Welfare Gains from Chinese Transport Infrastructure

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Abstract

Do Chinese aid projects contribute to human development outcomes in recipient countries? I empirically examine this question in the context of Cambodia. I investigate micro-level outcomes most likely to vary due to the large presence of Chinese projects in the infrastructure sector: long-term wealth, changes in time needed to reach drinkable water and whether distance is an issue to access proper healthcare. To do so, I use geo-referenced project data combined with demographic information from several waves of Demographic Health Surveys. Relying on innovative Difference-in-difference methods that takes heterogeneity of treatment-timing into account, I compute the average and dynamic treatment effects as well as their heterogeneity.

1 Introduction

"Without Chinese Aid, we go nowhere" argued in 2016 the spokesman of Cambodia's Council of Ministers. The size of China's presence in Cambodia is indeed dizzying. Its tentacular grip - development finance, FDI, exchange programs, military cooperation - prompted French geographer Emmanuel Véron to describe Cambodia as China's "client state" (Pedroletti, 2023). Figures of development finance[1] are particularly telling: over the 2000-2014 period, Cambodia was the largest receiver in number of Chinese projects and the second largest receiver of infrastructure projects [2]. Thus illustrating a key focus of China's outward development program and the priority set by the Cambodian government, China's presence has mostly benefited Cambodia's physical infrastructure and connectivity development (Sok, 2019; Vathanak, 2021).

Such infrastructure tend to be under-financed in developing countries[3], despite their critical role for development (OECD, 2013; Rostow, 1960). Theoretically, their positive macroeconomic impact on economic growth and trade through lower transportation costs are well known; they also play an important role in the spatial distribution of economic activity and population (Krugman, 1991; Weber, 1929). These gains have been investigated empirically over multiple countries in the case of Chinese-financed infrastructure[4] (Baniya et al., 2020; Bluhm et al., 2018; Villafuerte, Corong, & Zhuang, 2016; Xu et al., 2020; Zhai, 2018). But better transport infrastructure can also have a large influence at the micro level[5] by reducing time-distance and creating new economic opportunities. In developing countries, distance to public goods and services - and time taken to cover said distance - poses indeed crucial challenges of accessibility. This is especially the case in rural areas, where limited access to market places and public infrastructure poses important threats to people well-being. As one telling example, distance to school is a known deterrent of school participation, with heterogeneous effect depending on income level (Frenette, 2006). Long distances further discourage individuals from accessing healthcare in a timely fashion (Thornton, 2008). Illustrating this issue in Zambia, Renard (2022) finds that distance to a health facility plays an important

[1]In this study, I will use the terms Chinese development finance and Chinese aid interchangeably to represent China's overseas development finance flows coming from public actors. All financial flows considered in this analysis are aligned with the OECD's definitions of Official Development Assistance (ODA) and Other Official Finance (OOF), but they do not include official investment. ODA flows have a grant component of at least 25 percent and aims at improving development and welfare of recipient countries, while OOF are financial flows that do not meet either one of these two criterion.

[2]The first country was Sri Lanka. These figures are particularly noticeable given that Cambodia's population is only 16 million (Dreher, Fuchs, Parks, Strange, & Tierney, 2022).

[3]Many reasons could be given, notably the very high cost of such projects and the potential for social and environmental backlash.

[4]According to the World Bank (2019), BRI projects are likely to support trade and decrease poverty. Also focusing on BRI transport projects, Baniya, Rocha, & Ruta (2020) find that BRI projects improve trade flows among BRI countries, with effects at least three times higher when coupled with appropriate trade reforms. In a sample of low- and middle-income countries, Bluhm et al. (2018) find that Chinese infrastructure reduce economic inequalities within (but not between) regions, while Xu, Zhang, & Sun (2020) find the opposite for Africa.

[5]Living close to transport infrastructure has been showed to reduce local unemployment Guo, An, & Jiang (2022), alleviate poverty and increase access to public goods and services (Dreher et al., 2022; Setboonsarng, 2006)

role in the effectiveness of maternal and child health reforms. Reduced time-distance also supports economic activity, by providing better access to markets and information. Highly connected areas have indeed been showed to offer more economic opportunities and benefits to the local population. Hence, better transport infrastructure, because they reduce costs associated to travel notably in terms of time and fees, can increase people's accessibility to crucial welfare-enhancing goods and services as well as economic opportunities (Dreher et al., 2022; Paradowska, 2017).

In this study, I examine the impact of Chinese aid projects on selected Cambodians' socio-economic welfare outcomes[6]. Because the majority of such projects are allocated to infrastructure, I investigate outcomes most likely to vary due to reduced time-distance: time needed to reach drinkable water and time-distance to the nearest health facility. Since better infrastructures support economic development and activity on the long-run, I also look at changes in wealth. To conduct this empirical study at the micro-level, I leverage georeferenced project-data from Aiddata 1.0[7] and combine them with individual-level data from DHS. Indeed, when aid is geographically concentrated or has low financial value, effects can be difficult to detect at the national or ADM1 levels.

Whether Chinese-funded transport infrastructure effectively improve Cambodians' welfare through better accessibility remain uncertain, for several reasons. First, micro-level gains that can be derived from transport infrastructure are far from automatic (OCDE, 2020). The type of transport infrastructure[8], its location and quality are all important determinants of both accessibility and overall micro level benefits [9](OCDE, 2020; Setboonsarng, 2006). Yet, Chinese projects are known to be "demand-driven"[10] which opens procedures to higher risks of political capture by recipient governments[11]. According to Dreher et al. (2022), the key vulnerability is at proposal development stage: projects proposals tend to be prepared by politicians rather than technocrats, giving them much space to ask for projects that further their political goals. Furthermore, and contrary to other DAC donors, China does not systematically enforce due diligence or cost-benefit analysis of project proposals. For these reasons, Chinese projects could be ineffective at improving the well-being of Cambodians, especially when financed with concessional loans[12](Brautigam, 2011; Dreher et al., 2022; Tull, 2006). An illustration of such politically-motivated projects with poor allocation choice can be found in Dreher et al. (2019), which empirically showed the tendency of Chinese projects to go to the birth region of current African leaders; numerous case-studies also support this

[6]Socio-economic welfare is here defined as multi-dimensional measures of living conditions and well-being, both material (income, wealth...) and non-material (health, education, employment prospects...) (Paradowska, 2017).

[7]The latest version of the database at the time this paper is being written. I am currently waiting on the 3.0 version to make use of precise coordinates

[8]the dilemma between high-class roads vs low-class ones illustrates different targets: while high-class roads increase GDP more than low-class roads, they also have a much lower impact on poverty.

[9]"The gains for a given region depend on how many new customers can be reached via the improved transport network. [...] The crucial question is what improvements in accessibility the new infrastructure provides.[...] Accessibility and overall gains also depend on the wider transport network. If the additional infrastructure connects to an existing network with good accessibility or improves access to existing logistic centres, ports or airports, it is more likely to support significant benefits in terms of freight traffic volumes."

[10]contrary to the practices of OECD-DAC agencies.

[11]A tactic aimed at securing China's own political goal through exchange of political favors.

[12]Loans issued at close to market rates are subjected to more rigorous procedures.

phenomenon, with badly targeted projects that do not benefit the local population due to poor location choice or project type[13]. Chinese implementation methods reinforce risks tied to political capture, through quality of infrastructure. Worries are that China builds fast to the point of neglecting appropriate monitoring and evaluation systems Dreher et al. (2022). This further raise the probability of poorly built infrastructure with high maintenance costs, negative environmental spillovers and ultimately low use. Despite such criticisms, Mandon & Woldemichael (2023)' meta analysis find that Chinese aid tend to improve social outcomes in general[14]

Second, the context in which Chinese aid is disbursed is tremendously important. As Deborah Bräutigam puts it, "in the final analysis, the developmental impact of Chinese aid [...] will almost certainly vary country by country and sector by sector. The deciding factor in each case is likely not to be China, but individual [...] countries and their governments." (Brautigam, 2011). This country-heterogeneity was illustrated by BenYishay, Parks, Runfola, & Trichler (2016), which showed that the effect of Chinese infrastructure can be quite different depending on the country studied. They specifically highlight the importance of domestic governance to explain these differences, while Calabrese & Wang (2023) talk about regulatory strength. Similarly, Dreher et al. (2022) discuss how the effect of Chinese aid can range from great success in the case of Tanzania, to misusage and crippling indebtedness in Sri Lanka. As they argue, some countries might be better equipped to manage the afor-mentioned risks tied to Chinese aid[15]. In that regard, Cambodia's highly corrupt environment as well as weak environmental and social regulation[16] put the country at risk. The presence of important strategic interests[17] also means that there are strong incentives for China to exchange project financing for political favors from the Cambodian government. Hence, the aforementioned characteristics of Chinese aid - the "no-strings-attached" policy and overall lack of transparency - combined with an authoritarian and corrupted regime such as Cambodia, could seriously hamper gains in human development outcomes[18].

