



Does Chinese FDI in Africa inspire support for a china model of development?

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ABSTRACT

Chinese Foreign Direct Investment (FDI) to Africa is quickly becoming a centerpiece of China's approach to promoting development overseas. To this point, however, little is known about the extent to which those investment projects inspire popular support for a China model of development in Africa, or whether Chinese FDI invites skepticism and concern among community members in the region. In this study, we investigate the effects of proximity to Chinese FDI on local perceptions of China's approach to development in Africa. We geolocate 200 Chinese investment projects, and we spatially connect those data to responses from over 35,000 georeferenced survey respondents across 21 countries. By comparing responses from those living near operational Chinese FDI projects to responses from those living near eventual locations of Chinese investment but where no project yet exists at the time of the survey, we determine the proximity effects of Chinese FDI on views of the China model of development while accounting for the potential nonrandom location of those investment projects. The findings indicate that, on average, living near Chinese FDI projects reduces support for a China model of development. Furthermore, specific types of FDI projects evoke distinct evaluations of China's presence. Specifically, respondents living near manufacturing projects view infrastructure development as a positive contribution from China, whereas those living near resource-related projects express concerns about Chinese land grabs and job threats. Those living near service projects hold more mixed views. The results suggest that people living in close proximity to Chinese FDI projects in Africa are swayed less by global development narratives than by how those projects shape their everyday lives and experiences.

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1. Introduction

Foreign Direct Investment (FDI) constitutes a centerpiece of China's expansion into developing regions around the world. In Africa in particular, the stock of FDI from Chinese firms now surpasses the level of Chinese foreign aid, reaching nearly six billion dollars annually (CARI – China Africa Research Initiative, 2020). Estimates suggest that over 10,000 Chinese firms now operate in Africa (Jayaram et al., 2017), providing clear potential for China to burnish its image as a promoter of development through the activities of Chinese firms. The purpose of this paper is to evaluate the extent to which those FDI projects shape perceptions among African citizens of China's approach to development as it plays out in their countries. Do investment projects by Chinese firms in Africa bolster support for a “China model of development” among those living in proximity to the projects, or does living near such projects generate skepticism and concern?

The topic merits study for multiple reasons. First, the micro-level consequences of Chinese FDI in Africa remain relatively understudied, and thus not well understood. While research considers the impact of Chinese foreign aid on numerous individual-level outcomes (see Blair & Roessler, 2021; Blair et al., 2021; Hanusch, 2012; Isaksson & Kotsadam, 2018a; Xu & Zhang, 2020), studies of the effects of Chinese FDI tend either to treat the question in broad terms (Morgan, 2019) or to focus mainly on the mining sector and resource extraction (Knutsen et al., 2017; Lee, 2017; Wegenast et al., 2019). As Chinese firms expand their investment portfolios in the region, however, they increasingly reshape not just the mining industry but also manufacturing and the technology and service sectors, with consequences for nearby residents. Moreover, FDI is both distinct from foreign aid and itself highly variegated, so we can expect that different types of investment projects may affect the perceptions of local community members in profoundly different ways (Sun, 2014).

Second, to the extent that a clear “China model of development” exists, its political impact in Africa is built not solely on national-level policy choices but also on citizens' actual experiences with

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Chinese investment (Kastner & Pearson, 2021). This focus on citizens' responses to FDI has not until now been closely examined in the literature, however. By examining how citizens evaluate the Chinese approach to development as a function of investment in their own communities, we gain an improved understanding of what the concept actually means to citizens in Chinese FDI-receiving countries, which helps to elucidate the political success of this purported model more generally.

Third and relatedly, the presence of foreign entities can affect the popular support that citizens extend to their own political leaders, particularly in democratic settings (Knutsen & Kotsadam, 2020), which makes perceptions of Chinese FDI in Africa relevant to the receiving country's economic and foreign policy. In Zambia, for example, local complaints of sub-standard working conditions in the Chinese-owned Collum mine forced the Zambian government to reconsider its support for that Chinese investment initiative (Leslie, 2016). Empirical studies that analyze the effects of Chinese FDI on the communities in which they operate thus represent an important piece of the story.

To evaluate how Chinese FDI shapes perceptions of a China model of development, we spatially connect over 35,000 georeferenced survey respondents to 200 Chinese FDI projects in 21 countries across Africa. We record the distance between respondents and projects, and we determine whether those projects were operational at the time of the survey response. By comparing the effects of proximity to existing Chinese FDI projects to the effects of living near eventual project locations where no project yet exists, we are able to determine how those projects influence the perceived attractiveness of China's development approach while accounting for the time-invariant factors that may have resulted in the non-random location of those investment projects.

The findings add much-needed empirical nuance to our understanding of support for a China model of development in Africa. First, we find that Chinese investment does not bolster local support for a China model of development. In fact, respondents living in proximity to Chinese FDI projects are less inclined to view the China model as the best model for their country's future development. In secondary analyses, we disaggregate projects by sector to determine how the type of project in a locality might affect that community's view of China. The explanations that respondents give for FDI's two faces—one beneficial and the other costly—indeed differ according to the type of nearby FDI project. Those living near Chinese manufacturing projects are more likely to cite infrastructure improvements as a positive contribution from the Chinese but are relatively more dissatisfied with the quality of Chinese products. Those living in proximity to service projects are more likely to report the cultural exchange with Chinese people as contributing positively to China's image but also to express greater concern about the quality of Chinese products. Finally, respondents living in proximity to resource projects are more likely to cite concerns about Chinese land grabs and the usurping of local jobs as factors contributing to China's negative image. Together, we take these findings as evidence that people living in close proximity to Chinese FDI projects in Africa become particularly well-attuned to the transactional aspects of Chinese firms' presence in their communities and are swayed less by global development narratives than by how those projects shape their everyday lives and experiences.

Studying how Chinese FDI projects affect perceptions of a China model of development in Africa connects this paper to numerous literatures. First, it builds on the large and growing literature that evaluates the character and consequences of China's expanded presence in Africa, much of which focuses on the effects of foreign aid (Blair et al., 2021; Brazys & Vadlamannati, 2020; Isaksson & Kotsadam, 2018b; Knutsen & Kotsadam, 2020; Xu & Zhang, 2020). A second strand of literature to which this research relates

evaluates the political, economic, and development-related preferences of African citizens at the micro-level (see Dionne, 2018; Harris & Hern, 2019; McCauley, 2014). To this end, studies increasingly exploit the availability of geocoded data from the Afrobarometer public opinion surveys (see, for example, Brazys & Kotsadam, 2020; Isaksson & Kotsadam, 2018a; Isaksson & Kotsadam, 2018b; Wantchekon & Riaz, 2019; Wegenast et al., 2019), and our research builds on those efforts. Third, connections exist between this study and the debate over Chinese FDI as a cohesive political economic strategy. Numerous studies cite potential advantages to FDI-receiving countries (Jensen et al., 2012; Owen, 2019; Pandya, 2016), though others note potential costs associated with FDI (Brazys & Kotsadam, 2020; Christensen, 2019; Owen, 2019; Pinto & Zhu, 2016), and still others stress that China itself pursues no grand agenda in the investments of Chinese firms (Ye, 2020).

