on nighttime light emission by leveraging a synthetic control design. A total of 14 billion US dollars were invested, of which 11.4 billion US dollars were dedicated to transportation infrastructure. For sports venues, an increase in nighttime lights was only observable in the short run, while transportation infrastructure increased local economic development over a long time period, especially in rural areas. These findings suggest that transportation infrastructure is the main mechanism through which sports investments stimulate economic development. We contribute by focusing on several developing countries and not focusing on a single tournament.

3 Background: China's "Stadium Diplomacy"

China's annual expenditure on overseas development finance averages 85 billion US dollars (twice the amount of the United States of America). Since 2013, foreign investment has been allocated under the guiding strategy of the Belt and Road initiative. An internationally unique type of projects that China embraces are sports venues, particularly soccer stadiums. In 1958, China built the first soccer stadium abroad as a diplomatic gift to Mongolia (Chang et al., 2019). Since then, China has constructed nearly 150 major sports venues in Asia, Latin America, and Africa. About 90 of these were built in Sub-Saharan Africa. The practice has been termed "stadium diplomacy", as the allocation of the stadiums follows strategic and diplomatic considerations. Key motives behind China's overseas development finance include securing access to natural resources and gaining diplomatic recognition in line with China's foreign policy objectives. China has gained political clout in the General

Assembly of the United Nations.[4] Another driving motive behind China's development finance seems to be the alleviation of internal structural economic problems, such as industrial overcapacity and unemployment. Overseas infrastructure investments are essentially always contracted to Chinese construction corporations, which opens new markets for these enterprises and generates workplaces for Chinese workers. Furthermore, the importance of this motive is highlighted by the fact that domestic steel production is a key determinant for the magnitude of Chinese development finance in a given year (Dreher et al., 2021b).

The design and construction are contracted to Chinese companies, such as the state-owned Shanghai Construction Group. The projects are mainly financed via concessionary loans, have no or only low interest rates, and have 10 to 20 years of maturity. The total construction cost of a stadium can reach hundreds of millions of US dollars. A typical project involves hundreds of Chinese workers who build the stadiums with the support of domestic workers. The construction itself usually lasts for two to five years. Stadiums have been built for a wide variety of purposes, from wrestling arenas in Dakar, Senegal, to hockey centers in Fiji. Nonetheless, an overwhelming majority are built for soccer.[5] Appendix Figure A.1 shows the cumulative number of stadiums in Sub-Saharan Africa and highlights the accelerating pace of "stadium diplomacy" in the last two decades.

Building stadiums in the poorest countries of the world raises incomprehension and confusion in Western policymaker circles as well as the broader Western public Brautigam (2020). In light of widespread poverty and misery, why are state leaders so keen on constructing sports venues? Cultural and political factors could account for the popularity among recipient countries. Soccer is the most popular sport in Africa, especially among young people, who constitute the largest demographic group in African societies. National soccer teams attract a sense of pride and unity. Therefore, state leaders could use stadiums as a political tool to gain popularity among the broader public. The political dimension of "stadium diplomacy" becomes evident, as the allocation of Chinese development finance projects seems to be highly prone to political capture. Dreher et al. (2021a) show that development finance is disproportionally allocated to birth regions of African leaders.

---

[4] No African country has voted against the condemnation of the treatment of the Uyghur minority in China in July 2021.

[5] The Africa Cup of Nations provides a recurring theme for Chinese "stadium diplomacy". The soccer championship is one of the most popular sports events in Africa. Hosting the tournament requires significant investments in sports infrastructure. Most African countries lack the financial resources and construction know-how. Since 1992, ten of the last fifteen cups have taken place in countries that were supported by China.

Chinese overseas development financing is allocated based on a set of principles, as outlined in a white paper by Chinese officials in 2014. First, the allocation of the projects is based on non-interference. Second, according to Chinese officials, the aid allocation respects the sovereignty of receiving countries. In contrast to Western development finance, Chinese authorities impose little to no restrictions concerning human rights or environmental standards. The discretion of African leaders over the concrete design and implementation of a project could also account for the observed patterns of political favoritism in development finance allocation (Dreher et al., 2021a).

4 Data

4.1 Chinese Stadiums in Africa

There is limited official data on China's overseas development finance activities. The transparency of the construction process, when and why a stadium was built, is low. The financial contracts are not disclosed. For that reason, the data has to be retrieved from alternative sources. The list of African stadiums built and financed by China is based on data from Vondracek (2021), *Wikipedia*, and *AidData*. Dreher et al. (2022) provides the most comprehensive and traceable data collection on Chinese overseas development finance with a dataset that includes a total of 13,427 projects. These were collected by first gathering official data on financial flows from Chinese governments and recipient country governments, which were then reconciled with information from media reports.

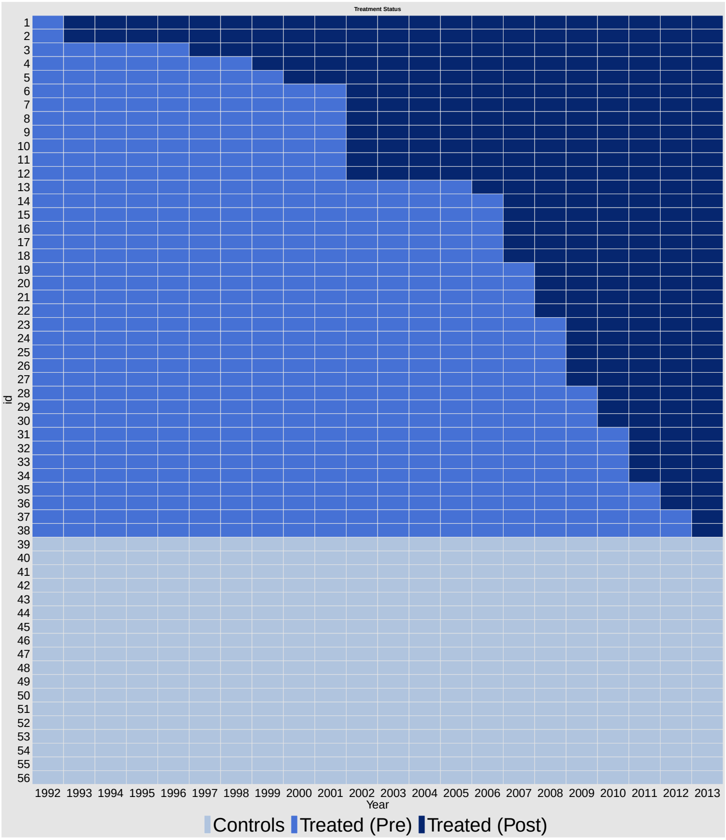
We take the stadium list from Vondracek (2021), which we later restrict to Africa. Afterwards, we add stadiums found on *Wikipedia* but which were not included on the list. In order to verify that the stadiums were actually built and financed with Chinese support, we reconcile the data with the Dreher et al. (2021b) overseas development finance database. The media accounts gathered by them matched the data collection efforts from Vondracek (2021) and *Wikipedia*. The geo-locations of the stadiums were obtained from *Google Earth*.

From 1958 onward, we identify 94 major sports venues that were built and financed by China in Africa.[6] As nighttime lights became available after 1992, we restrict the sample to stadiums constructed after 1992. The sample includes 69 stadiums built in 28 African countries, of which 56 have more than 10,000 seats and are therefore defined as actual stadiums and more than only sports grounds.[7] In our main

[6] Globally the data contains 143 stadiums, highlighting that a large majority was placed in Sub-Saharan Africa.
[7] A list of all stadiums is shown in Appendix Table B.1.

specifications, we consider only these larger stadiums to ensure that they have an economic impact. The treatment year is defined as the year the stadium was completed and inaugurated. Figure 1 visualizes the staggered treatment adoption. The geographical distribution is shown in Appendix Figure A.2.

Figure 1: Treatment Adoption



Notes: This figure shows the staggered treatment adoption. The ID stands for the corresponding stadiums. The stadiums are ordered according to their construction period. The dark blue represents the post-treatment period for stadiums built before 2013. Stadiums built after 2013 serve as control units and are depicted in light blue.