To my knowledge, this is the first study to look at such micro-level development outcomes from Chinese aid projects. It also contributes to a growing literature on micro-level Chinese aid effectiveness (Isaksson & Kotsadam, 2018; Kotsadam & Tolonen, 2016; Martorano, Metzger, & Sanfilippo, 2020). In term of context, I acknowledge the importance of country-

[13] The case of Chinese-financed projects in Hambantota, Sri Lanka, is a perfect example of such poorly tailored infrastructure project designed for political purpose. Hambantota district was the birth-place of former president of Sri Lanka Mahinda Rajapaksa. He convinced China to support its development plans for the district, with the construction of a deep seaport, a nearby airport, a road from the port to the airport and an expressway from Hambantota to the capital Colombo. The Hambantota airport is now know as "the world's emptiest international airport", the expressway has been showed to be over-priced due to an absence of competitive bidding. Finally, to avoid defecting on its debt, Sri Lanka was forced to grant China a major ownership stake and a 99 lease to operate Hambantota port. For more details, see Dreher et al. (2022), 9:14

[14] Their measure includes country-level HDI, and a selection of household-level health and education level.

[15] As Dreher et al. (2022) puts it, there is a "tension between efficacy and safety" when it comes to Chinese Aid.

[16] Cambodia systematically scores way under average for "regulatory quality", "rule of law" and "control of corruption", 3 dimensions reported in the World Governance Indicator (WGI) of the World Bank. Accessible here: https://info.worldbank.org/governance/wgi/Home/Reports

[17] A more detailed description of Chinese interests in Cambodia will be given in Chapter 2.

[18] Isaksson & Kotsadam (2018) also argued that it could reinforce bad governance, local corruption and poor quality of human rights.

heterogeneity when it comes to Chinese Aid and focus on Cambodia as a relevant case study. Indeed, many papers have been written on the impact of Chinese Aid over multiple countries (Dreher, Fuchs, Parks, Strange, & Tierney, 2021, 2018; Guillon & Mathonnat, 2020), but few have investigated its country heterogeneity despite studies proving its relevance (BenYishay et al., 2016; Calabrese & Wang, 2023; Dreher et al., 2022). Countries differ a great deal when it comes to China's presence: in amount, number and sector of projects but also in the national context, like rule of law and quality of governance. Cambodia, despite receiving both debt and concessional loans in tremendous amount from China, has not managed to attract the attention of many international observers and commentators. As a poor and autocratic country, with strong governance weaknesses, numerous corruption scandals and a striking openness to Chinese financial flows, I argue on the contrary that Cambodia deserves much more attention.

The paper is structured as follows. In Section 2 I introduce the characteristics of China's presence in Cambodia. In Section 3, I present the different sources of data used to construct the final database. My empirical strategy is presented in section 4 and results for aggregate and event-study outcomes are located in Section 5. In Second 5, I present my robustness results as well as my ideas to move this study forward in section 6. I conclude with a summary and a brief discussion in section 7.

2 Sino-Cambodian Development Cooperation

While their relationship goes back to the 13^{th} century, contemporary ties between China and Cambodia truly rekindled in the 1960s[19]. China's presence since grew strong and multifold, with bilateral agreements in almost every sector (Heng & Chheang, 2019). In terms of trade, their relationship experienced the highest growth among neighboring ASEAN countries during the 2000-2010 period. Regarding foreign private investments, Chinese firms largely dominate the investment scene[20], with Chinese state corporations investing "billions of dollars in dams, oilfields, highways, textile operations, and mines" (Burgos & Ear, 2010; Pedroletti, 2023; Pheakdey, 2012).

The role of China as a donor is similarly strong. After 1997, when a military conflict between the two major political sides in Cambodia broke out, traditional donors suspended their aid flows. On the contrary, China extended its full financial support to Hun Sen's political party and has been the largest provider of foreign aid since 2009 (see figures in Figure 2). Most funding is concessional and pin-pointed for large infrastructure projects[21]. China's focus on infrastructure in Cambodia, especially roads and bridges, echoes the government's agenda: the prolonged civil war is mostly responsible for the poor quality of the transport network, with high costs of transport and inadequate supply (Sok, 2019). A hindrance visible

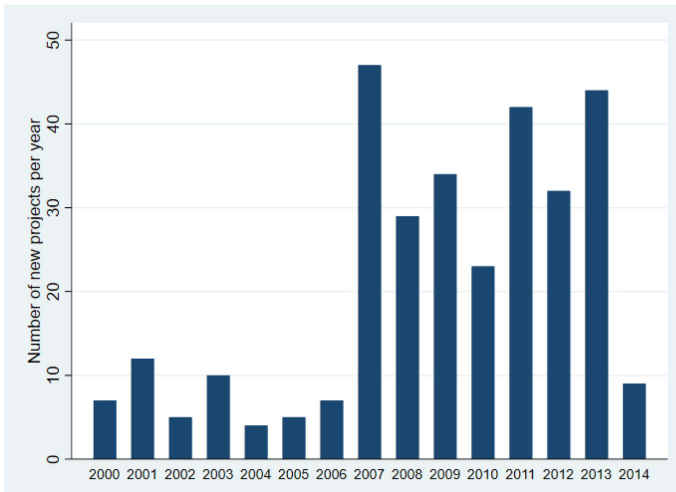
[19] China supported King Sihanouk in the 1960s and then supported the Khmer rouge regime of Pol Pot. While the extent of China's contribution to the Khmer rouge regime is unclear, it could have been as high as 90% of the Khmer's rouge entire foreign aid (Chen, 2018; Mertha, 2017)

[20] An average of 640 million US Dollar per year from 1994 to 2005, and 5.3 billion US Dollar from 2006 to 2010 (for Development of Cambodia, 2012)

[21] Which is somewhat surprising given that most Chinese infrastructure projects are financed through debt rather than concessional loans (Dreher et al., 2022)

at the cross-country level, where Cambodia performs systematically worst than its neighbors in logistics (Calabrese, Borodyna, & Nadin, 2022; Calabrese & Wang, 2023). According to Cambodian transport minister Sun Chanthol, Chinese support would be as high as to represent 70% of all Cambodia's upgraded roads and bridges in 2017 (Retka, 2017). The participation of Cambodia to the BRI since 2016 likely reinforced this trend.

Figure 1: Distribution of all Chinese aid in Cambodia over the 2000-2014 period, in number of projects.



According to Pheakdey (2012), motives for the exceptionally strong presence of China as a donor in Cambodia can be traced along four lines. The main one is political: Cambodia is the strongest ally of China in Southeast Asia (Kha, 2019). It supports the "One China" policy since 1997 and Cambodia's seat at the ASEAN also helps China to shape regional security. Second, Cambodia is a strategic geographic location. The port of Sihanouk province ensure China's access to a route for its exports and energy supply. Third, there are important economic benefits to their relationship: in return for its assistance, Cambodia has granted China privileged access to Chinese public and private investments, in particular in the south of the country - a typical goal of the "Going out" strategy. Moreover, Cambodia possesses important natural resources in crude oil, gas as well as mineral resources and China has been using its aid to facilitate FDI access in these strategic sectors (Burgos & Ear, 2010; of Cambodia, 2008). China also partly relies on Cambodia to outsource its agriculture: from 2000 to 2010, China was the second most important investor in agriculture in Cambodia (for Development of Cambodia, 2006). Finally, China has aimed to expand its cultural influence and values over the country.

3 Data

3.1 Chinese projects

Any empirical study on Chinese aid is confronted to two main issues. First, China does not disclose its official aid figures, leading to a large predominance of anecdotal evidences in studies that investigate Chinese aid (Wang et al., 2016). Second, China is not part of the OECD Development Assistance Committee. As such, its development flows do not meet the OECD-DAC categorizations which makes it difficult to identify real "aid" flows[22] (Strange et al., 2013). Faced with these challenges, research conducted by the Aiddata research lab from the University of William & Mary[23] worked on creating a series of Chinese projects databases. Its systematic, transparent and replicable methodology was first introduced in April 2013 and improved over the years (Bluhm et al., 2018; Strange et al., 2013). Its usefulness notably arises from a categorization based on OECD-DAC definitions, which enhances the comparability between donors [24]. Another major advance is the introduction of geo-referenced information that enabled more analysis at the sub-national level (Martorano et al., 2020).

This paper relies on the Aiddata Chinese Global Development Finance dataset version 1.0[25]. The entire database contains information on 4,373 Chinese development projects, over the 2000 - 2014 period and for a cumulative amount of 354.4 billion US Dollar. The sample used focuses on Cambodian projects, covering 9 sectors (using the OECD Creditor Report System (CSR) purpose codes). Additional available information are geographical locations, type of flows (ODA, OOF or Vague), status of completion, total financial amounts, whether a project is co-financed and start/end dates.