This paper contributes to those literatures in several respects. First, it represents one of the first studies to evaluate the effects of precise proximity to FDI projects in Africa. Other studies similarly evaluate proximity to foreign aid projects (Knutsen & Kotsadam, 2020; Xu & Zhang, 2020), and some research evaluates the proximity effects of FDI using town or city indicators (Brazys & Kotsadam, 2020) or data from other parts of the world (Eichenauer et al., 2021; Ratigan, 2021; Sim & Greer, 2021). We build on those studies by generating precision codes for the locations of Chinese FDI projects in the region. This study also distinguishes the interests of local populations in Africa from the ambitions that China and Chinese firms may have in expanding their operations in the region. Third, our empirical strategy allows us to compare otherwise very similar individuals whose sole notable difference is proximity to an active Chinese FDI project. This approach not only improves inferential leverage by accounting for broader determinants of China's reception in Africa, but it also controls for potential alternative explanations rooted in racial discrimination, culture, or other potential determinants at the individual level (e.g., Cheng, 2011). Finally, from a theoretical perspective, our study treats Chinese FDI projects in local communities not as symbolic proxies of China's presence or influence, but rather as tangible sources of change to local experiences and opportunities. From that perspective, the type of FDI project that locates in a community can affect the attractiveness of a China model of development in notable ways for the residents of that location.

2. Expectations

Despite widespread application of the term in research settings, policy circles, and evaluations of public opinion, the China model remains a loosely constructed development concept with different connotations to different audiences. The most prominent element of this debate, from what we can think of as the "supply" side, focuses on the intentions and foreign policy goals of China's leadership. Some Western critics suggest that China's government wishes to provide a model for other countries to follow, often expressing concern that this strategy will build Chinese allies at the expense of the U.S., bolster China's soft power, and perhaps underscore benefits of an authoritarian alternative to Western liberalism (e.g., Rolland, 2020). Chinese academics throughout the 2000s and 2010s eschewed the idea that China is offering an alternative model; even if China's reforms revealed developmental strengths, they argue, it does not represent a formal model designed to compete with a "Washington Consensus" (Yao, 2008; see also Kennedy, 2010; DeHart, 2012). Other recent studies (e.g., Ye, 2020; Yu, 2017) contend that China's overseas activities do not reflect a grand plan but rather serve as a solution for China's domestic economic challenges, such as production overcapacity. China's leadership has more recently acknowledged, particularly in reference to its Belt and Road Initiative (BRI), that it wishes to

provide some positive “wisdom” or “experience” from which poorer countries might learn, such as by facilitating infrastructure construction and connectivity among poor countries in win-win transactions that do not impose onerous conditions (Xi, 2017; Lu et al., 2018). We take the perspective that, for the most part, individual FDI projects are deployed in a fragmented manner that does not follow a pre-specified blueprint (Naughton, 2010; Ye, 2020). Ultimately, however, our research question is not about China's foreign policy intentions but about African citizens' reactions to a foreign economic actor whose presence is rapidly expanding.

In the debate over the impact of Chinese overseas economic activities on recipient countries and their citizens, observers disagree about whether the impact is positive, negative, or mixed (Ang, 2018; Chen et al., 2018). A “China model” is seen by some as offering a roadmap for lifting citizens out of poverty, regardless of domestic political circumstance or regime type (Lin, 2011; Ravallion, 2009). The BRI has also received praise for its support for infrastructure development abroad, the influx of Chinese capital and technology to developing countries, expanded markets for commodities, and coordinated areas for development (Bräutigam, 2011; Bräutigam & Tang, 2014; OECD, 2018; Ravallion, 2009). While the BRI provides a government-backed framework for overseas development, FDI from commercially-oriented Chinese firms represents a key catalyst for this expansion and diversification, which may suggest positive reactions to Chinese FDI. Conversely, more negative assessments tend to emphasize the neo-colonial aspects of a China model, including displacement of indigenous industries, excessive resource extraction, environmental degradation, and disappointing returns in terms of worker and managerial skills upgrades (Zhao, 2017). Chinese investments may also orient toward politically unstable countries with weaker governance, potentially exacerbating political weakness (Chen et al., 2018).

Studies of recipient countries conventionally focus on the costs and benefits of a China model of development at the macro level (Lu et al., 2018; OECD, 2018; World Bank, 2019). The micro-level consequences of Chinese FDI activity in Africa, however, remain relatively understudied, despite the implications for political leaders who embrace a stronger Chinese presence in their countries.¹ In particular, how citizens perceive and react to Chinese investments in their economy is not well understood. Individuals may instrumentally anticipate greater job opportunities in proximity to Chinese FDI projects, which might benefit political leaders where they materialize or may cost those leaders where they do not (Wang, Pearson, & McCauley, 2021). At the same time, individuals may view Chinese FDI as a measure of the commercial presence of China in their communities, with broader implications for how their own country's political economy is changing. We argue that those micro-level perspectives would be informed by the predominant types of projects to which local community members are exposed.

We theorize that micro-level attitudes about a China model in Africa turn on the actual experiences of citizens with China's economic presence. One factor that may shape the perceived attractiveness of a China model of development is the price and quality of products that Chinese firms bring to market by virtue of their local operations. While consumers in the low-income context of African states widely value the ability to access goods at lower cost, numerous studies suggest that Chinese products are viewed as hastily made with lower quality materials (Morgan, 2019; Muposhi et al., 2018). Of course, individual-level proximity to Chinese FDI would be less likely to shape product reviews for China's bigger, well-known firms. Reviews of Transsion smart phones, for example, are unlikely to differ with greater or lesser proximity to a Transsion service provider, as residents in all local-

ities have access to the products. Yet, given the increasing number of smaller Chinese businesses providing products and services in Africa, we expect that the attractiveness of a China model of development may now be especially informed by the quality and price of products produced and sold in local markets proximate to where one lives. Relatedly, views of the China model may be informed by the extent to which Chinese firms are seen as undercutting local competition (Selormey, 2020). These interests and concerns are most likely to arise in proximity to Chinese manufacturing and service projects.

Views of the attractiveness of a China model of development may also be shaped by Chinese investment in and exploitation of local land and resources. Since the outset of African independence from European colonial rule, African leaders such as Kwame Nkrumah have underscored the region's tenuous grasp on its own abundant natural resources (Nkrumah, 1961). Ethnic identities in Africa are also often associated with geographic homelands (Bates, 2008; Michalopoulos & Papaioannou, 2013), reinforcing a sense of pride in local lands and a fear of identity deconstruction when those lands are made available to outsiders for commercial purposes. Chinese FDI projects in the resource sector—where firms may extract raw commodities as well as gain ownership over commercially viable agriculture and resource lands (Zafar, 2007)—are particularly likely to generate concerns of exploitation (Antwi-Boateng, 2017). One may thus anticipate that for those living in proximity to Chinese resource-sector FDI, the prospect of jobs may be enticing, but the threat to control over local lands may undermine China's image and the attractiveness of a China model of development.