4.2 Nighttime Light Satellite Data

We deploy nighttime light satellite data as a proxy for local economic development. In the last decade, luminosity has become a well-established indicator of economic development at the country, regional, and local level in low-income countries with poor national statistics (see e.g., Henderson et al., 2012; Storeygard, 2016). A growing literature has investigated the economic and spatial impacts of shocks such as floods (Kocornik-Mina et al., 2020) or foreign aid (Dreher et al., 2021b) using nighttime brightness. One of the main advantages of nightlights is their spatial granularity. For the purpose of evaluating the economic impact of an infrastructure project, such as a stadium, nighttime lights are essentially the only practically implementable indicator of economic development. Additionally, nighttime lights are available on a yearly basis, allowing the construction of panel data. The seminal papers by Henderson et al. (2012) and Nordhaus and Chen (2015) highlight the broad-based applicability of these data to proxy GDP and the investigation of spatial patterns of development. While Henderson et al. (2012) demonstrate the ability to proxy for economic development, Bruederle and Hodler (2018) compare nighttime lights with other indicators from DHS. They show that nighttime lights can also proxy for other welfare indicators, such as mortality, life expectancy, and education at the local level. Therefore, luminosity is a powerful tool to capture welfare improvements in low-income countries at the local level.

The data comes from the Defense and Meteorological Satellite Programme (DMSP) by the National Oceanic and Atmospheric Association (NOAA) and provides global data from the period between 1992 and 2013. This time frame of the DMSP data set allows the inclusion of a large sample of stadiums to follow over a long period of time. The nighttime lights are captured on a 0 to 63 integer scale on a 30 arc-second pixel, which corresponds to approximately 0.84km^2 at the equator. The pixels are summarized at the cities' built-up area, where the stadium is located, and at buffers surrounding the stadiums' location. Three buffer sizes with a radius of 1, 5, and 10km surrounding a stadium are created.

Recent studies have improved our understanding of the circumstances in which nightlights have a high predictive power. Bluhm and Krause (2022) highlight non-linearities in the GDP-nighttime light relationship. Particularly, the authors show that the relationship yields lower elasticities in places with high GDP, high population density, and high relative importance of agriculture. Gibson et al. (2021) highlight the fact that the nighttime lights-GDP relationship is weak in rural areas with low population densities. The majority of the stadiums in our sample do not pertain to places with these characteristics. An exception constitutes places with high population densities, as some stadiums are located in major cities. This reduction in the nighttime light-GDP elasticity could induce a downward bias in the estimates. Thus, we estimate all specifications with the top-coded adjusted DSMP nighttime light satellite images provided by Bluhm and Krause (2022).

5 Empirical Strategy

5.1 Main Specification

This paper estimates the impact of stadiums, built and financed by China, on local economic development in Sub-Saharan Africa. Due to endogeneity concerns we cannot estimate the impact in a simple multiple regression framework. The relationship is affected by diplomatic, economic, and political considerations. The allocation of stadiums might be driven by the fact that richer and more prosperous areas demand more soccer stadiums. Even when including fixed effects, unobserved time-variant factors could bias the estimation. Therefore, we restrict the sample to cities that constructed a stadium financed by China. Thus, the identification relies on the timing of the stadium construction in comparison to the existence of a stadium.

We estimate the causal effect of stadiums built and financed by China on local economic growth in Sub-Saharan Africa in a difference-in-differences framework. The adoption of the treatment is staggered since stadiums are not constructed simultaneously. Figure 1 shows the rollout of the treatment over time. Due to the limited availability of nighttime lights, the regression will focus on stadiums built from 1992 onwards. Since DMSP nighttime lights are available until 2013 only, stadiums built after that year serve as never-treated control units. We estimate a two-way fixed effects model (TWFE) via OLS with year and stadium fixed effects. The main static specification is as follows:

$$Y_{it} = \beta D_{it} + a_i + a_t + \varepsilon_{it}. \tag{1}$$

Y_{it} is the outcome variable indicating the summed nighttime light intensity for stadium i in year t. We take the logarithm of nighttime lights to interpret the changes in growth rates. D_{ij} is a dummy variable turning and staying 1, if a stadium is completed. The parameter β is the parameter of interest and corresponds to a variance-weighted average of 2x2 difference-in-differences comparisons between early and late treated units, early and never treated, late and never treated and late and early treated units (Goodman-Bacon, 2021). The parameter corresponds to the average effect of the treatment on the treated (ATT) as long as the effects of the treatment are homogeneous. This assumption might not hold, as it seems plausible that some stadiums exhibit stronger effects on local economic development than others, especially when considering differences in seating capacity. The unit-specific fixed effects (a_i) eliminate time-constant stadium-specific differences. Time fixed effects (a_t) are included on an annual level and absorb unobserved heterogeneity across calendar years that is common to all stadiums. We employ clustered standard errors at the stadium level.

The parallel trends assumption that, in the absence of the treatment, the treatment and control group would have had the same nighttime light trajectories, is crucial for the validity of the identification strategy. This assumption cannot directly be tested, but event studies can present evidence of whether the treatment and control group developed similarly in the pre-treatment period. To investigate the dynamic effects of the treatment, we estimate event studies with the following specification:

$$Y_{it} = \sum_{j=\underline{T}}^{\overline{T}} \mu_j D_{ij} + \delta_i + \delta_t + \epsilon_{it}. \tag{2}$$

Recent literature has demonstrated that two-way fixed effect models with multiple time periods yield biased estimates under heterogeneous treatment effects. In this setup, the parameter of interest corresponds to a variance-weighted average of different 2x2 comparisons. Among these are also "forbidden comparisons" between late and early treated units. If treatment effects vary over time, this can cause some units to receive negative weights (Goodman-Bacon, 2021). To this end, we also estimate the newly proposed estimators by Sun and Abraham (2021) and Callaway and Sant'Anna (2021) as robustness tests.

5.2 Balancing Test

The main identifying assumption for interpreting our estimates of interests as causal is that the timing of the stadium completion is uncorrelated with other omitted factors that may affect local economic development. Although this assumption is not directly testable, we provide a number of robustness checks, including a balancing exercise, a placebo test, and a pre-trend analysis, bolstering our confidence that our results can be interpreted as causal. One approach to shed light on this assumption is to examine correlations between observable stadium characteristics (e.g., distances to growth-determining locations such as the capital, ports, or the transportation network) and completion dates. We report the bivariate regression estimates of the balance test in Appendix Figure A.3.

Although these distances might be captured in the stadium fixed effects, Appendix Figure A.3 shows that the completion year and the stadium distances are not correlated. We take data from *OpenStreetMap*, and thus, some infrastructure might be constructed after (or even due to) the stadium construction.

However, other characteristics, such as distance to the coast, capital city, and closest river, did not change over time. It would be a concern for our identification strategy if the distance to the next port (or the coastline as a natural proxy) was positively correlated. This would mean that with a higher distance, the completion of a stadium would be later. At the same time, the distance to a port is very likely to be correlated with economic development. The same holds for the distance to the capital city and infrastructure measures. We find no statistically significant correlations, though not all data corresponds to a time prior to the treatment.

6 Results

We are interested in the impact of Chinese-built stadiums on local economic development in Sub-Saharan Africa, estimated in a difference-in-differences (DiD) framework. Local economic development is measured by nighttime light intensity. First, we present the main results before we investigate the spatial extension and, look at dynamic effects via event studies.

6.1 Main Results

First, we estimate the growth effect of a newly constructed stadium by China in Sub-Saharan Africa on the whole city's urban footprint. We take this built-up area from *Africapolis*. Column (1) of Table 1 reports the results of the TWFE estimation with stadium and year fixed effects, while Column (2) includes additional year×region fixed effects, where the region refers to the region within Sub-Saharan Africa (west, central, east, south). The point estimate is in both specifications almost identical with 0.25, but the second specification is less precise. In Column (3), we drop the never-treated group and estimate only on the 38 stadiums which were constructed until 2013. This has the advantage that comparisons happen in a more homogeneous sample if one expects later constructed stadiums to be different or endogenously constructed later. However, it might give a higher weight to "forbidden" comparisons of later constructed stadiums versus already constructed stations, which might estimate an incorrect negative effect. Therefore, unsurprisingly, the point estimate shrinks slightly but remains statistically significant at the 1% level. Next, we add the small stadiums with a capacity below 10,000 seats. Although we excluded them originally as we did not expect the same effect as for larger stadiums (some of them did not seem to be actual stadiums but only soccer fields), the point estimate remains at 0.25 and is statistically significant at the 1% level.

Last, we estimate on a sample containing only stadiums that were constructed for an Africa Cup of Nations.[8] We argue that the exogeneity assumption is particularly well-justified for this particular sample restriction, as the allocation of the tournament hosting rights was obstructed by unexpected events such as the Ebola epidemic, internal political turmoil, like the civil war in Libya, and construction delays. These sudden changes create the need for infrastructure for hosting countries, where China is stepping in and finances and constructs the stadiums for the events. However, the sample shrinks to only 21 stadiums. These stadiums are arguably larger, and potentially, they come with further investments for the Africa Cup of Nations. Therefore, it is unsurprising to estimate a much larger effect of 0.41, statistically significant at the 1% level.