I proceed to some adjustments on the data. First, I only keep projects that are entirely financed by China by excluding projects co-financed with other donors. Most projects are either financed solely by China or co-financed by Cambodia, leading to the exclusion of only 10 projects. Second, I check for the precision level of the geographic location identified. Some projects are implemented in a limited geographic perimeter (such as a village or a town), while others are implemented at a more aggregated level (such as administrative level 1 or national level). Hence, geographic coordinates attributed to projects are always paired with the degree of precision of their location, which ranges from 1 to 8. This paper

[22]The three OECD-DAC categories are Official Development Assistance (ODA), Other Official Flows (OOF) and Private flows. ODA is defined as "[g]rants or loans to [developing] countries and territories ... and to multilateral agencies which are: (a) undertaken by the official sector; (b) with promotion of economic development and welfare as the main objective; (c) at concessional financial terms (if a loan, having a grant element of at least 25 per cent). In addition to financial flows, technical co-operation is included in aid". OOF are flows that do not meet either one of the two ODA conditions. Finally private flows "consist of flows at market terms financed out of private sector resources (i.e. changes in holdings of private long-term assets held by residents of the reporting country) and private grants (i.e. grants by non- governmental organizations and other private bodies, net of subsidies received from the official sector)". (OECD DAC glossary)

[23]https://www.aiddata.org

[24]Categorization into "ODA-like" flows, "OOF-like" flows and "vague official finance". This last category encompass flows that could be either ODA or OOF but for which there is insufficient information (Strange et al., 2013)

[25]Currently waiting on the 3.0, which will provide precise geographic coordinates in shape format instead of points

focuses on local outcomes and treatment relies on geographic distance to a project's exact location; hence, projects locations are key to the identification strategy. As a result, and following other studies (Cruzatti, Dreher, & Matzat, 2023; Isaksson & Kotsadam, 2018)[26], I focus on projects whose geographic coordinates correspond to an exact location (precision 1) or as "near", in the "area" of, or up to 25km away to an exact location (precision 2)[27]. Finally for projects spread across locations, each project-location coordinate is considered as a separate project (Martorano et al., 2020). Third, I check that all remaining projects are either "completed" or "implemented", which is the case[28]. The starting date used to compute treatment will be the starting date of the implementation phase - the time at which a project should start having an impact on the surrounding population. For one third of the project sample, the exact starting date is not available and I have to impute it manually. Since all agreement years are available, I compute the average time-gap between agreement date and actual start of completion for all projects in Cambodia that have both information[29]. Similar as observed in the literature, Chinese aid tends to be disbursed quickly, on average a little less than a year after the agreement; an average of 1 year is thus added to the year of agreement for projects with no start dates.

This gives a final sample of 61 projects in Cambodia over the 2000-2014 period, depicted in Figure 3. By relying on this sub-sample, I restrict the analysis to projects with a physical site compared to more intangible projects such as bilateral agreements or donations of equipment to political entities (Isaksson & Kotsadam, 2018). This analysis thus does not provide information on the effect of all Chinese aid to Cambodia, but only on the effect of being close to the physical site of a Chinese project. A test for differences in selected project characteristics nevertheless reveal no significant differences between excluded and sampled projects.

Table 1: Balance test between Cambodian projects and the sample of Cambodian projects used for analysis

	(1) Financial value	(2) ODA-like	(3) Commercial intent	(4) Development intent	(5) Mixed intent	(6) Representational intent	(7) Welfare type	(8) Economic type
Selected Cambodian	-8,780.94	-0.05	-0.03	-0.05	0.05	0.04	0.07	0.01
Constant	31,239,392.98***	0.75***	0.03**	0.76***	0.18***	0.03*	0.26***	0.65***
Observations	243	300	300	300	300	300	300	300
R^2	0.000	0.002	0.006	0.002	0.002	0.006	0.004	0.000

The distribution of selected projects by sector puts "Transport and storage" at the top, with 49.2% of the total (see Figure 2). This is consistent with previous research on Chinese aid that puts large infrastructure as the most financed sector (Chin & Gallagher, 2019; Guillon & Mathonnat, 2020). It is followed by "Government and Civil Society" projects

[26] This is not a similar selection of projects compared to other studies (Briggs, 2018; Dreher & Fuchs, 2015; Dreher & Lohmann, 2015) which investigate outcomes at higher levels of geographic aggregations, such as ADM2.

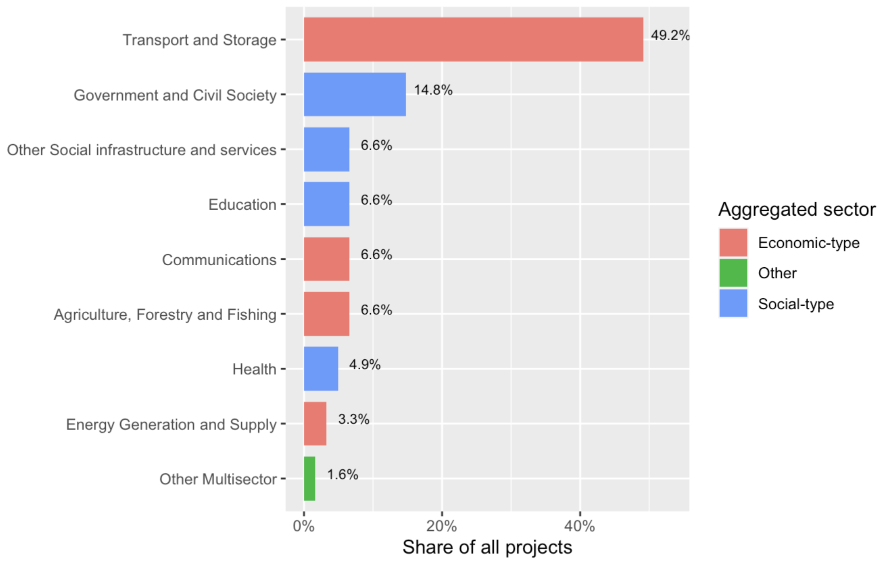
[27] At precision level 3, locations identified are similar to a second order administrative division (ADM2, such as a district or municipality) and this goes up to precision level 8, where the location is estimated to be a seat of an administrative division or the national capital.

[28] Projects are either completed (75%) or being implemented (25%)

[29] 119 projects out of 310

with 14,8% of the total: social-type projects in general (combining education, health and other social-oriented sectors such as "social infrastructure and services"[30]) account for 32.9% of all projects.

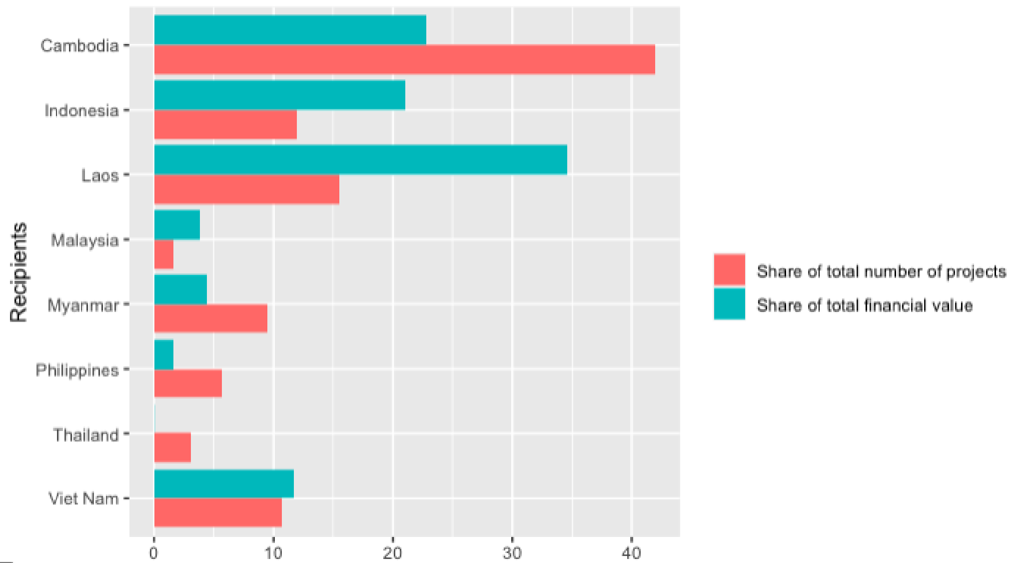
Figure 2: Distribution in number of Chinese Development projects by sector and aggregated sector.



Selected projects mostly fall in the "ODA-like" category, in contrast with the distribution of Chinese aid globally. Dreher et al. 2021 find that ODA-like flows tend to represent only 21% of total financial flows every year in the world over the period 2000-2014 (See Figure 3 in Appendix). This is particularly surprising as transportation projects tend to be predominantly financed through commercial flows Dreher et al. (2021). One could think of two reasons why this matters. First, ODA-like flows account for projects with a development intent. In Cambodia, one could thus expect the majority of Chinese aid projects to be designed to further Cambodia's development and thus impact human development outcomes. Second, ODA-like flows usually finance small projects. This helps explain the stark contrast between the high number of projects in Cambodia and their relatively low face value - especially compared to neighboring countries (see figure 3 for a comparison among East-Asian recipients)

[30]Social projects are projects in the following sectors "Education", "Health", "Water supply and sanitation", "Government and Civil Society" and "Other Social Infrastructures and Services".

Figure 3: Financial value and number of Chinese Aid as a share of the total, for East-Asian recipients from 2000 to 2014.