Third, views of the China model may be driven by benefits associated with development. People living close to Chinese development projects such as manufacturing factories are more likely to reap the benefits from their proximity. Thus, for these residents, Chinese investment is likely to contribute to a positive image of China and the China model. In addition, major infrastructure projects such as roads and bridges are likely more extensive in proximity to Chinese firms' manufacturing centers, facilitating the transport of citizens' own goods to market.² Nearby residents certainly notice those economic activities and benefit from them indirectly, in terms of improved local transit options. Thus, to the extent that local residents in Africa maintain a positive image of China and the China model, infrastructure development is likely another cause. Furthermore, we anticipate that the positive effects of infrastructure development would be most obvious in proximity to manufacturing and perhaps resource projects, where improved roads would be especially important to those firms' success and thus more likely to be undertaken.

Finally, the effects of proximity to Chinese FDI projects on views regarding a China model of development in Africa may work through a cultural mechanism. Batchelor and Zhang (2017) note that cultural diplomacy is a longstanding feature of Chinese overseas engagement that can pay dividends for cooperation and acceptance. Xing et al. (2016) cite cultural similarities between Chinese and African traditions that can reinforce positive perceptions as exposure increases. Furthermore, despite potential concerns regarding the quality of Chinese products, proximity to Chinese businesses and entrepreneurs may inspire a local appreciation for economic dynamism and resourcefulness, following decades of more measured Western influence (Sautman & Yan, 2009). We might expect these cultural features to reflect positively on a China model of development particularly in proximity to service sector projects, though we note that exposure to the adverse

¹ An exception is Chen et al. (2018).

² We note that major infrastructure projects are frequently supported by Chinese foreign aid rather than FDI.

consequences of Chinese FDI, as well as potential racial discrimination, may offset cultural affinity for the Chinese.

Our claims suggest that perceptions of China's development model in Africa should be driven not by cultural differences or by macro-level messaging about China's expansion, but instead by individuals' own experiences with various types of nearby Chinese businesses. We recognize that Africans may interpret a China model of development in different ways, some focusing on local job creation, others treating Chinese FDI as a proxy for China's broader presence in their countries, and still others evaluating Chinese investment as an alternative development framework distinct from Western approaches. We suggest that the findings of this study may shed light on that very question. In any case, we stress that individuals are most likely to evaluate development models and the local presence of foreign powers based on the changes they experience around them. We argue that those experiences likely differ based on the type of Chinese FDI project to which one is exposed.

3. Data and empirical strategy

3.1. Data

To determine the effects of proximity to Chinese FDI projects on views of the China model in Africa, we connect data from the *fDi Markets* database to public opinion data from the Afrobarometer surveys.

The Financial Times' *fDi Markets* data records over 30,000 foreign direct investment projects from around the world. We limit the dataset to Chinese FDI projects in Africa, given that the purpose of this study is to understand the effects of rising Chinese investment on Africans' views of China. We then discarded cases in countries for which we have no public opinion data, which limits the study environment to 21 countries.³ Next, we used location information gleaned from English, French, and Chinese language media reports on the projects, along with longitude and latitude information in Google Maps, to geolocate those projects in space. To account for the precision of those geolocations, we developed a precision coding scheme that approximates the 8-point scheme used by the AidData lab for foreign aid projects, where 1 represents an exact location and 2 represents a location "in the area of" or within 25 km of an exact location.⁴ We dropped the 146 projects for which we could not identify the location with at least a precision code of 2. In addition, we added a code of 9 to the precision coding scheme that represents projects located in an exactly georeferenced industrial zone but for which we could not locate the specific project location within that zone; these projects, in addition to those with precision codes 1 or 2, are included in the dataset. We determined the operational year of projects from media reports.

In total, the dataset includes 200 FDI projects in the 21 countries. As Fig. A1 in the Appendix illustrates, projects that were excluded due to imprecise geolocations do not differ notably from the precisely located ones in terms of observable characteristics such as the sector, state- versus private-owned status, and year of establishment, giving us confidence that those projects do not differ from the included ones in ways that might correlate with the outcomes of interest.⁵ We acknowledge potential shortcomings

³ The *fDi Markets* database includes 438 new investment projects from mainland Chinese firms in 26 African countries. In addition to dropping data from the five countries for which we do not have public opinion data, we expanded the dataset to include cases

⁴ See Table A1 in the Appendix for details on all codes in the precision coding scheme.

⁵ The only observed difference is that precisely located projects are somewhat more likely to be small-scale, which is no surprise given that many such projects are storefronts with readily available geocoordinates.

in any dataset that relies on media sources, though we stress the extensive nature of the dataset beyond the *Financial Times*' own reporting, as well as its use in other studies (e.g., Owen, 2019). We prefer the *fDi Markets* data over other potential sources because we wish to focus on greenfield investments in new physical facilities rather than mergers and acquisitions, given our interest in African citizens' reactions to new Chinese projects in their communities.

To evaluate expectations regarding the type of projects located in respondents' communities, we further code the FDI projects by sector. In addition to information on the size, investing enterprise, and general location of projects, the *fDi Markets* database classifies projects as belonging to one of approximately 30 different project types, such as beverages, consumer electronics, renewable energy, and real estate. We group those project types into three sectors: manufacturing, resources, and service. See Table A2 for details on the classification scheme. In total, 39.5 percent of Chinese FDI projects in our dataset fall under manufacturing, 14 percent are resource projects, and 46.5 percent are classified as service sector projects. Table A3 shows the type of projects by country, and, for illustrative purposes, Table A4 offers a list of representative projects in our 21 countries.

To measure the perceptions of those who live in proximity to Chinese FDI projects in Africa, we rely on data from the Afrobarometer public opinion surveys. The Afrobarometer now includes seven rounds of nationally representative data collected every two to three years since 1999. Not all survey questions are posed in each round, and to measure views of a China model of development, we are limited to the Round 6 data from 2014 to 2015, which includes 35,951 respondents in the 21 different countries for which we also have data on Chinese FDI (Afrobarometer, 2016). Despite the inability to track attitudes over time, we view the existence of Round 6 data pertaining to the China model as fortuitous, coming at a time when FDI from Chinese firms in Africa was increasing markedly but prior to the intensification of political-economic disputes between China and the United States that may have introduced new concerns for survey respondents. Nevertheless, given that the data are cross-sectional and that we do not have public opinion data from all countries in which Chinese investment projects are located, we caution against generalizing the findings to all African countries or to all time periods. See Fig. 1 for a mapping of the locations.

The main outcome of interest is the respondent's perception of a China model of development.⁶ We rely on a survey question that asks respondents which country, if any, would be the best model of development for their own country. Respondents are offered several choices including China, the United States, and former colonial powers; we code the variable as a dummy indicating the selection of China as the best model for development. Irrespective of respondents' underlying interpretation, we view the question as sufficiently clear to determine how proximity to Chinese FDI projects affects views of a China model of development. In this paper, we do not evaluate the factors that determine support for other countries' models of development in Africa; the objective is only to determine how proximity to Chinese investment affects views of the China model. Fig. A2 shows support for the China model of development by country.

We also include a secondary dependent variable, based on responses to the following question: "In general, do you think that China's economic and political influence in [respondent's country] is mostly positive or mostly negative, or haven't you heard enough to say"? The variable is coded on a five-scale, where 1 = very negative and 5 = very positive. We present results for this outcome variable both in its ordinal form and as a dichotomous variable,

⁶ See Table A5 for details on the coding of all variables.