Table 1: The Effect of Stadiums on Local Economic Development

Log(Light Intensity)	(1)	(2)	(3)	(4)	(5)
Stadium	0.2505***	0.2521**	0.2087***	0.2435***	0.4079***
	(0.0710)	(0.0986)	(0.0598)	(0.0666)	(0.0749)
Total number of stadiums	56	56	38	69	21
Number of untreated units	18	18	0	28	5
Stadium FE	✓	✓	✓	✓	✓
Year FE	✓		✓	✓	✓
Year-region FE		✓			
Observations	1,232	1,232	792	1,518	462
R^2	0.97431	0.97594	0.97076	0.97657	0.98442
Within R^2	0.05581	0.05110	0.03472	0.04945	0.20084

Notes: Outcome: light intensity, measured as the logarithmic sum of light intensities of DMSP-OLS pixels from Bluhm and Krause (2022) within the town area, coming from *Africapolis*. Stadium refers to a dummy variable taking the value one if in year t or any year afterward a Chinese-financed stadium was completed and zero otherwise. The number of untreated units refers to stadiums built after 2013. Column (4) adds small stadiums with less than 10,000 seats. Column (5) contains only stadiums constructed for the Africa Cup of Nations. Standard errors clustered at the stadium level and reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

For our preferred specification, Column (1) of Table 1, we test different standard error specifications. In Column (2) of Appendix Table B.2, standard errors are clustered at a higher level. When clustering at the country level instead of at the stadium level, they increase only slightly. In Column (3), we apply Conley standard errors to account for the spatial nature of the data. Finally, we apply two-way standard errors, clustered at the country and year level, as in some countries, stadiums were constructed in more than one year. In all specifications, standard errors are only slightly larger than in Column (1) of Table 1.

[8] In the following Africa Cup of Nations China was involved in the stadium construction since 1992: Burkina Faso (1998), Mali (2002), Ghana (2008), Angola (2010), Gabon and Equatorial Guinea (2012), Equatorial Guinea (2015), Gabon (2017), and Cameroon (2021).

Next, we investigate the spatial extension of the effects. To that end, we draw buffers of different sizes surrounding the stadium location. Table 2 reports the regression output for three different buffer sizes (1, 5, and 10km). As expected, the effect size decreases in line with the size of the buffers from 0.35 for the smallest buffer (1km) to 0.18 for the largest buffer (10km). The 5km buffer is close to the cities' estimate from Table 1 (0.22 versus 0.25).

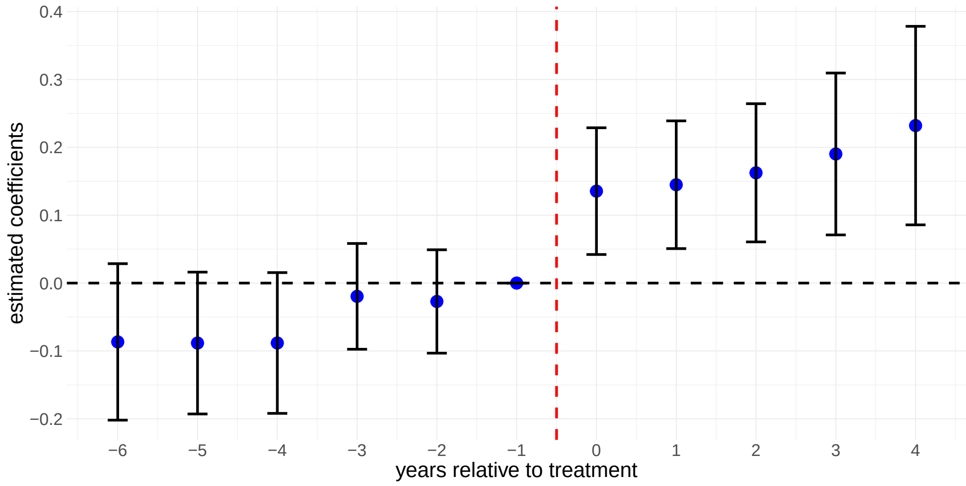
Table 2: Spatial Extension of the Effect of Stadiums on Local Economic Development

Log(Light Intensity) Buffer Radius	(1) 1km	(2) 5km	(3) 10km
Stadium	0.3494**	0.2183*	0.1780*
	(0.1343)	(0.1148)	(0.0936)
Total number of Stadiums	56	56	56
Number of untreated units	18	18	18
Stadium FE	✓	✓	✓
Year FE	✓	✓	✓
Observations	1,232	1,232	1,232
R^2	0.90091	0.94293	0.93306
Within R^2	0.03081	0.01636	0.01316

Notes: Outcome: light intensity, measured as the logarithmic sum of light intensities of DMSP-OLS pixels from Bluhm and Krause (2022). Columns (1), (2), and (3) report the 1, 5, and 10km buffer around the stadium, respectively. Stadium refers to a dummy variable taking the value one if in year t or any year afterward a Chinese-financed stadium was completed and zero otherwise. The number of untreated units refers to stadiums built after 2013. Standard errors clustered at the stadium level and reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Event studies provide further insights into the dynamic effects and the plausibility of the parallel trends assumption. Figure 2 presents the event study estimates for our preferred specification (Table 1, Column 1). Three aspects are notable. First, conditional on fixed effects, there is no statistically significant difference in the trajectories of treatment and control group in the pre-treatment periods. The stable pre-treatment periods lend credibility to the parallel trends assumption. However, the first three estimates are all clearly negative (though lacking statistical significance). This indicates some positive but small effects during the construction period of the stadium, which lasts for two to five years. Second, the treatment year yields a large and instantaneous increase in nighttime light emissions in the year the stadium is constructed of about 0.14. Third, the event study estimates exhibit a slight increase in nighttime light intensity over time in the post-treatment periods. The coefficient gradually increases from about 0.14 to about 0.23 four years after treatment. Taken together, the event study estimates provide evidence that there is no violation of the parallel trends assumption and highlight the persistent and increasing effects of stadiums on local economic activity.

Figure 2: Event Study for the Effect of Stadiums on Local Economic Development



Notes: This figure presents the event study results for the TWFE-OLS estimation as defined in Equation 2. Outcome: light intensity, measured as the logarithmic sum of light intensities of DMSP-OLS pixels from Bluhm and Krause (2022) within the town area, coming from *Africapolis*. The event is defined as the year of completion of a stadium. Stadium and year fixed effects are included. Standard errors clustered at the stadium level. Confidence intervals are reported at the 95% level.

6.2 Robustness

Alternative Estimators Next, we discuss the validity of the two-way fixed effects (TWFE) estimator in settings with staggered treatment adoption and heterogeneous treatment effects. Recent literature has shown that the TWFE estimator does not have a simple causal interpretation in these circumstances. As a robustness test, we re-calculate the results with different newly proposed estimators like Sun and Abraham (2021) and Callaway and Sant'Anna (2021). Goodman-Bacon (2021) demonstrates that β_{TWFE} corresponds to a variance-weighted average of different 2x2 DiD comparisons between three different groups. First, the estimator compares early versus late treated units; second, treated versus untreated units; and third, the problematic comparison between the late and early treated units. These "forbidden comparisons" bias the TWFE estimator if treatment effects are heterogeneous. Furthermore, certain comparisons can receive negative weights, which in extreme cases could even yield a negative overall estimate, even if the true average treatment effect on the treated is positive. Goodman-Bacon (2021) proposes plotting the different 2x2 comparisons. This table proposed by Goodman-Bacon (2021) gives an intuitive understanding of the magnitude of the bias. So, how big of a problem could the bias be in our DiD setup? Table 3 presents the weights for the different 2x2 comparisons for the main specification. The late versus early comparison has a weight of 18 percent. Thus, if treatment effect heterogeneity is present, a bias is induced by these comparisons.

Table 3: Robustness: Decomposition of TWFE Estimator

	Type	Weight	Average Estimates
1	Earlier vs Later Treated	0.32	0.21
2	Later vs Earlier Treated	0.18	0.25
3	Treated vs Untreated	0.49	0.31

Notes: The table reports the Goodman-Bacon (2021) decomposition of the main specification. The TWFE estimator in a setting with multiple treatment timing corresponds to a variance-weighted average of three different comparisons. The table reports the weights and average estimates for the main specification.

Next, we show the dynamic event study for the estimators by Sun and Abraham (2021) and Callaway and Sant'Anna (2021). Overall, the results remain mostly robust when applying the novel DiD estimators. In Appendix Figure A.4, the estimation following Sun and Abraham (2021), only in one pre-treatment period, the estimate deviates statistically significantly from zero. The post-treatment estimators have a similar size to the main specification (Figure 2) and are all highly statistically significant. In Appendix Figure A.5, the estimation following Callaway and Sant'Anna (2021), no statistically significant deviation from zero is evident in the pre-treatment periods. In fact, all point estimates are very close to zero. Even closer than in the classical TWFE estimation. This corroborates the credibility of the parallel trends assumption. The post-treatment estimators have a similar size to the main specification and increase further in the last period, four years after the stadium completion. However, one of the estimates lacks statistical significance at the 5% level (period t+2).