3.2 DHS

Dependent variables as well as various controls are retrieved from DHS surveys, a large-scale survey program that relies on standardized questionnaires. Repeated cross-sectional data for a country can be obtained by combining different survey waves. For this analysis I combine 4 DHS survey waves to have a long enough period of analysis: 2000, 2005, 2010 and 2014. Since Chinese projects are concentrated in transportation, I expect the biggest impact to come from this sector: I thus investigate potential spillovers on human development, either in terms of material or non-material aspects.

- *Time to drinkable water*: having access to drinkable water is key for health. Contaminated water propagates diseases and puts households - especially children - at health risks that could easily be avoided. This variable could be impacted through various direct and indirect channels. The direct channel relies on sanitation, health or social infrastructure projects, that could improve the quality of existing wells or build new ones. But no such project is present in the data (see table 6 in the appendix for the list and detail of projects used in the analysis). This puts the most likely channel (and unique one) to be the indirect one, through enhanced transportation projects which would reduce overall time needed to travel and access wells. The data contained an important number of missing variables, so missing values are replaced manually by the mean of the existing data within DHS cluster level.

- *Distance to a health facility*: better transportation infrastructure are likely to make hospitals more accessible. This will be measured using answers from women age 15-49, indicating whether distance is an issue to access proper healthcare.

- *Index of material living conditions (DHS)*: improvements in the two afor-mentioned variable could also come from better wealth levels following a reorganization of economic activity. Better wealth would allow households to purchase clean water or access proper transportation. Hence, I check for changes in wealth to disentangle channels and capture a potential increase that could be supported by Chinese projects in various sectors.

Descriptive statistics of these variables can be found in table 2.

Table 2: Descriptive statistics

	(1) 2000 mean	obs	(2) 2005 mean	obs	(3) 2010 mean	obs	(4) 2015 mean	obs
Dependent variables								
Time to access water	12.07	11,677	10.64	14,018	12.33	14,984	12.63	15,697
Distance to hospitals	0.40	15,34	0.38	16,819	0.36	18,747	0.35	17,576
Wealth index (1 to 5)	2.82	11,677	2.93	14,018	2.91	14,984	2.96	15,697
Independent variables								
Rural residency	0.85	12,189	0.85	14,194	0.83	15,635	0.86	15,822
Dependency ratio	1.01	12,189	0.90	14,194	0.78	15,635	0.79	15,822
Size of household	5.39	12,189	5.01	14,194	4.81	15,635	4.67	15,822
Woman head of household	0.25	12,189	0.24	14,194	0.27	15,635	0.27	15,822
Age head of household	44.66	12,189	45.41	14,194	46.05	15,635	47.10	15,822
Access to electricity	0.17	12,189	0.20	14,194	0.31	15,635	0.56	15,822
Improved floor	0.91	12,189	0.91	14,194	0.93	15,635	0.92	15,822
Treatment information								
Percentage treated by year	2.00	244	20.51	2,922	39.90	6,246	54.70	8,656
Average project number	1.0	244	2.4	2,922	4.5	6,246	6.1	8,656
Average comm. value ($)	2.8e+06	244	1.4e+07	2,922	4.9e+07	6,246	7.3e+07	8,656

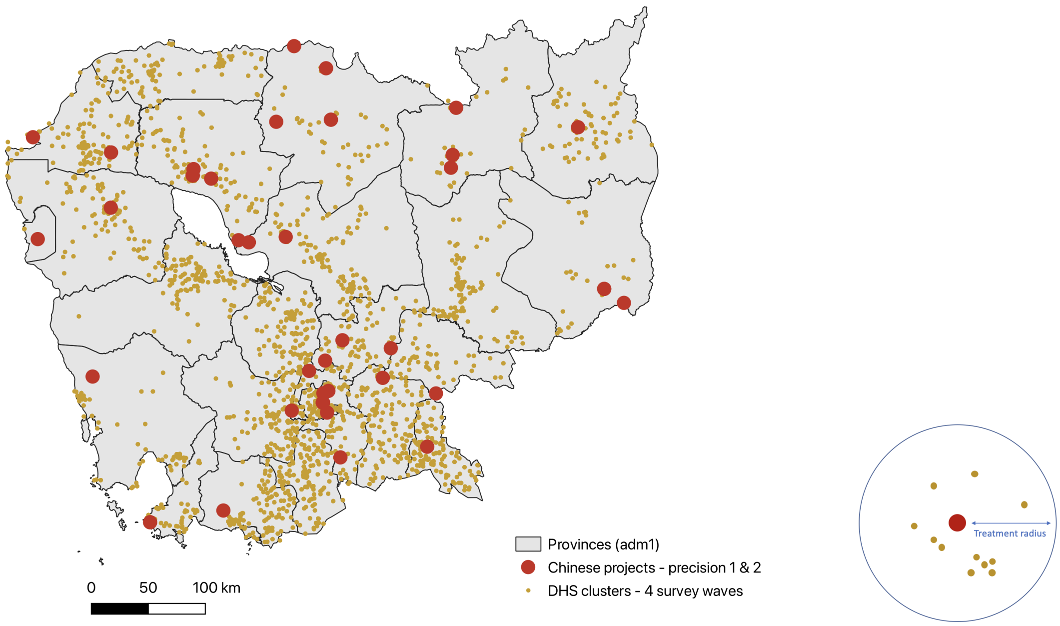
3.3 Treatment definition

The final database is obtained by matching household DHS data to project data using geo-referenced information. Treatment is defined geographically: observations localised within 25km of at least one completed or ongoing Chinese project are considered treated (see Figure 4 for a mapping of projects and DHS clusters) (Isaksson & Kotsadam, 2018; Kotsadam & Tolonen, 2016; Martorano et al., 2020). Treatment is binary and irreversible, hence the first time an individual is treated is its final treatment date[31]. Observations treated in the first DHS wave cannot be used in the rest of the computation as there are "always treated units": only 2% of the sample is excluded, posing no real threat on sample selection. All post-2000 survey waves are used to compute aggregated and dynamic treatment effects.

There are few limits to keep in mind before moving to the empirical strategy. Two are inherent to the data used: Aiddata is unlikely to represent Chinese projects in a truly exhaustive manner and DHS have a cross-sectional structure, not a panel. While the first

[31] The distribution of treatment over the population by survey wave can be found in table 2. Information on intensity can also be found there.

Figure 4: Mapping of Chinese Development Projects, DHS clusters in Cambodia and treatment area.



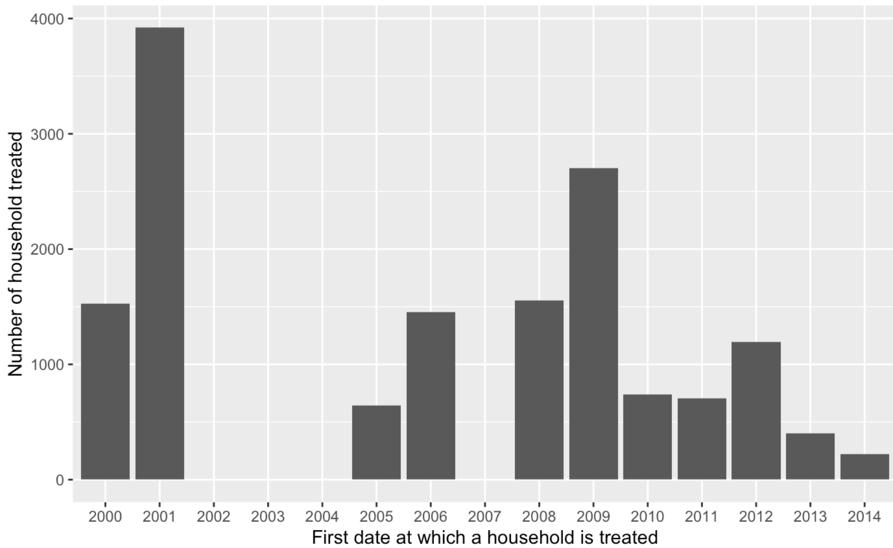
cannot be addressed, the second is mitigated by using an empirical model robust to cross-section (see section 4). One additional limit relates to the way geographic coordinates are attributed to DHS observations. Households are grouped in clusters and attributed the same geographic coordinates. Traditionally, geographic coordinates are randomly displaced by a maximum of 5km to maintain respondent confidentiality[32]. To check whether this is an issue for my results, I will test different radius size in the robustness section.

Finally, I do not use the intensity of treatment - either in terms of number of projects or financial value. This is mostly due to the restrictions imposed by the model and will be developed in section 4. But measures of treatment intensity also poses serious concerns of measurement error, especially when looking at financial value[33].

[32]More information on the procedure can be found on DHS website https://dhsprogram.com/Methodology/GPS-Data.cfm.

[33]Indeed, financial figures reported indicate committed values not disbursed values and they have not been officially confirmed by China - as such, they are subject to potentially important variation. Furthermore, financial commitments are only available for the whole project but not at the project site level.

Figure 5: First date at which a household is treated.