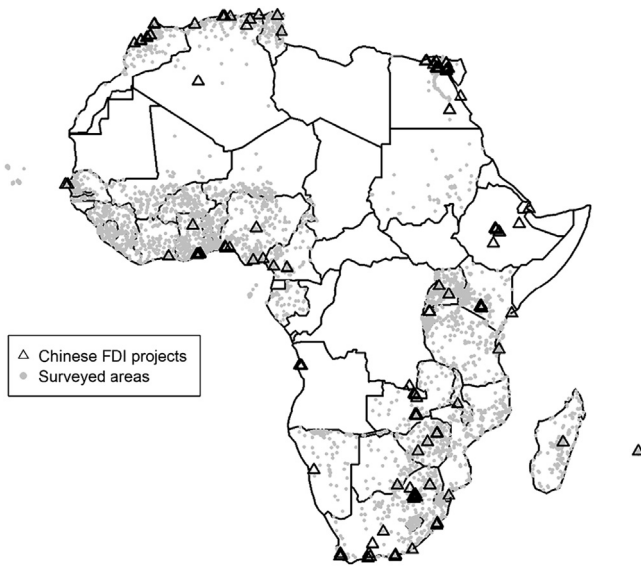


Fig. 1. Locations of Chinese FDI and Surveyed Areas in the Round 6 Afrobarometer.

coded 1 for responses of “somewhat positive” and “very positive” and 0 otherwise.

To further evaluate the mechanisms behind respondents’ views, we exploit questions that ask which factors contribute most to China’s positive image and to its negative image. Options regarding China’s positive image include 1) China’s local business investment, 2) China’s investment in infrastructure or other development in [respondent’s country], 3) the cost of Chinese products, and 4) an appreciation of the Chinese people, culture and language.⁷ We code respondents’ selection of each reason as a discrete dichotomous variable. Reasons for China’s negative image include 1) Chinese economic activities taking jobs or business from [respondent’s country], 2) land grabbing by Chinese individuals or businesses, 3) China’s extraction of resources from Africa, 4) the quality of Chinese products, and 5) the behavior of Chinese citizens in [respondent’s country]; we again treat each explanation as a discrete, dichotomous outcome.

3.2. Empirical strategy

First, we determine the proximity of respondents to Chinese FDI projects. Afrobarometer respondents are geolocated by enumeration area, typically representing a small village or a neighborhood in urban areas. Having generated geolocations for the Chinese FDI projects, we code respondents as living in proximity to one such project if a project falls within a given spatial radius of the enumeration area. We conduct analyses using radii of both 25 km and 50 km, measuring from the centroid coordinate of the enumeration area.⁸

Next, we wish to evaluate the effects of proximity to Chinese FDI projects while accounting for the potential nonrandom location of those projects that could correlate with views of the China

⁷ Additional options include China’s support for [respondent’s country] in international affairs and China’s policy of non-interference in the internal affairs of African countries. We do not evaluate the effects of proximity to Chinese FDI on those outcomes as the study focuses on local development-related concerns.

⁸ For sector-specific analyses, we code respondents’ proximity based on the presence or absence of a nearby project of that type, irrespective of co-location with other types of Chinese FDI. We do this both for theoretical reasons, as we do not expect proximity to one type of project to significantly alter the effects of another type of project, and because too few respondents live proximate to one exclusive type of project to allow for effective analyses.

model. For that reason, a simple comparison of respondents located near Chinese investment and those far away from such investment would be insufficient. Instead, we code the operational year of Chinese FDI projects in our dataset, which ranges from 2003 to the present. If, at the time of the Round 6 Afrobarometer survey in 2014–2015, a project was operational, we code respondents living within 25 km (or 50 km) of that project as geographically proximate to an *active* Chinese FDI project, noting the project sector as manufacturing, resource, or service. If, on the other hand, a Round 6 respondent is located in proximity to an eventual project location but where no project yet exists, we code the respondent as proximate to an *eventual* project.

Given that eventual sites represent the locations of future or announced projects, this comparison mitigates potential threats to inference that could come from comparing outcomes across locations that differ in both their suitability for Chinese investment and, perhaps, their residents’ perceptions of the China model of development.⁹ This approach follows numerous studies that evaluate the effects of proximity to both foreign aid and FDI projects in low-income countries (Brazys & Kotsadam, 2020; Isaksson & Kotsadam, 2018a; Knutsen et al., 2017). We further illustrate, in Fig. A3, that the sample is balanced on individual-level covariates across the categories of respondents close to active projects, eventual projects, and not close to any project, with the exception that those close to both active and eventual FDI projects tend to reside in more urban locations. This is to be expected given that many service and manufacturing sector projects locate in urban and peri-urban areas. Table A6 reports the number of survey respondents proximate to active projects, eventual projects, and not close to any Chinese FDI project for all included countries.

We estimate the effects of proximity to Chinese FDI projects using OLS regressions to facilitate interpretation.¹⁰ The baseline model takes the form

$$Y_{iv} = \beta_1 Active_i + \beta_2 Eventual_i + \lambda X_i + \alpha_c + \epsilon_i$$

where Y is the outcome of interest for individual i living in enumeration area v . *Active* is a dichotomous variable representing proximity to a Chinese FDI project that is operational at the time of the survey respondent’s participation in the Round 6 survey. As the date of project implementation is recorded only by year with no information on the month or day, we conservatively record respondents as proximate to an active project only if the project was operational in the year prior to the commencement of the Round 6 survey within individual i ’s country. *Eventual* is a dichotomous variable representing proximity to an eventual project that does not yet exist. We include a vector (X_i) of individual controls that includes age, age squared, gender, and education.¹¹ Analyses also include country fixed effects and standard errors clustered at the enumeration area level.

The key estimand is the difference in β_1 and β_2 ; that is, in the effect of living proximate to an active Chinese FDI project versus living near an eventual Chinese FDI project. In the results tables that follow, we thus begin by presenting the effects of proximity to active projects and eventual projects for each outcome of interest, using those respondents not close to any project as the base-

⁹ This approach assumes that perceptions in eventual locations are similar to (or can serve as counterfactuals for) perceptions in active places, aside from not having Chinese FDI. The assumption could be violated in two obvious ways. First, in an extreme case, active cases could be almost entirely in one sector and eventual ones in a different sector. Our analyses by sector help to mitigate this concern, as we compare active and eventual in the same sector. Second, a location may change due to unobserved time-varying factors. We conduct analyses with narrower timeframes to address this possible concern.

¹⁰ See Freedman (2008).

¹¹ Education is coded on a ten-point scale in Round 6 from no formal education to post-graduate.

line. We then present the statistical difference in the proximity effects of active and eventual projects ($\beta_1 - \beta_2$), noting the p-values of those differenced outcomes.¹²

4. Results

Table 1 presents descriptive statistics for the survey respondents. Approximately 14 percent of respondents from the Afrobarometer Round 6 surveys live within 50 km of an active Chinese FDI project. Overall, close to one-quarter of respondents (24.4 percent) view China as the best model of development for the future of their country. Respondents have a mean age of 37 years and an average education level of just above primary school completion, suggesting that the sample is not biased toward better educated areas or individual respondents.