Is It the Stadium, Itself? We calculate "donut" buffers to preclude the concern that the effect is driven by the light emanating from stadiums themselves. These "donut" buffers only consider the outer part of a circle, cutting a hole inside, which is not considered in the analysis. We run these regressions with various outer and inner radii. The effect size is between 0.22 and 0.17. Dropping a circle with a radius of 1km, the 5 and 10km buffer estimates are very similar to the respective main effects in Table 2 (Columns 1 and 2). A marginally statistically and smaller but still economically significant estimator is even found when removing an inner radius of 3km (Columns 3 and 4). Hence, the effect is not driven by the light emanating from the stadiums themselves.

Moreover, the Africa Cup of Nations stadiums provide further evidence why the increase is not only driven by the stadium illumination system itself. These stadiums were used intensely for the respective Africa Cup of Nations, which took place shortly after the stadiums' completion. If the effect was solely driven by the stadiums themselves, one would expect a spike in nighttime light emissions in the first

Table 4: Robustness: Spatial Extension of the Effect of Stadiums on Local Economic Development (Without a Buffer Directly Surrounding the Stadium)

Log(Light Intensity)	(1)	(2)	(3)	(4)
Outer and Inner Buffer Radius	5 minus 1	10 minus 1	5 minus 3	10 minus 3
Stadium	0.2159*	0.1770*	0.2029*	0.1733*
	(0.1136)	(0.0933)	(0.1059)	(0.0936)
Stadium FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
Total number of stadiums	56	56	56	56
Number of untreated units	18	18	18	18
Stadium FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
Observations	1,232	1,232	1,232	1,232
R^2	0.94340	0.93390	0.94105	0.93319
Within R^2	0.01632	0.01314	0.01494	0.01171

Notes: Outcome: light intensity, measured as the logarithmic sum of light intensities of DMSP-OLS pixels from Bluhm and Krause (2022). Donuts with different inner and outer radii are shown. The outer radius takes the values of 5 and 10km, while the inner radius takes the values of 1 and 3km. Stadium refers to a dummy variable taking the value one if in year t or any year afterward a Chinese-financed stadium was completed and zero otherwise. The number of untreated units refers to stadiums built after 2013. Standard errors clustered at the stadium level and reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

post-treatment year and a reduction in the effect after the Africa Cup of Nations is finished. The event study in Appendix Figure A.6 does not exhibit this pattern.[9]

Can It Be Other Investments? Stadiums might not be the only investment coming from China. Therefore, we control for other investments coming from Dreher et al. (2022). The data, which collects Chinese foreign aid from 2000 to 2014, is geo-referenced so that we can assign aid to the cities where stadiums were constructed. Out of 13,427 projects, we can assign 841 to our stadium locations.

First, we calculate competitive treatments. In Column (1) of Table 5, the competitive treatment is a dummy that turns one if at least one aid project is present in a city. In Columns (2) through (4), we split projects into different available sectors. Health, other social, and transportation are the three largest groups, accounting for 70 percent of all projects. One might expect that transportation projects reduce the coefficient of the main effect. However, the main effect remains in all specifications. The effect of other projects is rather small. For instance, if there is any other social infrastructure, cities grow by half a percent. All other coefficients are smaller, and the transport coefficient actually lacks statistical significance. When testing all sectors simultaneously, none of the competing treatments is large, and

9 We show an event study for a sample containing only stadiums built for the Africa Cup of Nations (Table 1, Column 5).

all lack statistical significance (Column 5).[10] The main effect shrinks lightly with 0.22 and remains statistically significant at the 1% level.

After that, we use the full variance of the data by defining the competitive treatment as the cumulative amount of aid. We find very similar results, with the only significant coefficient being the transportation sector in the full specification (Column 10). The main effect remains statistically significant at the 1% level in all specifications and even increases slightly to 0.28 in the full specification.

Table 5: Robustness: Aid Data

Log(Light Intensity)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Stadium	0.2373***	0.2328***	0.2436***	0.2335***	0.2188***	0.2565***	0.2510***	0.2807***	0.2407***	0.2754***
	(0.0713)	(0.0721)	(0.0708)	(0.0728)	(0.0734)	(0.0714)	(0.0704)	(0.0767)	(0.0713)	(0.0762)
All projects	0.0003***				0.0003					
	(4.45×10^{-5})				(0.0015)					
Health projects		0.0049*			0.0038					
		(0.0027)			(0.0034)					
Other social projects			0.0002***		-0.0002					
			(3.43×10^{-5})		(0.0015)					
Transport projects				0.0011	0.0004					
				(0.0007)	(0.0015)					
All projects (mio 2017 USD)						-0.0418				-0.0113
						(0.0698)				(0.0659)
Health projects (mio 2017 USD)							-0.0088			0.0181
							(0.1044)			(0.1016)
Other social projects (mio 2017 USD)								-0.1432		-0.1772
								(0.1048)		(0.1088)
Transport projects (mio 2017 USD)									0.1515	0.2020*
									(0.1069)	(0.1157)
Total number of stadiums	56	56	56	56	56	56	56	56	56	56
Number of untreated units	18	18	18	18	18	18	18	18	18	18
Stadium FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	1,232	1,232	1,232	1,232	1,232	1,232	1,232	1,232	1,232	1,232
R^2	0.97467	0.97467	0.97452	0.97464	0.97501	0.97435	0.97432	0.97462	0.97452	0.97498
Within R^2	0.06878	0.06897	0.06350	0.06793	0.08149	0.05730	0.05586	0.06710	0.06340	0.08020

Notes: This table presents results with competitive treatments for other Chinese aid added to the main specification (Equation 1). Outcome: light intensity, measured as the logarithmic sum of light intensities of DMSP-OLS pixels from Bluhm and Krause (2022) within the town area, coming from *Africapolis*. Stadium refers to a dummy variable taking the value one if in year t or any year afterward a Chinese-financed stadium was completed and zero otherwise. The number of untreated units refers to stadiums built after 2013. The amount from *AidData* is measured in one million US dollars (constant 2017). While Columns (1) trough (5) use a project dummy (turning one when *AidData* contains a project in a city), Columns (6) trough (10) use cumulative project values. Standard errors clustered at the stadium level and reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The Role of Increased Electricity A plausible objection that could be raised is that the increase in nighttime light activity is driven by the connection to the electricity grid. The effect, therefore, would not reflect an actual improvement in regional development but rather just the improved connectivity to the electricity grid or the brightness of the stadium illumination system itself. We argue that this is not the case for at least two reasons. First, the connection to the electricity grid precedes the actual

[10] In contrast to Column (1), where "all projects" actually gives the estimates for all categories combined, here "all projects" gives the estimate for all the *remaining* categories combined.

completion date of a stadium. Consequently, in the event study in Figure 2, one would expect to see an increase in local nighttime light emissions before the actual treatment year. However, the event study does not exhibit an increase in nighttime lights in the pre-treatment period. Instead, we find a moderately increasing effect over the entire post-treatment period. Second, we find statistically significant effects on nighttime light activity in large spatial buffers surrounding the stadiums. It seems very implausible that the effect is driven on a spatial extension of 5 or 10km solely by the stadium illumination system as the total area under investigation is very large. Moreover, we exclude the area directly surrounding the stadium. The effect still remains, which indicates that more fundamental development happens even 5 to 10km away from the stadium.

Permutation Test We identify the causal effect of stadiums on local economic development under the assumption that the timing of the treatment is exogenous to other omitted factors that may affect local economic development. We randomly assign the treatment before the actual year of completion for a given stadium. We re-estimate our preferred specification using these placebo treatment dates 1,000 times. We take the p-value from each estimation and order them by their size. The resulting plot can be seen in Appendix Figure A.7. The rank and the p-value give almost a straight line. Our estimated p-value from Table 1, indicated by the red vertical line, is among the lowest ten (lowest 1%). Giving further credibility to a highly statistically significant estimate.

7 Discussion: Economic Mechanisms

A large literature has investigated the economic impact of stadiums and sports facilities in high-income countries. The overall evidence points to little to no economic benefits associated with sports facilities both at the local and the city level (Coates, 2023; Propheter, 2019). These findings have questioned and often invalidated the case for policy support in the form of subsidies for professional sports franchises. However, nearly all studies focused on high-income countries. We discuss how the erection of stadiums can raise local economic development, specifically in a developing country context. Three mechanisms stand out: the sports venue channel, the infrastructure channel, and human capital formation.