4 Estimation

4.1 Empirical Strategy

In settings where treatment happens at different time - depending on project dates - and by different types of projects, classic Two-Fixed Effects models have been showed to produce misleading estimates (De Chaisemartin & d'Haultfoeuille, 2020; Goodman-Bacon, 2021). Following recent methodological advances in Difference-in-differences (Did) models, I thus use the semi-parametric model introduced by Callaway & Sant'Anna (2021). Callaway and Sant'Anna's model has four main advantages compared to similar existing models. First, the model does not require a fixed geographic area to group units, rather, units are groupes by their treatment dates[34]. Second, it works well with repeated cross-section data. Third, by reweighing for the distribution of covariates between treatment and control groups it allows to adjust for a potential selection bias in project allocation (Horvitz & Thompson, 1952; Martorano et al., 2020; Wooldridge, 2007)). It also partly deals with concerns related to an evolution in the Chinese allocation strategy: if a group B treated at a certain time possesses characteristics different than a group A treated before, group B will be matched to control units with similar characteristics. Conditional parallel trends can thus be specific across groups of units treated at different times (Callaway & Sant'Anna (2021)). Fourth, by taking better account of differences in treatment-timing, the model can be used to compute average treatment effect according to different time-periods since treatment.

Using this model, an estimation of the average treatment effect can be done by identifying the ATT "in period t for the group of units first treated in period g"[35] Callaway & Sant'Anna

[34]For this reason, models from De Chaisemartin & d'Haultfoeuille (2020) is unusable

[35]The notation g can also be referred to as "treatment starting-time" for groups or cohorts

(2021), denoted by:

$$ATT(g,t) = E[Y_t - Y_{tg-1}|G_g = 1] - E[Y_t - Y_{tg-1}|D_t = 0, G_g = 0]$$

where G equals 1 if a unit i is first treated at time g and 0 otherwise. This means estimating different coefficients for different groups of units treated at different time g[36]. Separately estimated ATT(g,t) can be further aggregated to form a single causal ATT, using weights proportional to group size (Callaway & Sant'Anna, 2021)[37]. This allows me to estimate the following regression for each of my ATT(g,t) as follow:

$$Y^g_{icpt} = \beta_0 + \beta_1 G^g_{icp} + \beta_2 T_t + \beta_3 (G^g_{icp} * T_t) + Z_{icpt} + \theta_t * \eta_p + \varepsilon^g_{icpt}$$

Y^g_{icpt} is the dependent variable for groups of units i located in a DHS cluster c living in province p, first treated during time-period g and measured at time t. G equals 1 if a unit i is first treated during g and 0 otherwise. Z_{icpt} is a vector of household-level characteristics i, as well as population density at the DHS cluster level c. The interaction of time-fixed effect θ_t and province fixed effects η_p control for time trends in provinces as well as unobservables at the province level as well as time-specific characteristics that could be correlated with my dependent and independent variables. Finally, ε_{icpt} is a time-varying unobservable error term for which I use clustered standard errors for the interaction of province and survey year. Indeed, I expect errors to be correlated among households (individuals) from the same province and over time, as they will be subjected to the same unobservable factors - such as a change of policies or other common shock. Indeed, the Cambodian administration is highly centralized and provinces are the main administrative units in charge of implementing sub-national measures agreed on at the central level (OECD, 2016).

Because I do not have survey data t for every year a household is treated[38], I have to match groups of households treated at different times to each of my survey years or treatment years. As a result, I am not able to precisely distinguish between different treatment effects due to treatment length of exposure, but I can still average it within survey years[39].

4.2 Parallel Trends Assumption

The key identifying assumption is that in the absence of treatment by a Chinese project, the outcomes of interest for the target and control population would have evolved similarly[40]. In this analysis, I have reasons to believe this might not be the case. First, the allocation of Chinese aid projects is unlikely to be random and may lead to an important selection bias.

[36] For example, a group first treated at $g = 2005$ will have different estimates according to the period chosen $t = 2010$ or $t = 2014$.

[37] For an illustration of all ATT(g,t) computed to obtain the final aggregated ATT, see table 2 in the Appendix.

[38] For example I only have survey year 2005 even though some households are also treated in 2002

[39] For example, households treated after the first wave of 2000 (my pre-treatment wave) and between 2001 and 2005 are considered to be treated in 2005. The same is done for households treated between 2006 and 2010, considered to be treated in 2010, and households treated between 2011 and 2014 which are considered treated in 2014.

[40] With the most basic hypothesis being random sampling (i), irreversible treatment (ii), non-anticipation of treatment (iii)

Second, this selection bias is susceptible to evolve as motives for project allocation might change over time. Hence, despite the presence of covariates, individuals living away from any project site might still behave differently from those living close to a present or future project site.

To deal with this concern, I take two steps. First, I use both "not-yet-treated" units and "never-treated" units as controls[41]. Isaksson & Kotsadam (2018) as well as Cruzatti et al. (2023) follow a similar intuition: to reduce the selection bias, they compare individuals in locations where Chinese projects are being implemented at the time of the survey, with individuals in locations where there will be a Chinese project in the future but aid has not yet been disbursed. In the robustness section, I will test for the same setup using only "pure controls" (not-yet-treated units). This will reduce the time-frame of results but also reduce identification concerns. Second, I use a reweighting procedure, that combines both the outcome regression (OR) by Heckman, Ichimura, & Todd (1998) and the inverse probability weighting (IPW) approach of Abadie (2005)[42] (Callaway & Sant'Anna, 2021; Sant'Anna & Zhao, 2020). Hence, each group treated at a given time g will be matched to a control group with similar pre-selected characteristics. Such characteristics should be correlated to both my outcomes and the probability to receive an aid project in a particular year.

I build on the literature and on the results of my descriptive analysis to identify potential drivers of Chinese project allocation at the local level. I assess the strength of my hypothesis using a probit model (see table 1 of the appendix section):

- Chin & Gallagher (2019) demonstrate that Chinese development finance allocation can be described as a "coordinated credit space model". Chinese projects are financed through different structures (combining state banks with commercial ones), but in a coordinated fashion that supports the "big push" approach of Rosenstein-Rodan (1943, 1961). The consequences of this strategy, aimed at promoting synergies between sectors and overcoming coordination failures, are two-folds:

    - Chinese-financed projects tend to be geographically concentrated, whether with other Chinese projects or western donor projects. To take this into account, I test for the predictive power of the financial presence of the WB in a province, on treatment outcome. The data is retrieved from Aiddata, the World Bank Geocoded Research Release, Version 1.4.2 and takes the period 2000-2014 into account[43]. The result of the probit model shows a significant coefficient but very

[41] In the Callaway & Sant'Anna model, the parallel trends assumption has two alternatives, that differ by the control group they use: conditional parallel trends on the "never-treated" units or "not-yet treated". The default model does not use only "not-yet" treated units as control but combines both groups to have enough observation and make full use of the time-frame available in the data.

[42] This estimator is the doubly robust estimator developed by Sant'Anna & Zhao (2020). It is more robust against misspecifications than the OR or IPW taken alone. While outcome regression, IPW or a combinaison of both are similar in terms of identification, it is not for the estimation. Outcome regression necessitates to adequately model the evolution of outcomes for both treated and non-treated groups. The IPW only requires to adequately model the conditional probability of a unit i to be in group g given their covariates. The doubly robust procedures necessitates only one of those two models to be correctly identified.

[43] I rely on treatment intensity to account for a higher probability of Chinese development projects to be located in provinces where there is also an important presence of other donors.

low magnitude. Thus, I do not use this variable as a covariate[44].

  - Chinese projects are likely to be located in places perceived as conducive for development, an hypothesis supported by Dreher et al. (2019) which show that Chinese projects tend to be allocated in the wealthier parts of countries. I check for this positive selection in the Cambodia context using a t-test of difference in means at baseline (2000), between population living in areas never treated and population living in areas that will be treated. The results can be found in table 1. As expected, households living in treatment areas are overall better-off than households living in never-treated areas, along various dimensions: they are on average more educated, richer, take less time to reach a drinkable water source and benefit from better demographic characteristics. Hence, I use the probit model to select material and demographic conditions of living most predictive of treatment. In terms of material conditions, having access to electricity, increased quality of flooring and living in densely populated areas are all good predictors of treatment[45]. For demographic conditions, household size, sex of the household head, dependency ratio and whether a household lives in a rural area are identified as predictors.

- In a study on Chinese development flows in Africa, Dreher et al. (2019) identify a systematic tendency of Chinese aid to be allocated to the birth region of political leaders[46]. The current prime Minister of Cambodia Hun Sen has been in position for the last 23 years and was born in Peam Kaoh Sna in the province of Kampong Cham (Mehta & Mehta, 2013). However, descriptive statistics on the allocation of projects by province do not show that Kampong Cham receives more aid than other provinces - both in terms of number of projects and their financial value. This characteristics is not used in the model.

Relying on these identified characteristics for re-weighting, additional steps are taken to assess their plausibility with regards to the pre-trend hypothesis. Placebo-type test will be conducted for each aggregate coefficient as well as an estimation of pre-trends in all event-studies. More tests will be proposed in the robustness section.

[44]This WB variable could probably be refined to better fit the micro-level data.

[45]A visual observation of proximity between projects and roads (in 2022) seem to indicate that being closed to a major road is a good predictor of treatment. It is confirmed by the strong positive correlation between the two. Roads indeed favor transportation and economic gains, which in turn favor agglomeration benefits that trickle down over human development outcomes. But for the moment this variable will not be included, as I do not have been able to recover the 2000 road network and only have the current road network available.