4.1. Perceptions of the attractiveness of a China model of development

We present the results for our primary analyses regarding perceptions of a China model of development in Table 2. Column 1 reports results for perceptions of the China model as the best model for the future development of the respondent's country, with the key independent variable of proximity to Chinese FDI measured using 25 km buffers. In Columns 2 and 3, the dependent variable is the degree to which respondents view China's economic and political influence in positive terms, in ordinal and dummy form, respectively. We repeat those analyses in Columns 4 through 6 using buffers of 50 km.

The results suggest that, rather than bolstering views of a China model of development, proximity to Chinese FDI projects results in weaker support for a China model. Using radii of both 25 km (Column 1) and 50 km (Column 4), the coefficients on *Active* are negative, while the coefficients on *Eventual* are larger and positive; these results indicate that respondents living near eventual project locations hold optimistic views of the China model, but when nearby projects are actually operational, the optimism vanishes. Indeed, the difference in responses between those living near active FDI projects and those living near eventual FDI locations (that is, the *Active-Eventual* difference) is negative and statistically significant, with p-values of 0.006 (for 25 km buffers) and 0.000 (for 50 km buffers). The differences indicate that living within 50 km of an active Chinese FDI site makes respondents about 4.5 percentage points less likely than those living near eventual project locations to view the China model as the best option for their own country, holding other factors constant. Considering that, on average, 24.4 percent of respondents view China as the best model of development, this drop in support among those living near an operational Chinese FDI project is equivalent to an 18 percent decrease.

As Columns 2, 3, 5, and 6 of Table 2 indicate, proximity to Chinese FDI projects is also not a significant predictor of perceptions that China's economic and political influence is positive; all of the (*Active-Eventual*) differences are negative, though none are sta-

¹² We noted that some countries only have observations on *Active* or *Eventual*. By using the sample from all countries, we rely on model extrapolation, assuming that the estimated relationships hold in countries with no observations in a particular category. Alternatively, we could restrict the sample to the 9 countries that have observations in all categories (using 25km buffers). While avoiding model extrapolation, this approach also jettisons potentially useful information, as countries with observations on *Active* but not *Eventual* will be discarded. As a robustness check, we report results using the restricted sample.

tistically significant.¹³ Together, the findings do not bode well for China if an objective of expansive Chinese commercial activity in Africa is to bolster the appeal of a China model of development.

The analyses in Table 2 apply buffers of 25 km and 50 km to determine proximity to Chinese FDI projects; these distances are consistent with other studies that evaluate the proximity effects of FDI and foreign aid projects (Brazys & Kotsadam, 2020; Isaksson & Kotsadam, 2018a; Knutsen et al., 2017). In Fig. 2, we further illustrate the relationship between proximity to Chinese FDI projects and perceptions of the China model as the best option for development using variable distances up to 200 km. We establish spatial windows every 25 km up to 200 km, and we run the same analyses controlling for individual-level demographic factors and including country fixed effects, with standard errors clustered at the enumeration area level. We then plot the *Active-Eventual* difference. This analysis confirms the patterns presented in the regression table: at closer proximity, those living near active project locations are notably less likely to favor a China model than are those living near eventual project locations, resulting in point estimates significantly below the zero line. As the distance increases to include respondents further away from project locations, the results attenuate to zero as anticipated, though support for a China model remains lower among those living near active Chinese FDI projects for distances up to 75 km.

4.2. Sector-specific effects

To better understand the mechanisms behind respondents' skepticism of the China model, and to explore patterns in the effects of proximity to particular types of Chinese FDI projects, we next conduct analyses by project sector. If our theory that direct exposure to FDI projects shapes perceptions of the China model is correct, then projects with different impacts on community members might elicit different responses. We begin by replicating the models that evaluate the determinants of support for the China model and of a positive image of China, only this time disaggregated by sector type. We then consider how proximity to different types of Chinese FDI correlates with different explanations for the two sides of Chinese commercial activity in respondents' communities.

Analyses of support for the China model and of China's positive image among respondents living proximate to manufacturing projects, resource projects, and service projects are reported in Appendix Tables B1–B3, respectively. Focusing on the *Active-Eventual* difference, we find evidence consistent with the pooled findings: respondents living in proximity to all three project types are significantly less likely to view the China model as the best model of development for their country, and their views of China's economic and political image remain ambiguous.

Respondents were also asked what factors they think contribute most to China's positive image and its negative image. In results pooled across project sectors, we find no evidence that any one factor is statistically responsible for China's positive image among respondents: both in proximity to active projects and eventual project locations, the substantive effects of proximity on favorable views of China's business assistance, infrastructure development, cost of products, and culture are all negligible, and the differences

¹³ The crosstab in Table A7 indicates modest correlation between our two outcome variables: among the respondents who call China's model the best for their country, 79 percent also have positive perceptions of China's economic and political influence. Among those who do not choose China as the best model of development, views of China's economic and political influence remain rather positive, a finding in keeping with the generally positive survey evidence of perceptions of China in Africa (Burke, 2007; Ndulo, 2008; Sautman & Yan, 2009). We note that our main dependent variable is measured compositionally, so the choice of one country precludes the choice of others even if the respondent maintains positive views of other countries' influence.

Table 1
Descriptive statistics.

Variables	N	Mean	St.Dev.	Min	Pctl_25	Pctl_75	Max
Close to active Chinese FDI (25 km)	35,951	0.106	0.308	0.000	0.000	0.000	1.000
Close to eventual Chinese FDI (25 km)	35,951	0.101	0.301	0.000	0.000	0.000	1.000
Close to active Chinese FDI (50 km)	35,951	0.138	0.345	0.000	0.000	0.000	1.000
Close to eventual Chinese FDI (50 km)	35,951	0.128	0.334	0.000	0.000	0.000	1.000
China as the best model of development	35,938	0.244	0.429	0.000	0.000	0.000	1.000
China's image (dummy)	35,934	0.579	0.494	0.000	0.000	1.000	1.000
China's image (ordinal)	30,725	3.625	1.240	1.000	3.000	5.000	5.000
China's business investment	35,942	0.191	0.393	0.000	0.000	0.000	1.000
Investment in infrastructure/development	35,942	0.264	0.441	0.000	0.000	1.000	1.000
The cost of Chinese products	35,942	0.240	0.427	0.000	0.000	0.000	1.000
Chinese people and culture	35,942	0.020	0.141	0.000	0.000	0.000	1.000
China's extraction of resources	35,942	0.104	0.305	0.000	0.000	0.000	1.000
Land grabbing	35,942	0.072	0.259	0.000	0.000	0.000	1.000
Taking jobs or business away	35,942	0.136	0.343	0.000	0.000	0.000	1.000
The quality of Chinese products	35,942	0.393	0.488	0.000	0.000	1.000	1.000
Chinese people's behavior	35,942	0.054	0.225	0.000	0.000	0.000	1.000
Urban	35,951	0.851	0.980	0.000	0.000	2.000	2.000
Age	35,733	37.033	14.332	18.000	26.000	45.000	105.000
Gender	35,951	0.504	0.500	0.000	0.000	1.000	1.000
Education	35,855	3.703	2.104	0.000	2.000	5.000	9.000

Table 2
Chinese FDI and Perceptions of the China Model and China's Image

	Distance buffers: 25 km			Distance buffers: 50 km		
	Best model	Positive image		Best model	Positive image	
	China	Ordinal	Dummy	China	Ordinal	Dummy
Active	(1)	(2)	(3)	(4)	(5)	(6)
	-0.010	-0.046	-0.005	-0.007	-0.006	0.010
	(-1.142)	(-1.529)	(-0.438)	(-0.784)	(-0.216)	(0.992)
Eventual	0.026	-0.025	0.005	0.038	-0.004	0.019
	(2.406)	(-0.876)	(0.418)	(3.750)	(-0.146)	(1.656)
Active-Eventual	-0.036	-0.020	-0.010	-0.045	-0.002	-0.009
F test: Active-Eventual = 0	7.541	0.282	0.421	13.001	0.002	0.377
p value	0.006	0.595	0.516	0.000	0.966	0.539
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of countries	21	21	21	21	21	21
Number of enumeration areas	4773	4759	4773	4773	4759	4773
Number of observations	35,627	30,542	35,623	35,627	30,542	35,623
Adjusted R squared	0.049	0.130	0.101	0.050	0.130	0.101

Note: All models include individual controls of urban, age, age squared, gender, and education. We report t-statistics in parentheses. Standard errors are clustered at the survey enumeration level.