Concerning the first channel, recurring sporting events can increase local employment as people visiting stadiums increase commercial activity and attract businesses. This mechanism is in line with findings by (Abbiasov and Sedov, 2023), who use mobile foot traffic data to study the impact of sports facilities in the US. For football and baseball stadiums, they find an increase in commercial and hospitality sector activity in the vicinity of stadiums. The increase in nighttime light emission that we capture in the vicinity of stadiums could thus reflect localized spillover effects and increased commercial activity.

Second, the erection of a stadium constitutes and is accompanied by significant infrastructure investments. Better roads, connection to the electricity grid, and overall improvements in accessibility could drive local economic activity. Our findings resonate with the broader narrative of the positive impact of Chinese infrastructure investments on economic growth in Sub-Saharan Africa, as documented by Mandon and Woldemichael (2023) and Dreher et al. (2021b). This channel could also account for the contradictory evidence of studies conducted in high-income countries, which generally find weak or no evidence of beneficial effects on economic outcomes. The marginal benefit of basic infrastructure investments is higher in countries with lower stock of infrastructure. Thus, the presence of improved infrastructure, including improved road access, might account for the persistent increase in nighttime light emissions. However, the results from Table 5 indicate very little additional growth from other infrastructure investments.

Thirdly, the construction of stadiums could raise human capital formation in Sub-Saharan African countries. Chinese corporations send Chinese workers to construct the stadiums together with local Sub-Saharan African workers. Therefore, Sub-Saharan African workers could learn from their experience and construction know-how. These human capital spillovers could further foster economic development in the years after the stadium was completed.

Moreover, stadium construction can yield additional benefits both at the city and country level. Evidence by Ahlfeldt and Maennig (2010) highlights the aesthetic and architectural value of stadiums and their positive effects on neighborhoods. Sports facilities allow Sub-Saharan African countries to host international events like the Africa Cup of Nations, Cricket World Cup, and All-African Games. These events can stimulate the local economy in the short-run, while the long-run evidence is more ambiguous (Baade and Matheson, 2016). National pride is often predicated on football events. Stadiums might thus allow the local population to appreciate and benefit from sports events, providing a quality of life amenity.

8 Conclusion

China has financed and constructed substantial amounts of stadiums in low-income countries. We investigate the impact of these sports venues on the local economy in Sub-Saharan Africa in a difference-in-differences framework. We compare cities, where a stadium was completed to those which were not yet completed. Thus, we estimate an ATT with the identification assumption that the timing of stadium completion is exogenous to other omitted factors that may affect local economic development. To proxy for regional development, we use nighttime light satellite data.

Western policymakers conceive of China's construction of stadiums as expensive and superficial "white elephant" projects, which ultimately defy the purpose of raising living standards in low-income countries. The notion that stadiums do not have a beneficial impact on the local economy is corroborated by a set of studies investigating high-income places in the US and Europe. This paper finds a different pattern in low-income countries. We show that stadium infrastructure can result in an increase in local economic activity. We find that nighttime light emissions in cities with Chinese stadiums increase after the completion of the stadium, compared to cities, where a stadium was not yet constructed. This holds both for the cities' built-up area and the area around the stadium (in different buffer sizes and also when excluding the area directly around the stadium). Event study estimates highlight a persistent and growing effect of stadiums on nighttime light emissions while not showing any statistically significant pre-trend prior to the stadium's completion.

Nonetheless, the conclusion that China's "stadium diplomacy" constitutes a sensible and effective type of development policy for low-income countries cannot be drawn prematurely. First, constructing sports stadiums might by far not be as cost-effective as other policy interventions like educational and health-related measures. Second, it is crucial to balance the benefits with a recognition of the potential negative impacts associated with Chinese overseas development finance. As highlighted by (Isaksson and Kotsadam, 2018) and (Isaksson and Kotsadam, 2020), these projects can lead to unsustainable levels of public debt, increased political leverage for China, and environmental destruction. These factors must be carefully considered in any comprehensive assessment of the economic impact of stadium construction in Sub-Saharan Africa.

References

Abbiasov, T. and Sedov, D. (2023). Do local businesses benefit from sports facilities? the case of major league sports stadiums and arenas. *Regional Science and Urban Economics*, 98:103853.

Acker, K. and Brautigam, D. (2021). Twenty years of data on china's africa lending. Briefing Paper No. 04/2021.

Ahlfeldt, G. and Maennig, W. (2010). Stadium architecture and urban development from the perspective of urban economics. *International Journal of Urban and Regional Research*, 34(3):629–646.

Baade, R. A. and Matheson, V. A. (2016). Going for the Gold: The Economics of the Olympics. *The Journal of economic perspectives*, 30(2):201–218.

Bartik, T. J. and Zimbalist, A. (1998). Sports, Jobs and Taxes: The Economic Impact of Sports Teams and Stadiums. *National tax journal*, 51(2):411–414.

Bluhm, R., Dreher, A., Fuchs, A., Parks, B., Strange, A., and Tierney, M. (2020). Connective financing: Chinese infrastructure projects and the diffusion of economic activity in developing countries. Technical report, AidData Working Paper 103.

Bluhm, R. and Krause, M. (2022). Top lights: Bright cities and their contribution to economic development. *Journal of Development Economics*, 157, 102880.

Brautigam, D. (2020). A critical look at Chinese 'debt-trap diplomacy': the rise of a meme. *Area Development and Policy*, 5(1):1–14.

Bruederle, A. and Hodler, R. (2018). Nighttime lights as a proxy for human development at the local level. *PLOS ONE*, 13(9):e0202231.

Burnside, C. and Dollar, D. (2000). Aid, policies, and growth. *The American Economic Review*, 90(4):847–868.

Busse, M., Erdogan, C., and Mühlen, H. (2016). China's impact on africa–the role of trade, fdi and aid. *Kyklos*, 69(2):228–262.

Callaway, B. and Sant'Anna, P. H. (2021). Difference-in-Differences with multiple time periods. *Journal of Econometrics*, 225(2):200–230.

Chang, W., Xue, C., and Ding, G. (2019). Architecture of Diplomacy: Chinese Construction Aid in Asia, 1950–1976. *ARENA Journal of Architectural Research*, 4(1):3.

Coates, D. (2023). Growth effects of sports franchises, stadiums, and arenas: 15 years later. In *The Economic Impact of Sports Facilities, Franchises, and Events: Contributions in Honor of Robert Baade*, pages 59–87. Cham: Springer International Publishing.

Coates, D. and Humphreys, B. R. (1999). The growth effects of sport franchises, stadia, and arenas. *Journal of Policy Analysis and Management*, 18(4):601–624.

Coates, D. and Humphreys, B. R. (2008). Do Economists Reach a Conclusion on Subsidies for Sports Franchises, Stadiums, and Mega-Events? *Econ journal watch*, 5(3):294–315.

Cruzatti, J., Dreher, A., and Matzat, J. (2023). Chinese aid and health at the country and local level. *World Development*, 167:106214.

Dreher, A. and Fuchs, A. (2015). Rogue aid? An empirical analysis of China's aid allocation. *Canadian Journal of Economics*, 48(3):988–1023.

Dreher, A., Fuchs, A., Hodler, R., Parks, B. C., Raschky, P. A., and Tierney, M. J. (2019). African leaders and the geography of china's foreign assistance. *Journal of Development Economics*, 140:44–71.

Dreher, A., Fuchs, A., Hodler, R., Parks, B. C., Raschky, P. A., and Tierney, M. J. (2021a). is Favoritism a Threat to Chinese Aid Effectiveness? A Subnational Analysis of Chinese Development Projects. *World Development*, 139:105291.

Dreher, A., Fuchs, A., Parks, B., Strange, A., and Tierney, M. J. (2021b). aid, China, and Growth: Evidence from a New Global Development Finance Dataset. *American Economic Journal: Economic Policy*, 13(2):135–174.

Dreher, A., Fuchs, A., Parks, B., Strange, A. M., and Tierney, M. J. (2018). Apples and dragon fruits: The determinants of aid and other forms of state financing from china to africa. *International Studies Quarterly*, 62(1):182–194.

Dreher, A., Fuchs, A., Parks, B., Strange, A. M., and Tierney, M. J. (2022). *Banking on Beijing: the aims and impacts of China's overseas development program.* Cambridge University Press.

Feddersen, A., Grötzinger, A., and Maennig, W. (2008). Investment in stadia and regional economic development-evidence from fifa world cup 2006. Working paper, Hamburg Contemporary Economic Discussions 16.

Gibson, J., Olivia, S., Boe-Gibson, G., and Li, C. (2021). Which night lights data should we use in economics, and where? *Journal of development economics*, 149: 102602.

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of econometrics*, 225(2):254–277.