[46]In the same study, Dreher et al. (2019) identify a less robust effect of ethnicity of birth leader. However in Cambodia, the Khmers are largely dominant and constitute 90% of the Cambodian population. Controlling for the political leaders'ethnicity does not make sense in this context of low ethnic diversity.

Table 3: Results of a Student's T-test: differences in characteristics for households living in treated areas and household living in non-treated areas, using baseline data (survey year 2000).

	(1) Average years of education	(2) Wealth index	(3) Time to water	(4) Size household	(5) Age of head of household	(6) Rural	(7) Dependency ratio
Characteristics	0.75***	0.68***	-1.72***	0.04	1.78***	-0.08***	-0.11***
Constant	2.17***	2.56***	12.99***	5.36***	43.66***	0.90***	1.07***
Observations	12129	12235	11493	12235	12235	12235	12235
R^2	0.033	0.057	0.008	0.000	0.004	0.012	0.005

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5 Results

5.1 Aggregated ATTs

I assess the credibility of my assumptions and proceed to a placebo-type test from Callaway & Sant'Anna (2021): it tests indirectly whether the conditional parallel assumptions hold by looking at changes in my outcomes variables before treatment. It is similar to checking whether all pre-treatment estimates are equal to 0 for all group-time (Callaway & Sant'Anna, 2021; De Chaisemartin & d'Haultfoeuille, 2020; Marcus & Sant'Anna, 2021). If the conditional parallel trend assumption hold, the pre-treatment effects for treated units compared to not and not-yet treated units can be expected to be 0. Results of these tests can be found in table 4: with the p-values obtained, I cannot reject the null hypothesis of a joint pre-treatment effect of 0 for any of my outcome variables, providing indirect support to the parallel trend assumption (Marcus & Sant'Anna, 2021). This test will be used again in the event-study section to investigate whether conditional parallel trends also appear to hold for sub-groups exposed to the same length of treatment.

Table 4: Placebo test

	(1) Time to water	(2) Distance to health facility	(3) Wealth index
Chi2	3.02	1.13	4.54
p-value	0.39	0.77	0.21
Observations	53,324	65,494	54,889

H0: All Pre-treatment are equal to 0

The results of my estimation are reported in table 5. A significant decrease in the time to reach drinkable water can be observed, while other outcomes remain seemingly unaffected. Several explanations can be advanced for these results. Regarding distance to health facilities, it could be that only a low number of transportation projects crossed path with existing health facilities, thereby reducing its capacity to improve access. For

Table 5: Main results

	(1) Time to water	(2) Distance to health facility	(3) Wealth index
Treatment	-2.34**	0.01	0.10
	(1.17)	(0.04)	(0.13)
p-value	0.04	0.78	0.42
Observations	54,145	65,494	55,710

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

improvements in household possessions - captured by the wealth index - it can take a long time to emerge as it requests households to save over multiple time-period. Poor household do not often have this luxury, as their income is entirely spent on immediate consumption and needs (food, water, or healthcare for a sick member of the family) (Banerjee & Duflo, 2011). Thus, I expect average effects to differ across groups of households treated at different times. The literature on the subject does argue that when the effects of aid are small, the aggregate estimate might not reflect its real effect (Briggs, 2017; Dreher & Lohmann, 2015). The dynamic relationships will be analysed in the following section.
An alternative explanation for the lack of significance could also be the result of Cambodia's political environment. Michaelowa & Weber (2007) demonstrate that with high level of development aid - which could be considered to be the case here in aggregate terms, but not in terms of face-value - there can be negative spillovers, such as political capture and deterioration of governance. The presence of a corrupt government in Cambodia supports this idea. Moreover, China has been accused of favoring Chinese labor rather than local labor, which could reduce economic spillovers in the construction phase and reduce any potential impact on wealth (Cooper, 2019; Wegenast, Krauser, Strüver, & Giesen, 2019)

5.2 Event-study

I compute the event-study parameter that is the (weighted[47]) average effect of treatment l periods after adoption for different adoption cohorts, using the model from Callaway & Sant'Anna (2021). The results are reported in table 6. Periods before treatment allow to check for pre-treatment trends based on group-time (Callaway & Sant'Anna, 2021)[48]. All plots contain pre-treatment estimates to test the parallel trends assumption indirectly across group-time with the same length of exposure to treatment. For all pre-treatment periods, whether 5 years or 10 years before treatment, treatment effects remain non-significant for all estimations. This provides additional credibility to the parallel trends hypothesis.

Coefficients for different length of exposure do not alter the initial conclusions. Only

[47]As mentioned earlier, weights correspond to relative frequencies in the treated population

[48]The identification in event studies differ from previous ATT(g,t) identification. Periods after treatment are measured as $E(Y|t)$ - $E(Y|g_{-1})$ with g_{-1} the last period before first treatment for group g. Periods before treatment are measured as $E(Y|t)$ - $E(Y|t_{-1})$

Table 6: Event-study results

	(1) Wealth	(2) Time to water	(3) Distance to health facility
10 years before treatment	0.09	-2.47	0.02
	(0.14)	(1.49)	(0.10)
5 years before treatment	0.17	0.75	-0.05
	(0.11)	(1.37)	(0.06)
0 to 5 years after treatment	0.03	-1.89	0.05
	(0.12)	(1.39)	(0.05)
5 to 10 years after treatment	0.07	-0.62	-0.03
	(0.15)	(1.25)	(0.05)
10 + years after treatment	0.32	-6.47**	-0.00
	(0.27)	(2.56)	(0.12)
Observations	55,710	54,145	65,494

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

time to drinkable water is negatively impacted by treatment, and only for groups treated for more than 10 years. Since this outcome should be affected as soon as a related-project is implemented, this suggests a compositional effect: it is quite possible that only those individuals treated at the beginning of my sample witnessed a change in their time to access drinkable water. The significance of their effect would be averaged out in the "0 to 5 years of treatment" and "5 to 10 years of treatment" groups.

For other outcomes, it would appear that if there is indeed a slow and dynamic change in pattern in human development outcomes, it is not revealed in these variables and this environment. For the wealth index, it could also be that my time-frame is too narrow to capture the length of exposure needed for the effect to become significant. But in general, the effect could be either nonexistent or too small to be detected - again, it could be due to low committed financial amount combined to low number of projects in related sectors.

5.3 ATTs for sub-populations

One last explanation for the lack of significance could be that the effect is only sizable for certain sub-populations but not large enough to manifest itself over the entire population. Project could be targeted to specific areas, such as richer areas, and thus benefit only those with already wealthier status. On the contrary, since Chinese intervention are likely to be small in size, they could benefit the poor population, because they have a lot more to gain. Hence, I investigate the heterogeneity of effects by looking at treatment effects on two sub-population based on their value on the wealth index (see Table 7). I split my sample at the median index value, which is 3.

It appears that improvements in time to access drinkable water are driven by the poorer group and for groups with the longest exposure to treatment. As effects only appear after prolonged exposure, it reinforces the previous concern of group compositional effects. Those units with longer exposure are also those with higher intensity of treatment and with more relevant projects for selected outcomes.

6 Robustness

I further investigate the geographical range of my findings and compute the same model but using a different treatment zone of 50km (Isaksson & Kotsadam, 2018). Results can be found in tables 3 and 4 of the appendix. In those results, there are no significant coefficients anymore, revealing a non-surprising sensibility to project-distance.

Regarding identification concerns, in particular the parallel trend hypothesis, I estimate my regression again, using only "pure control" - those units living in a zone that will be treated in the future but is not at the moment of the survey[49]. Even though it necessarily limits the temporal dimension, it helps with concerns related to proper identification. For these sub-populations and for each outcome, the results of the Placebo tests provide again indirect proof supporting parallel trends (see Table 5 of the appendix).

7 Working progress

There are still many areas left to investigate in this study. Here are the next steps I have planned:

- Replace project information from Aiddata 1.0 by those in the most recent (and upcoming version) Aiddata 3.0[50]. Aiddata 1.0 only has start and end points of projects as GPS coordinates, which is a big issue for transportation projects and projects with a large physical site. The forthcoming Aiddata 3.0 should remedy to this issue by having project geographic location as lines and shapes rather than points.

- Focus on actual transport infrastructure projects for a more coherent understanding of changing outcomes, and focus on the reduction in time-distance channel

- Look at the aggregate and dynamic effects for each groups of units treated at different times. As I mentioned in the results section, there might be one group driving my estimates. It would be useful to understand the dynamics of each group of units to see whether this is actually the case.

- Re-estimate with lower-level geographic fixed effects, at the district level. It could be that the province fixed effect is too large compared to the level of my treatment and dependent variable and thus does not capture all un-observable factors affecting individuals.

- Investigate other factors of heterogeneity, along urban/rural and gender lines

[49] Could also be called inactive project areas.