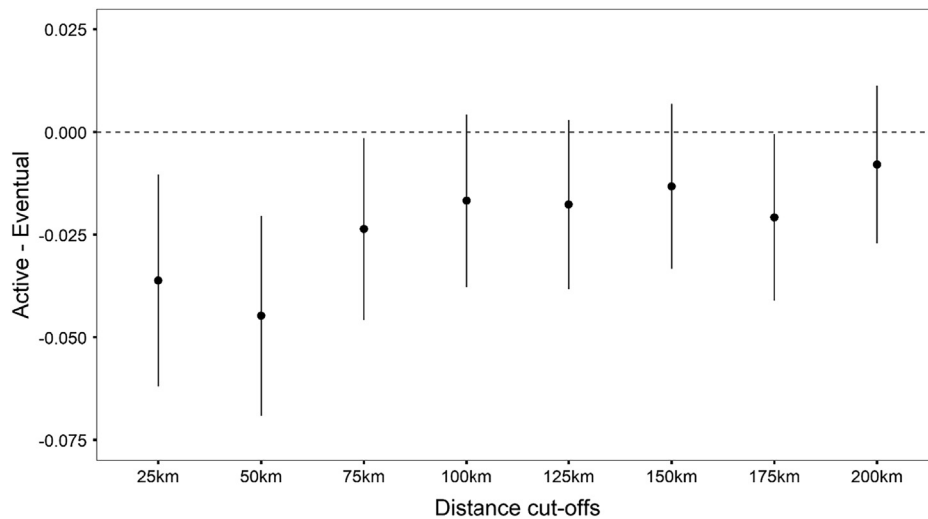


Fig. 2. Chinese FDI and Perceptions of the China Model: Effects by Distance Note: Effects are estimated using datasets with distance buffers at 25 km, 50 km, 75 km, 100 km, 125 km, 150 km, 175 km, and 200 km. The differences between Active and Eventual are plotted with 95% confidence intervals. All models include individual controls and country fixed effects. Standard errors are clustered at the survey enumeration level.

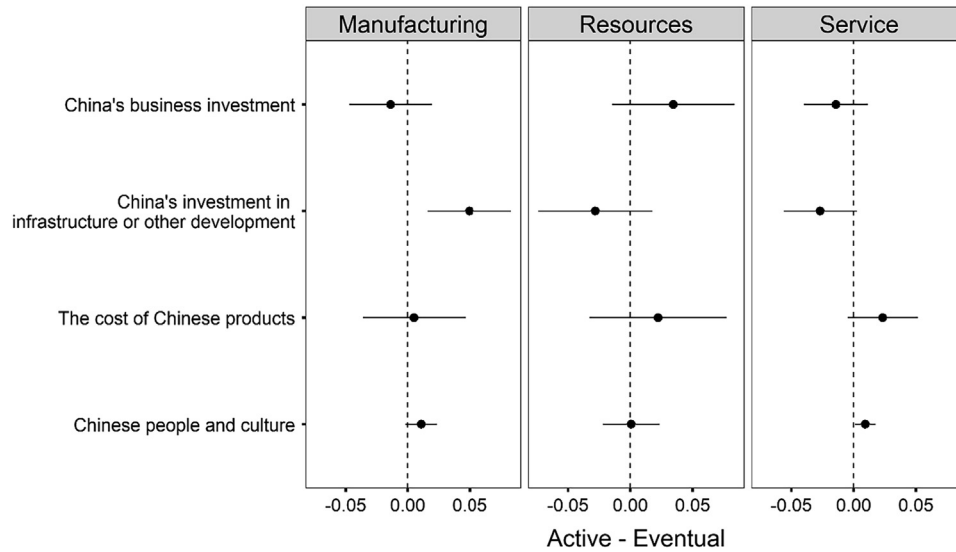


Fig. 3. Factors Contributing Most to China's Positive Image: Results by Sector Note: For each positive factor, the differences between Active and Eventual are plotted with 95% confidence intervals. The results are estimated using the 50 km distance cut-off. Positive estimates mean that respondents are more likely to choose this as the most important factor contributing to China's positive image. All models include individual controls and country fixed effects. Standard errors are clustered at the survey enumeration level.

between respondents who are proximate to active and eventual locations are statistically indistinguishable from zero. See Table C1 for details.

Disaggregating responses based on proximity to different types of Chinese FDI projects tells a more nuanced story. Fig. 3 presents the effects of proximity on each potential explanation for China's positive image, separated by sector type. Regarding Chinese manufacturing projects, those who live in close proximity to active manufacturing sites are significantly more likely to attribute China's positive image to its investment in local infrastructure and development; the *Active-Eventual* difference is positive and statistically significant at both 25 km and 50 km radii (see Table C2 for regression results). This we speculate is a function of the development benefits from Chinese manufacturing investments and the associated road and transit improvements that accompany Chinese manufacturing for the purpose of carrying goods to market. Proximity to resource projects is not statistically related to any particular feature that speaks to China's positive image (see Table C3 for details). In the context of Chinese service projects, conversely, those living near the projects do not emphasize infrastructure development; instead, they are more likely to attribute China's positive image to its people and culture ($p = .028$ using 50 km buffers) and to the affordable cost of Chinese products ($p = .101$ at 50 km buffers; see Table C4).

Respondents also offer nuanced views regarding the reasons for negative images of China in Africa. First, in results pooled across project type, proximity to Chinese FDI correlates statistically with one explanation for China's negative image: the quality of products (see Table D1). That is, respondents who live close to an active Chinese FDI project are statistically more likely than those living near eventual project locations to suggest that, to the extent that people have a negative view of China, it can be attributed to the poor quality of products that Chinese companies bring to market in their country. The difference of 0.043 ($p = .003$) using a 50 km buffer indicates that proximity to an active project makes respondents 4.3 percentage points more likely than their counterparts close to eventual project locations to view the quality of Chinese products as reflecting poorly on China, relative to the baseline of those not close to any project location. Given that, on average, 39.3 percent of respondents view the poor quality of Chinese products as the

factor contributing most to China's negative image, this is equivalent to an 11 percent increase. We note that, in the manner in which the Afrobarometer questions were posed, we are unable to determine whether respondents themselves associate poor quality products with China or whether they interpret the negative aspects of China's image as owing to this factor more broadly, among their compatriots.