Henderson, J. V., Storeygard, A., and Weil, D. N. (2012). Measuring Economic Growth from Outer Space. *The American economic review*, 102(2):994–1028.

Isaksson, A.-S. and Kotsadam, A. (2018). Chinese aid and local corruption. *Journal of Public Economics*, 159:146–159.

Isaksson, A.-S. and Kotsadam, A. (2020). Chinese Aid to Africa: Distinguishing Features and Local Effects. IFN Working Paper No. 1337.

Kocornik-Mina, A., McDermott, T. K., Michaels, G., and Rauch, F. (2020). Flooded cities. *American economic journal. Applied economics*, 12(2):35–66.

Lessmann, C. and Seidel, A. (2017). Regional inequality, convergence, and its determinants – a view from outer space. *European Economic Review*, 92(C):110–132.

Mandon, P. and Woldemichael, M. M. T. (2022). Has Chinese Aid Benefited Recipient Countries? Evidence from a Meta-Regression Analysis. IMF Working Papers 2022/046.

Mandon, P. and Woldemichael, M. T. (2023). Has chinese aid benefited recipient countries? evidence from a meta-regression analysis. *World Development*, 166:106211.

Martorano, B., Metzger, L., and Sanfilippo, M. (2020). Chinese development assistance and household welfare in sub-saharan africa. *World Development*, 129:104909.

Mitnik, O. A., Sanchez, R., and Yatextasciitildenez-Pagans, P. (2018). Bright investments: Measuring the impact of transport infrastructure using luminosity data in haiti. IZA DP No. 12018.

Nordhaus, W. and Chen, X. (2015). A sharper image? estimates of the precision of nighttime lights as a proxy for economic statistics. *Journal of economic geography*, 15(1):217–246.

Pfeifer, G., Wahl, F., and Marczak, M. (2018). Illuminating the World Cup effect: Night lights evidence from South Africa. *Journal of Regional Science*, 58(5):887–920.

Propheter, G. (2019). Professional sports as economic activity magnets: Some evidence from employment microdata. *Journal of Urban Affairs*, 41(6):842–852.

Rajan, R. G. and Subramanian, A. (2008). Aid and growth: What does the cross-country evidence really show? *The Review of Economics and Statistics*, 90(4):643–665.

Santo, C. (2005). The economic impact of sports stadiums: Recasting the analysis in context. *Journal of Urban Affairs*, 27(2):177–192.

Storeygard, A. (2016). Farther on down the Road: Transport Costs, Trade and Urban Growth in Sub-Saharan Africa. *The Review of Economic Studies*, 83(3):1263–1295.

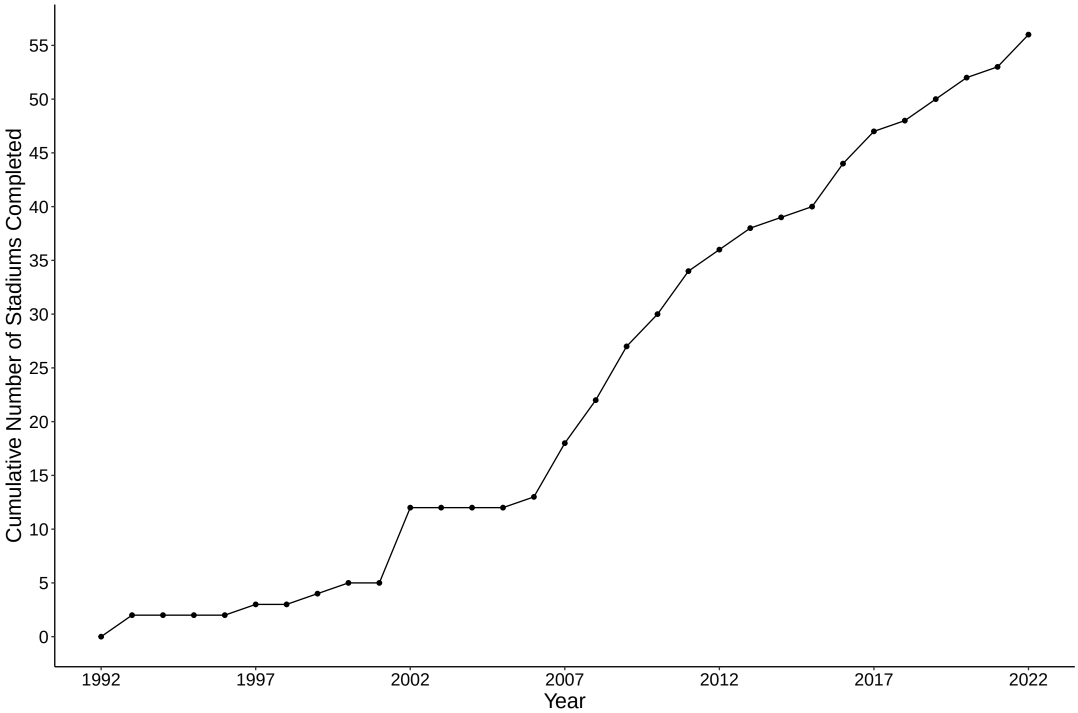
Sun, L. and Abraham, S. (2021). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics*, 225(2):175–199.

Vondracek (2021). China's Stadium Diplomacy and its Determinants. *Journal of China and international relations*, 7(1).

Wright, J. and Winters, M. (2010). The politics of effective foreign aid. *Annual Review of Political Science*, 13:61–80.