[50] Information on this database here: https://www.aiddata.org/data/aiddatas-geospatial-global-chinese-development-finance-dataset-version-3-0

Table 7: Event-study by sub-population

	(1) Distance to health facility	(2) Time to water
Panel 1 : wealth index above median		
ATT	0.07	-0.40
	(0.07)	(1.30)
5 years before treatment	-0.04	0.54
	(0.07)	(1.74)
0 to 5 years after treatment	0.08	-0.81
	(0.07)	(1.48)
5 to 10 years after treatment	0.06	0.11
	(0.09)	(2.05)
Observations	16,334	8,054
Panel 2 : wealth index under median		
ATT	0.04	-1.64
	(0.07)	(1.48)
5 years before treatment	-0.14	1.90
	(0.13)	(2.18)
0 to 5 years after treatment	0.09	-2.77
	(0.09)	(1.88)
5 to 10 years after treatment	-0.09	1.19
	(0.09)	(1.71)
Observations	6,445	9,183

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

- Investigate intensity of treatment - number or financial value of projects, depending on the reliability of the data available. The literature on Did models with heterogeneity of treatment-timing has very recently started to work on such models with continuous treatment (Callaway, Goodman-Bacon, & Sant'Anna, 2024; de Chaisemartin, d'Haultfoeuille, Pasquier, & Vazquez-Bare, 2022). As for now, comparing effects across different intensity requires stronger assumptions that made previously and are difficult to interpret due to treatment effect heterogeneity.

- Finally an open-question, about whether to conduct a cross-country analysis rather than focusing on Cambodia. While this would modify much of this present paper,data, I would also gain in terms of scale and external validity, as well as number of projects.

8 Conclusion

The scale of China's development program has expanded a lot since 2000, notably driven by large-scale initiatives such as the BRI. However, the effects of China's aid disbursements in recipient countries are still not well understood, in part due to the absence of fully exhaustive and reliable data. This has led to a body of qualitative study blaming China for providing "rogue aid" with a blatant disregard for international safeguards (Strange et al., 2013; Wang et al., 2016). The development of the Aiddata methodology, used to collect information on Chinese aid projects, and the subsequent release of Aiddata's Global Development Finance datasets, have led to an increase in empirical analysis that put this vision into perspective.

While the focus of the literature has initially been put on the various allocation drivers of Chinese development finance (Broich, 2017; Dreher & Fuchs, 2015; Dreher et al., 2018; Guillon & Mathonnat, 2020) and its effectiveness on economic outcomes (Bluhm et al., 2018; Dreher et al., 2021; Dreher & Lohmann, 2015), crucial indicators of social and human development have remained almost absent of the literature. This recently evolved with a series of papers investigating governance (Gehring, Wong, & Kaplan, 2018; Isaksson & Kotsadam, 2018) and welfare outcomes (Cruzatti et al., 2023; Martorano et al., 2020)). Yet, these analysis rely almost exclusively on samples constituted of African countries, except in large cross-countries analysis (Cruzatti et al., 2023). This probably reflects the tremendous development needs of the continent. It is also the result of the concentration in number of Chinese aid projects (Dreher et al., 2021; Oh, 2020). However, figures in terms of project financial size rather than number of projects reveal that Southeast Asia is home to an important share of Chinese projects Dreher et al. (2021). Indeed, China's global strategy, geo-strategic issues in the region as well as BRI routes explain well the importance of forming strong relationships with neighbor countries.

My first results show that in Cambodia, Chinese aid only significantly impact time to drinkable water but not distance to a health facility or wealth. Looking at results for sub-populations by wealth level show that projects still benefit the health of the poorest population after more than 10 years of exposure. While these results are disappointing, they are not surprising in the Cambodian context. The low face-value of projects combined to the deteriorated political environment in the country appears to prevent any sizeable effect on health and economic welfare to appear. It could also be that projects are poorly targeted to the population needs.

This study contributes to the literature by providing local evidence of Chinese development finance's effects on a range of human development outcomes: health and material living conditions. It contributes to the literature by using geo-referenced project data in an Asian country, Cambodia, and investigates the heterogeneity of Chinese aid effect across different sub-populations. It further builds on innovative methodological papers that developed difference-in-difference models to account for heterogeneity of treatment effects and timing.

The results showed here suffer from limitations that have already been stated. First, studies on international aid carry a risk of endogeneity and omitted variable bias, resulting from its non-random allocation. Even though I used efficient approaches to tackle this issue, one can never be certain that the conditional parallel trends truly hold for the periods under scrutiny. Second, data from Aiddata rely on unofficial and incomplete sources. On this question, Horn, Reinhart, & Trebesch (2021) believe that around half of Chinese development flows to developing countries remain unaccounted for. Hence, the conclusions of this study might not hold in reality, even though I mitigated this issue by only taking the presence of a project as treatment and not its financial value. It is clear that further analysis on Chinese development flows would largely benefit from disclosed information from China and/or additional information on activities entailed by projects. Third, my identification relies on the correct identification of Chinese projects' physical sites. But Aiddata 1.0 only provides start and end GPS points which is an important issue for infrastructure projects with a large or extensive physical presence. Finally, there a lot more human development variables that could have been investigated in this study, such as consumption pattern or subjective well-being. Heterogeneity of effects should also be investigated further to better understand how projects affect the population. Similarly, future studies should investigate countries outside Africa, in order to understand whether results found in the literature for African countries also hold in other geographical locations.

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10 Appendix

Figure 1: Chinese Aid presence in ASEAN countries, in cumulative number of funded-projects from 2000 to 2014.

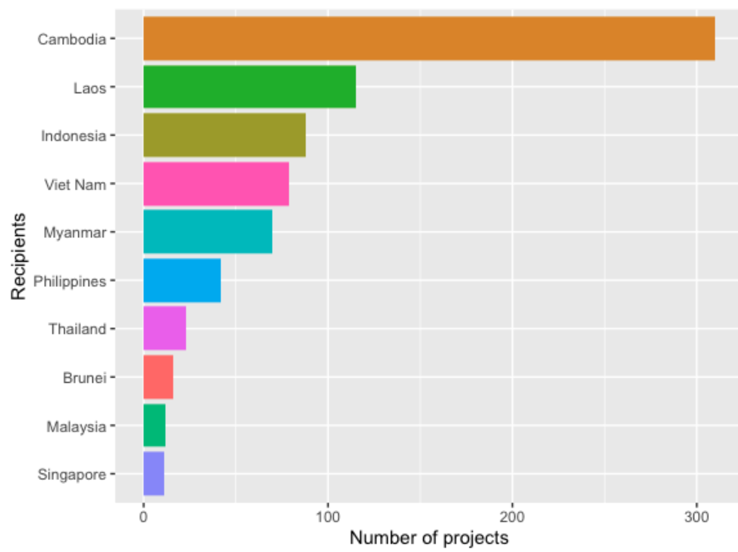

Figure 2: Number of new projects with precision 1 and 2, per year in Cambodia

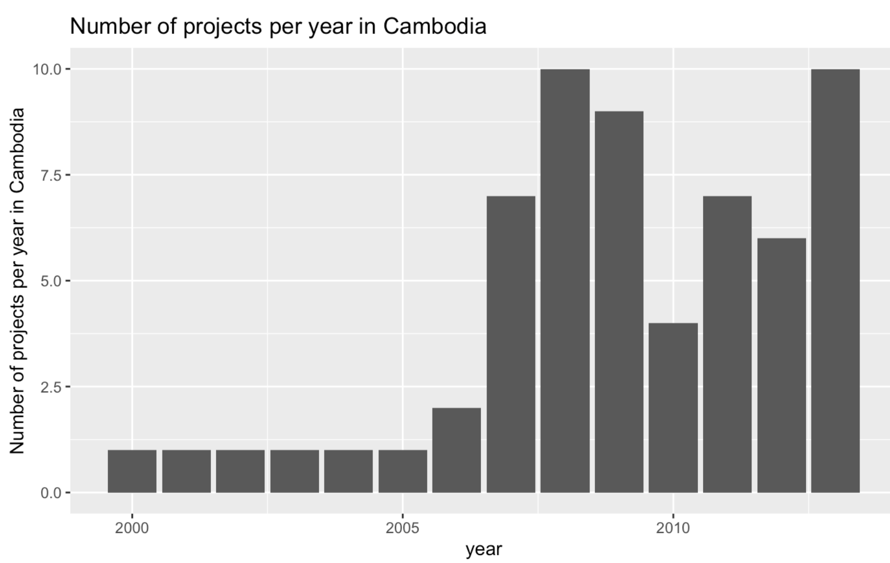

Figure 3: Distribution of projects by aggregated sector and type of financing flows.

Figure 4: Mapping of Chinese Development projects (2000-2014) over population density in Cambodia (2000).