In proximity to different types of Chinese FDI projects, views on the causes of China's negative image again differ. As Fig. 4 illustrates, those living near active manufacturing projects are more likely than their counterparts living near eventual manufacturing locations to view product quality as a cause of negative views of China, though they are also less likely to suggest that extraction of resources from Africa is a problem with China's presence (see Table D2 for details). This may be a function of anticipated extractive practices that in fact are less common to the types of manufacturing plants that Chinese firms construct in the region, which often include products such as beverages, medical devices, and packaging. Conversely, those living near Chinese resource projects are more likely to suggest that land grabbing by Chinese businesses or individuals ($p = .090$ using 50 km buffers but significant for 25 km buffers, $p = .015$) and the threat to local jobs ($p = .034$ using 50 km buffers) explain the negative image of China in Africa (see Table D3). This finding is consistent with concerns about a new commercial colonialism in the region, and it suggests that community members in African countries indeed evaluate Chinese investment projects, and China's model of development more broadly, according to the precise impact that those projects have locally. Finally, proximity to active service projects is again associated with greater concerns regarding the quality of Chinese products (Table D4).

A case emblematic of the patterns we see in our analyses is an investment by the China National Offshore Oil Company (CNOOC) in a new drilling and refinery location and associated offices in Hoima, Uganda. Prior to the project's operationalization in 2014, the Ugandan government touted it as an opportunity to "dramatically increase" development in the country.¹⁴ As the project was

¹⁴ See details in the Fortune of Africa report on Uganda: <https://fortuneofafrica.com/ug/oil-and-gas-sector-in-uganda/>.

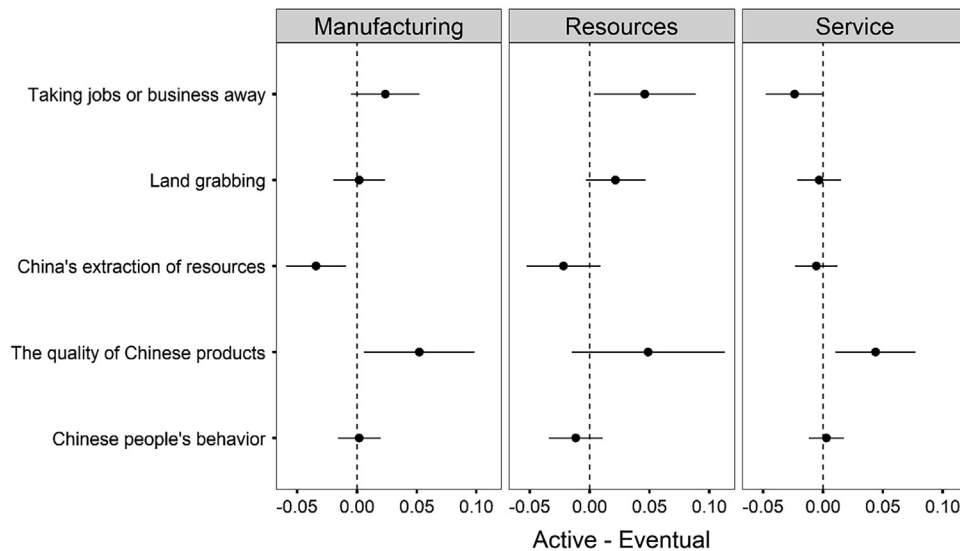


Fig. 4. Factors Contributing Most to China's Negative Image: Results by Sector *Note:* For each negative factor, the differences between Active and Eventual are plotted with 95% confidence intervals. The results are estimated using the 50 km distance cut-off. Positive estimates mean that respondents are more likely to choose this as the most important factor contributing to China's negative image. All models include individual controls and country fixed effects. Standard errors are clustered at the survey enumeration level.

implemented, however, residents of 13 nearby villages had their lands seized to accommodate the refinery, with compensation falling short of agreed upon rates (Musisi, 2015). Widespread frustration followed, and in our dataset, just 12.5 percent of nearby residents surveyed a year later expressed support for the China model as the best model of development for their country.

4.3. Robustness tests

The sector-specific findings above highlight the extent to which African respondents evaluate the China model of development as a function of the specific Chinese investment projects in their local communities. We explore the robustness of the findings through a series of additional tests.

First, we run models using subnational, ADM1 fixed effects rather than country fixed effects to account for potential patterns across regions within the included countries. As the results in Table E1 show, the *Active-Eventual* difference in preferences for a China model of development remains negative and statistically significant.

Next, to reinforce the identification strategy, we restrict the timeframes within which respondents can be classified as living proximate to an active or eventual Chinese FDI project. Our baseline dataset connects respondents from the Round 6 Afrobarometer survey in 2014–2015 to active or eventual Chinese FDI projects from 2003 to 2018. However, enumeration areas may change in systematic ways over that time period, as might the characteristics of projects that locate in them. Indeed, as Fig. E1 in the Appendix illustrates, more recent projects are more likely to be in the service sector and initiated by private firms as opposed to state-owned ones. We thus employ tighter temporal windows to improve inferences regarding the causal impact of projects in respondents' communities. Tables E2–E5 in the Appendix present the results with samples restricted to within four years, three years, two years, and one year, respectively. Despite the reduction in sample sizes, proximity to Chinese FDI projects—again measured as the difference between the effects of proximity to active and eventual projects—remains a statistically significant predictor of weaker support for the China model using 50 km buffers all the way down to windows of two years. The relatively small sample size in the

one-year window increases the standard errors to the point that the *Actual-Eventual* difference is no longer statistically significant, though the estimate remains substantively consistent.

Third, we restrict the analyses to the nine countries (using 25 km buffers) and seven countries (using 50 km buffers) in which projects can be located within those distances of respondents in both the active and eventual stages.¹⁵ Doing so addresses the concern that the main findings rely on modeled extrapolations that potentially mask heterogeneous effects of operational Chinese FDI projects across countries. The results, presented in Table E6, indicate that—despite a sample size of approximately half the original—the *Active-Eventual* difference remains negative and statistically significant at the 50 km spatial buffer for support for a China model of development. Additionally, rather than using those not close to a Chinese FDI project at any stage as the baseline category, we exclude all respondents not close to any project, thus comparing those living close to active projects against a baseline of those proximate to eventual project locations. Again the sample size is severely restricted, but the coefficients on support for the China model remain negative and statistically significant. See Table E7.

We also run the analyses separately for projects in capital city regions, which comprise about 40 percent of the total, and in rural regions, in order to ensure that the results are not driven by big-city respondents. As Table E8 shows, the results are actually somewhat weaker both substantively and statistically in capital city regions, though proximity to Chinese FDI undermines support for a China model of development in both settings.

Next, we surmise that the findings may be driven in particular by younger respondents, who may be more likely to experience both the positive and negative views of Chinese FDI as they seek jobs and make greater use of new technologies and services. Thus, in Tables E9–E14 we analyze the explanations for positive and negative views of China by age category. The results indicate that proximity to Chinese FDI does not make younger respondents aged 18–28 particularly inclined to cite any one reason for China's pos-

¹⁵ With wider buffers, two countries lose observations on eventual locations as more observations are now coded as active. Once a respondent is close to at least one active project, it is coded as active even if the respondent is simultaneously close to other eventual projects

itive image. Among respondents aged 29–41, conversely, proximity to Chinese FDI correlates significantly with excitement over the lower cost of Chinese products. On the other hand, among both the younger age category and those aged 29–41, respondents who live in proximity to Chinese FDI are significantly more likely to cite the poor quality of Chinese products as a detriment to China’s image.