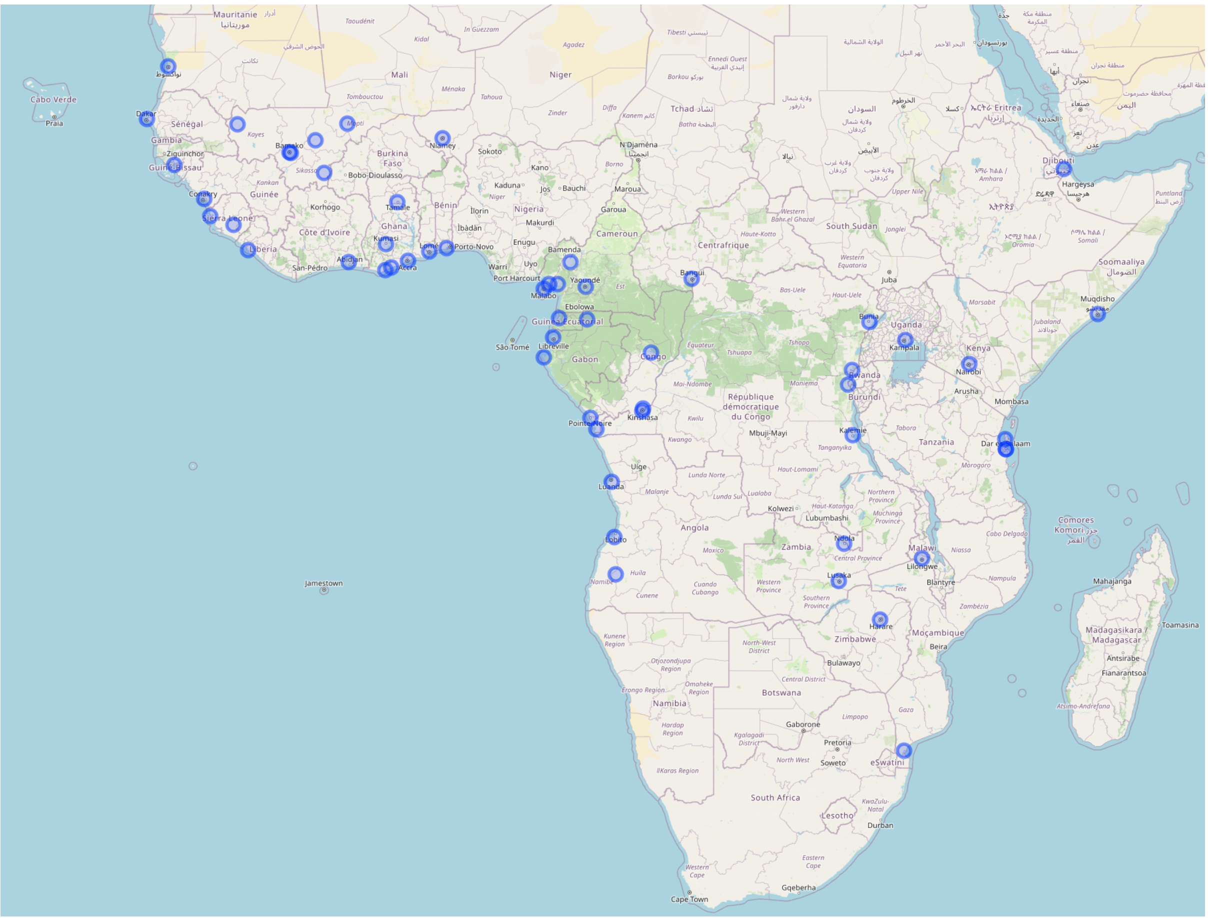
A Figures

Figure A.1: Cumulative Number of Stadiums



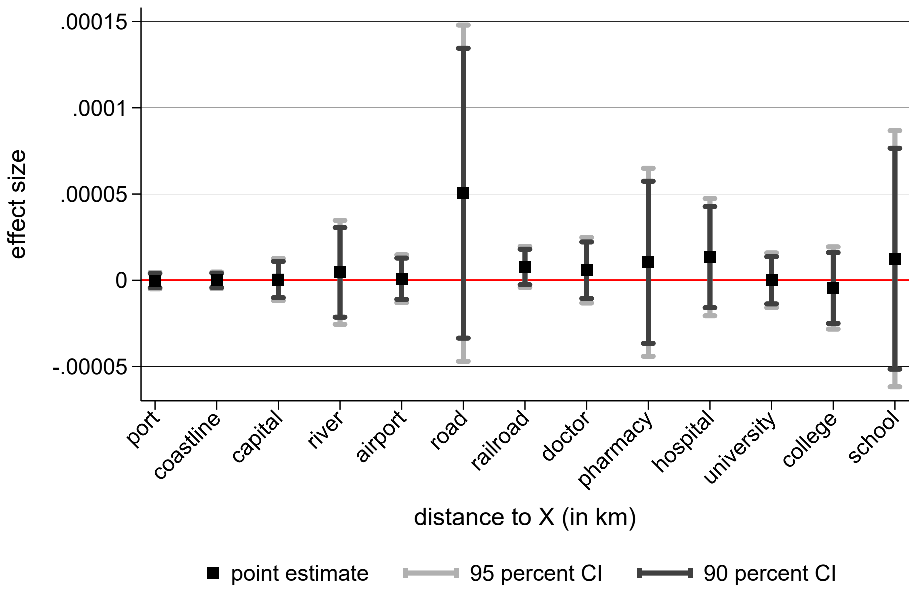
Notes: This figure shows the cumulative number of stadiums in Sub-Saharan Africa built and financed by China and used in the main analysis between 1992 and 2022.

Figure A.2: Stadiums' Geographical Distribution



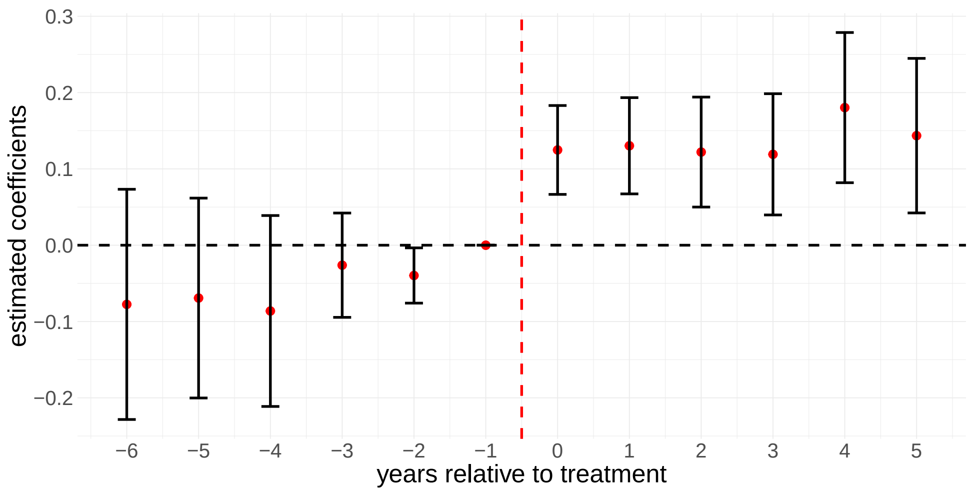
Notes: This figure shows the geographical distribution of all 56 stadiums used in the main analysis.

Figure A.3: Balance Test (Distances)



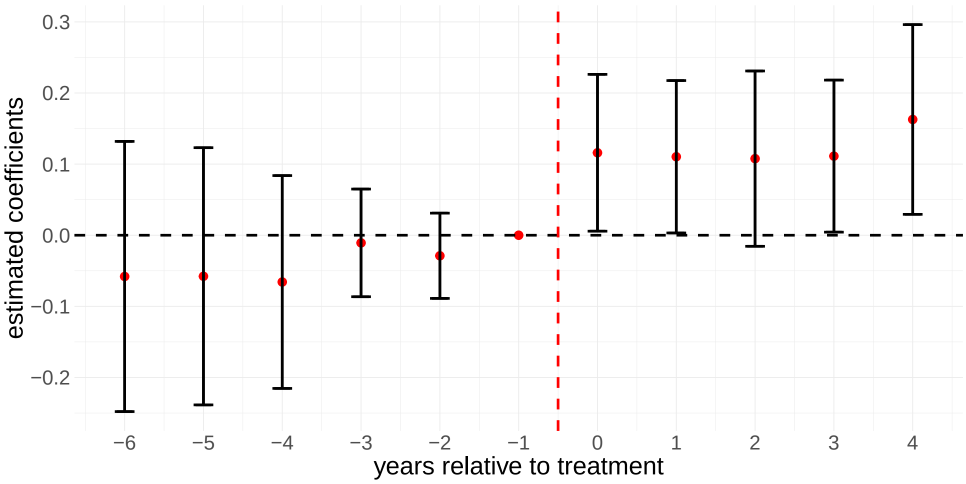
Notes: This figure shows the balance test for correlations between stadium completion years and stadium distances. Stadium distances to various infrastructures and geographies are calculated, and each distance is used in a single regression, showing the estimates in this figure. Data comes from *Natural Earth* and *OpenStreetMap*. Confidence intervals are reported at the 90 and 95% level.

Figure A.4: Robustness: Event Study with Novel Estimators I



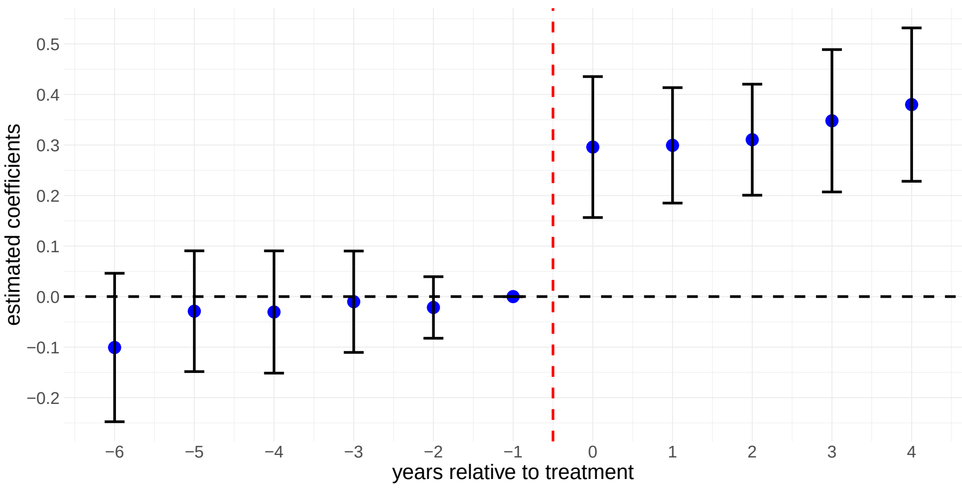
Notes: This figure presents the event study results for the estimator proposed by Sun and Abraham (2021). Outcome: light intensity, measured as the logarithmic sum of light intensities of DMSP-OLS pixels from Bluhm and Krause (2022) within the town area, coming from *Africapolis*. The event is defined as the year of completion of a stadium. Stadium and year fixed effects are included. Standard errors clustered at the stadium level. Confidence intervals are reported at the 95% level.

Figure A.5: Robustness: Event Study with Novel Estimators II



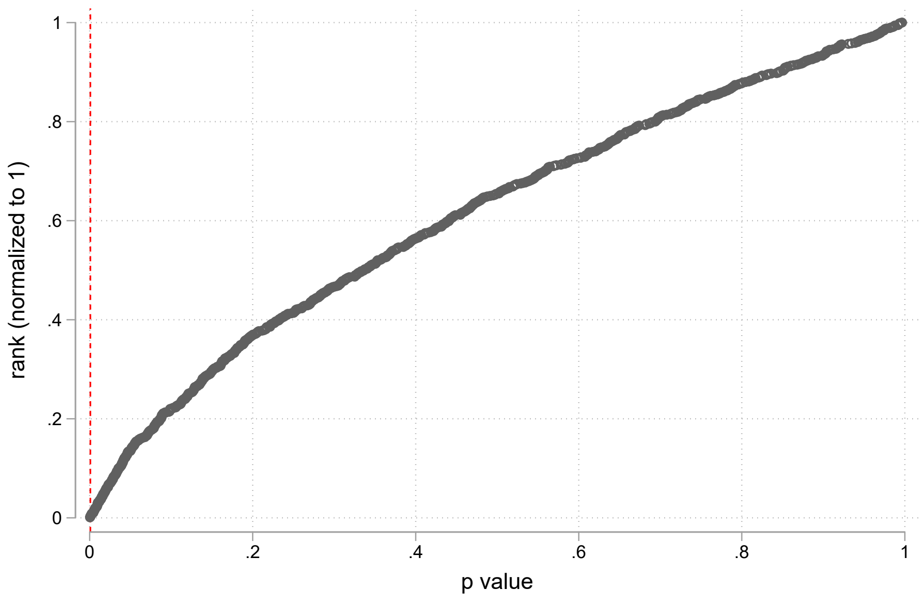
Notes: This figure presents the event study results for the estimator proposed by Callaway and Sant'Anna (2021). Outcome: light intensity, measured as the logarithmic sum of light intensities of DMSP-OLS pixels from Bluhm and Krause (2022) within the town area, coming from *Africapolis*. The event is defined as the year of completion of a stadium. Stadium and year fixed effects are included. Standard errors clustered at the stadium level. Confidence intervals are reported at the 95% level.

Figure A.6: Robustness: Event Study with Africa Cup of Nations Sample



Notes: This figure presents the event study results for the TWFE-OLS estimation as defined in Equation 2 on a sample containing only stadiums built for the Africa Cup of Nations. Outcome: light intensity, measured as the logarithmic sum of light intensities of DMSP-OLS pixels from Bluhm and Krause (2022) within the town area, coming from *Africapolis*. The event is defined as the year of completion of a stadium. Stadium and year fixed effects are included. Standard errors clustered at the stadium level. Confidence intervals are reported at the 90 and 95% level.

Figure A.7: Permutation Test



Notes: This figure presents the distribution of p-values when randomly assigning the treatment date 1000 times in the pre-treatment period in the main specification (Equation 1). The red vertical line shows the p-value from Table 1 (Column 1).

B Tables

Table B.1: Overview of Stadiums

Recipient State	Year of Completion	Stadium Name	Capacity	City Name
Senegal	1992	Stade Aline Sitoe Diatta	9999	Ziguinchor
Democratic Rep. Congo	1993	Stade de Martys	80000	Kinshasa
Djibouti	1993	El Hadj Hassan Gouled Aptidon Stadium	20000	Djibouti City
Uganda	1997	Mandela National Stadium	45000	(Namboole) Kampala
Niger	1999	Stade General Seyni Kountche	50000	Niamey
Togo	2000	Kegue Stadium	40000	Lome
Mali	2002	Stade du 26 Mars	50000	Bamako
Mali	2002	Stade Modibo Keita	35000	Bamako
Mali	2002	Stade Abdoulaye Nakoro Cissoko	15000	Kayes
Mali	2002	Stade Barema Bocoum	30000	Mopti
Mali	2002	Stade Amari Daou	30000	Segou
Mali	2002	Stade Babemba Traore	30000	Sikasso
Sierra Leone	2002	National Stadium	45000	Freetown
Central African Republic	2006	Barthelemy Boganda Sports Complex	20000	Bangui
Congo	2007	Municipal Stadium	13594	Pointe Noire
Equatorial Guinea	2007	Estadio de Malabo	15250	Malabo
Equatorial Guinea	2007	Estadio de Bata	35700	Bata
Liberia	2007	Samuel Kanyon Doe Sports Complex	35000	Monrovia
Tanzania	2007	Mkapa National Stadium	60000	Dar es Salaam
Congo	2008	Denis Sassou-Nguesso Stadium	5000	Dolisie
Ghana	2008	Sekondi Takoradi Stadium	20000	Sekondi Takoradi
Ghana	2008	Tamale Stadium	21017	Tamale
Ghana	2008	Accra Sports Stadium	40000	Accra
Ghana	2008	Baba Yara Stadium	40528	Kumasi
Angola	2009	Estadio 11 de Novembro	48000	Luanda
Angola	2009	Estadio Nacional de Ombaka	35000	Benguela
Angola	2009	Estadio Nacional do Chiazi	20000	Cabinda
Angola	2009	Estadio Nacional da Tundavala	20000	Lubango
Senegal	2009	Stade Alassane Djigo	10000	Dakar
Senegal	2009	Stade Ely Manel Fall	5000	Diourbel
Congo	2010	Marien Ngouabi Stadium	20000	Owando
Tanzania	2010	Amaan Stadium	15000	Zanzibar
Zimbabwe	2010	Zimbabwe National Sports Stadium	60000	Harare
Cameroon	2011	Yaoundé Multipurpose Sports Complex	5263	Yaoundé
Gabon	2011	Stade de l'Amitie	40000	Libreville
Guinea	2011	Nongo Stadium	50000	Conakry
Mozambique	2011	Estadio Nacional do Zimpeto	42000	Maputo
Tanzania	2011	Uhuru Stadium	23000	Dar es Salaam
Kenya	2012	Moi International Sports Center	60000	Nairobi
Senegal	2012	Stade Lamine Gueye	8000	Kaolack
Zambia	2012	Levy Mwanawasa Stadium	49800	Ndola
Guinea Bissau	2013	Estadio 24 de Setembro	20000	Bissau
Senegal	2013	Caroline Faye Stadium	5000	Mbour
Senegal	2013	Stade Massene Sene	2500	Fatick
Senegal	2013	Stade Al Boury Ndiaye	1500	Louga
Senegal	2013	Stade de Kolda	1000	Kolda
Senegal	2013	Stade de Tamba	1000	Tambacounda
Zambia	2013	National Heroes Stadium	60000	Lusaka
Senegal	2014	Stade Regional de Matam	999	Matam
Senegal	2014	Stade Mawade Wade de Medina	1200	Saint Louis
Sierra Leone	2014	Bo Stadium Bo	10000	Bo
Congo	2015	Stade Municipal de Kintélé	60000	Brazzaville
Cameroon	2016	Stade de Limbe	20000	Limbe
Cameroon	2016	Bafoussam Omnisport Stadium	20000	Bafoussam
Cameroon	2016	Stade Ahmadou Ahidjo	40000	Yaounde
Ghana	2016	Cape Coast Stadium	20000	Cape Coast
Gabon	2017	Stade de Port-Gentil	20000	Port-Gentil
Gabon	2017	Stade de Oyem	20500	Oyem
Malawi	2017	Bingu National Stadium	41100	Lilongwe
Mauretania	2018	Nouakchott Olympic Stadium	25000	Nouakchott
Tanzania	2018	Mao Tse Tung Stadium	5000	Zanzibar
Cameroon	2019	Stade de la Reunification	39000	Douala
Democratic Rep. Congo	2019	Kalemie Stadium	15000	Kalemie
Cote d'Ivoire	2020	Stade National de la Côte d'Ivoire	60000	Abidjan
Somalia	2020	Mogadishu Stadium	65000	Mogadishu
Benin	2021	Stade de l'Amite	35000	Cotonou
Democratic Rep. Congo	2022	Goma Stadium	15000	Goma
Democratic Rep. Congo	2022	Bukavu Stadium	10000	Bukavu
Democratic Rep. Congo	2022	Bunia Stadium	10000	Bunia

Notes: The table reports all 69 stadiums with their recipient state, year of completion, name, capacity, and the city they are located in.

Table B.2: Robustness: Clustering

Log(Light Intensity)	(1)	(2)	(3)	(4)
Stadium	0.2505***	0.2505***	0.2505***	0.2505***
	(0.0710)	(0.0842)	(0.0890)	(0.0785)
Total number of stadiums	56	56	56	56
Number of untreated units	18	18	18	18
Stadium FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
Cluster	Stadium	Country	Conley	Country + Year
Observations	1,232	1,232	1,232	1,232
R^2	0.97431	0.97431	0.97431	0.97431
Within R^2	0.05581	0.05581	0.05581	0.05581

Notes: The table presents robustness checks to the level of clustering standard errors based on Equation 1. Outcome: light intensity, measured as the logarithmic sum of light intensities of DMSP-OLS pixels from Bluhm and Krause (2022) within the town area, coming from *Africapolis*. Stadium refers to a dummy variable taking the value one if in year t or any year afterward a Chinese-financed stadium was completed and zero otherwise. The number of untreated units refers to stadiums built after 2013. Clustered standard errors reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.