Additionally, we replicate the main analysis using other foreign powers’ economic models as the dependent variable. The findings, presented in Table E15, are noteworthy: support for the U.S. model of development remains unchanged in proximity to Chinese FDI, and the decline in support for the China model is offset by a rise in support for the former colonial power. We take this finding as suggestive of the possibility that respondents pine for the foreign power they know best when confronted with economic involvement from a new major player. The results also provide reassurance that popular reactions to nearby Chinese FDI are reasoned rather than arbitrary.

Finally, we conduct a placebo test to further gauge the robustness of the relationship. Using a randomization inference, we randomize respondents’ status as proximate to active or eventual Chinese FDI projects, while maintaining the same ratio as in our original dataset. The idea is to create counterfactuals in which the timing of projects could have been different, such that, for example, respondents close to eventual projects could have instead been close to active projects, with some probability. We then calculate the *Active-Eventual* difference to generate one placebo effect, and we repeat the process 5,000 times. Next, we compare the observed effect to those placebo effects—which should have a distribution centered around zero—to determine whether proximity to active projects indeed reduces support for the China model. The outcome, shown in Fig. 5, confirms that the negative effect of proximity to active Chinese FDI projects on views of the China model of development falls well outside the range of effects generated randomly.

5. Conclusion

Chinese FDI projects are increasingly making footprints in African communities, emblemizing a China model of development for those who live nearby. In this paper, we consider how proximity to those projects reshapes Africans’ views of the China model. Research to this point has focused primarily on the macro-level consequences of outward investment from Chinese firms, but much less is known about its micro-level effects.

To evaluate this relationship, we geolocate Chinese FDI projects in Africa and merge those data with georeferenced public opinion data. Doing so allows us to spatially connect over 35,000 survey respondents to 200 Chinese investment projects. To mitigate concerns regarding the potential nonrandom location of Chinese investment, we rely on variation in the start dates of FDI projects to categorize respondents as living near an active Chinese project, an eventual one, or no Chinese FDI at any stage. By comparing the difference in effects between those who live near an operational project and those who live near a project site that will eventually host Chinese investment but that does not at the time of the survey, we are able to determine the extent to which proximity to Chinese FDI changes local residents’ outlook on the China model while accounting for time invariant factors that may correlate with both the selection of investment sites and, potentially, views about China.

The results indicate that, for whatever benefits Chinese investment may generate at the macro or national levels, such investment does not appear to boost support among Africans for China’s approach to development. We find that proximity to active

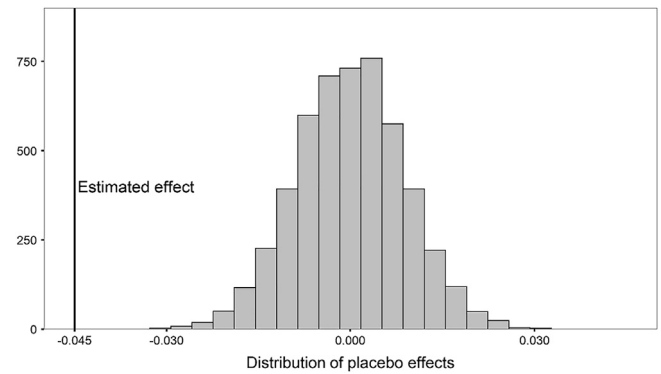


Fig. 5. Chinese FDI and Perceptions of the China Model: Randomization Inference
 Note: The randomization inference is conducted using the dataset with a 50 km distance cut-off. For respondents who are close to active or eventual Chinese FDI, we randomize their status as proximate to active or eventual projects using the same ratio as in the original dataset. For each placebo dataset, we have 4957 respondents randomly assigned as active and the remaining 4596 as eventual. Respondents who are not close to Chinese FDI are the same from the original dataset. As the main analysis, we calculate the differences between Active and Eventual to get the placebo effects. The process is repeated 5000 times. We plot the true estimated effect together with the distribution of 5000 placebo effects.

Chinese FDI projects results in an 18 percent decline in support for the China model compared to those who live near eventual project locations, and the results persist up to distances of approximately 75 km. Furthermore, the findings underscore the importance that community members in Africa place on the local costs and benefits that they experience due to Chinese investment: respondents living near manufacturing projects view infrastructure development as a positive contribution from the Chinese; those living near service projects appreciate the cultural exchange with Chinese entrepreneurs and staff but lament the poor quality of Chinese products on the market; and those living near resource-related projects express concerns about Chinese land grabs and job threats. These results run counter to broader narratives suggesting more uniformly positive or negative reactions to Chinese FDI and the China model in Africa (Sautman & Yan, 2009). We note further that respondents have relatively positive views of the China model in proximity to eventual project locations, but once projects are operational, that excitement dissipates, and the nuanced effects of particular project types shape their evaluation of China’s image.

These findings contribute to numerous literatures. Regarding the literature on China’s presence in Africa, this study looks beyond China’s own motivation and the national-level consequences for African states to instead consider the consequences of Chinese investment for the community members living near Chinese projects. To the set of studies that evaluates micro-level preferences in Africa, our paper explores an outcome—support for a China model of development—that has important political and economic implications but which remains understudied, particularly in terms of the proximity effects of Chinese investment projects. Regarding the literature on FDI as a political economic strategy, the results shed important light on the variation in popular reactions to FDI, demonstrating that those reactions may shift as a function of the particular type of project that locates in a community.

Beyond its contributions to the literature, the study has important implications for political decision-making in Africa. Chinese firms are poised to continue expanding their investment in African communities (Jayaram et al., 2017), and to this point many African leaders have welcomed those investments, tacitly or explicitly endorsing a China model of development in the process. What this study suggests is that the embrace of Chinese investment may

eventually prove costly in terms of political support for African leaders. At a minimum, political decision-makers may learn to exercise greater measures to combat the adverse popular effects of particular types of Chinese investment, even as they facilitate the positive aspects of Chinese manufacturing, resource, and service projects.

Future research might build on these findings in numerous ways. We encourage additional studies that exploit the precise geolocation of Chinese FDI projects to evaluate other related outcomes, and indeed to similarly study the effects of precisely geolocated investment from other countries. Studies might also examine more closely the mechanisms underpinning support for or rejection of the China model in Africa; we speculate that attitudes differ depending on the particular type of project located in a community, and we provide suggestive evidence in support of this claim, but future studies could be designed precisely with this objective in mind. Finally, as Chinese investment to Africa continues over time, researchers may be in position to determine how skepticism of the China model impacts economic and foreign policy decisions in countries receiving Chinese FDI.

CRedit authorship contribution statement

John F. McCauley: Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Supervision. **Margaret M. Pearson:** Conceptualization, Resources, Writing – review & editing, Funding acquisition. **Xiaonan Wang:** Conceptualization, Methodology, Data curation, Writing – review & editing.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.worlddev.2021.105738>.

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