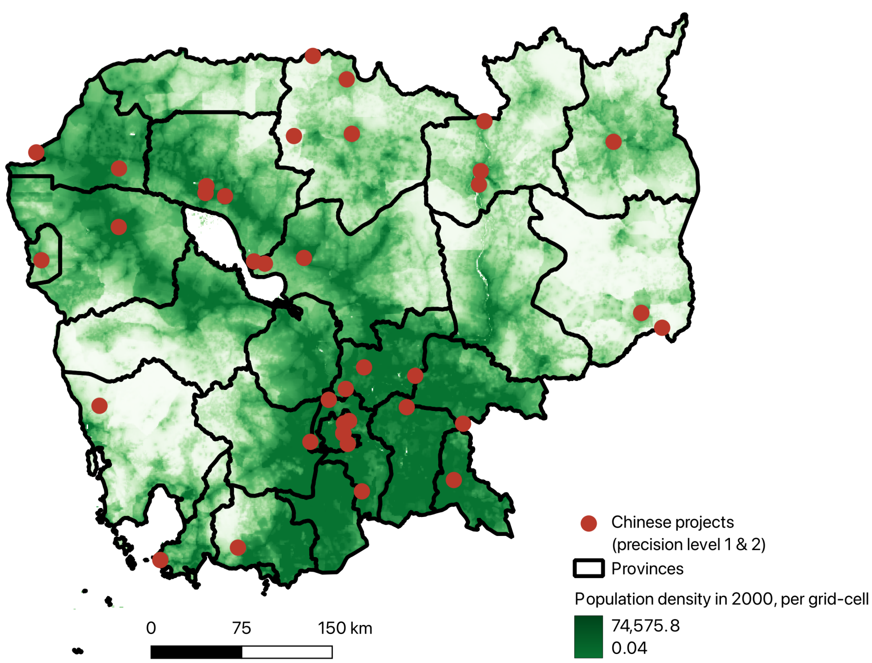

Table 1: Results of a probit model on identified covariates

	(1)
Dependency ratio	-0.0241***
	(-10.13)
Woman head of household	0.0177***
	(4.51)
Rural place of residency	0.0328***
	(7.20)
Population density by quintile (DHS cluster level)	0.0869***
	(44.60)
Access to electricity	0.184***
	(49.54)
Cumulative financial value of WB projects by province	-7.74e-11***
	(-4.79)
Improved floor	0.0555***
	(8.18)
Observations	57506

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2: Estimation of all ATT(g,t) before aggregation, for the outcome "time to access drinkable water"

	Coef.	Std. Err.	P-value
g2005			
t 2000,2005	-0.96	1.84	0.60
t 2000,2010	0.70	1.58	0.66
t 2000,2015	-1.57	2.70	0.56
g2010			
t 2000,2005	-0.87	1.88	0.64
t 2005,2010	-2.46	1.75	0.16
t 2005,2015	-2.29	2.19	0.29
g2015			
t 2000,2005	-2.04	1.47	0.16
t 2005,2010	1.93	1.68	0.25
t 2010,2015	-1.01	1.78	0.57

Control: not yet treated and never-treated. Number of observations: 54,328

ATT(g,t) estimated before treatment are used to estimate pre-treatment trends.

Table 3: Results for treatment zone of 50km

	(1) Wealth	(2) Time to water	(3) Distance to health facility
Placebo test			
Chi2	0.48	1.29	1.13
p-value	0.90	0.73	0.78
Aggregated ATT(g,t)			
Treatment	0.16	-0.43	0.01
	(0.11)	(1.51)	(0.04)
p-value	0.13	0.77	0.78
Observations	54,889	53,324	65,494

H0: All Pre-treatment are equal to 0

Table 4: Event-study results for treatment zone of 50km

	(1) Wealth	(2) Time to water	(3) Distance to health facility
10 years before treatment	-0.13	-0.44	0.02
	(0.25)	(2.07)	(0.10)
5 years before treatment	0.06	0.62	-0.05
	(0.11)	(1.60)	(0.06)
0 to 5 years after treatment	0.15	0.07	0.05
	(0.13)	(1.64)	(0.05)
5 to 10 years after treatment	0.07	-0.46	-0.04
	(0.15)	(1.65)	(0.05)
10 + years after treatment	0.33	-1.48	-0.00
	(0.23)	(3.14)	(0.12)
Observations	54,889	53,324	65,494

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Placebo test, main results and event-study using only "not-yet" treated units as control

	(1) Time to water	(2) Distance to health facility	(3) Wealth index
Chi2	0.59	1.05	0.64
p-value	0.44	0.30	0.42
Treatment	-0.88	0.06	-0.04
	(1.12)	(0.06)	(0.10)
p-value	0.43	0.31	0.67
5 years before treatment	1.48	-0.09	0.15
	(1.92)	(0.08)	(0.18)
0 to 5 years after treatment	-1.85	0.07	-0.13
	(1.40)	(0.07)	(0.07)
5 to 10 years after treatment	0.79	0.05	0.09
	(1.68)	(.09)	(0.18)
Observations	17,237	22,779	18,456

H0: All Pre-treatment are equal to 0

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 5: Location of Chinese and World Bank projects with precision 1 and 2

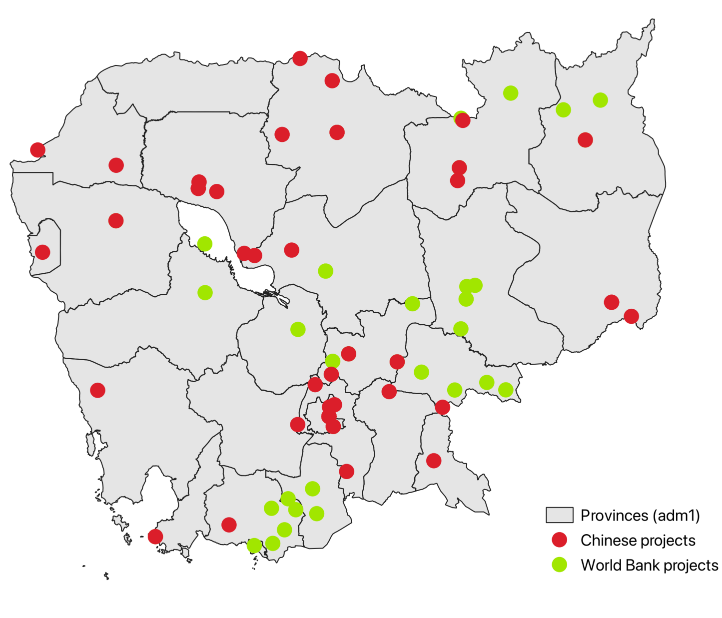

Table 6: List and detail of projects used in analysis

Project number	Project title
Agriculture, Forestry and Fishing	
33060	China Finances Cambodia's Construction of Agricultural Laboratory Building (Linked to Project ID#32209)
38771	China provides loan for Stung Chikreng Water Resources Development Project (Phase I) in Cambodia
38815	China Provides 330 Million Yuan Loan for Staung River Basin Water Resources Development Project Phase I
39178	China finances 200m USD Vaico Irrigation Project (linked to #48911)
Communications	
32146	EXIMbank loan RMB135M for Cambodia GMS-IS Section (Phase I) (Linked to Project ID#32113)
32146	EXIMbank loan RMB135M for Cambodia GMS-IS Section (Phase I) (Linked to Project ID#32113)
32146	EXIMbank loan RMB135M for Cambodia GMS-IS Section (Phase I) (Linked to Project ID#32113)
32146	EXIMbank loan RMB135M for Cambodia GMS-IS Section (Phase I) (Linked to Project ID#32113)
Education	
32171	Chinese Corner at University of Cambodia
32212	China donates language books to Cambodia
32459	Donation to Royal University of Phnom Penh Library (Linked to Project ID#32458)
38774	China Provides Electronic Library to the Royal Academy of Cambodia
Energy Generation and Supply	
33054	China builds $280 million Kamchay Dam Hydropower Station
33123	EXIMbank concessional loan Lower and Upper Sections of Stung Russey Chrum/Orussei hydropower project
Government and Civil Society	
32038	China to provide Cambodia with Construction Assistance for Senate Library and Offices
32042	China donates de-mining equipment (108,000 USD) to Cambodia
32140	Donation of Office Supplies
32156	China provides grant for the construction project of New Office Buildings for the Senate (Linked to Project ID#32201)
32166	Funding for construction of Cambodian government office
32174	China donates office supplies and equipment for ASEAN Summit
32242	China provides office supply donation to Cambodia (linked to project ID #32241)
33076	China Donates Port Security Inspection Equipment to Cambodia
35662	Funding for 'Project of New Council of Ministers Building of the Kingdom of Cambodia'

Project number	Project title
Health	
38731	Chinese ophthalmologists perform free cataract operations for Cambodian patients (linked to #38733)
38733	Chinese ophthalmologists perform free cataract operations for Cambodian patients (linked to #38731)
38733	Chinese ophthalmologists perform free cataract operations for Cambodian patients (linked to #38731)
Multisec	
32069	Chinese Engineers and Technicians provide expertise for Cambodian Shopping Center
Other	
32062	Restoration of Chau Say Tevoda temple of Angkor Wat
32129	China organizes Khmer New Year art performances in Cambodia
32161	Restoration and Conservation Project for Takeo Temple of Ankor Wat (Linked to project ID#32201)
38749	China provides grant for the Rehabilitation of the Chau Say Tevoda Temple of Angkor (Linked to Project ID#32062)
Transport	
32105	EXIMbank concessional loan for National Road No.10/57 (Linked to Project ID#35687)
32105	EXIMbank concessional loan for National Road No.10/57 (Linked to Project ID#35687)
32119	Concessional loan for Cambodia National Road No. 78
32119	Concessional loan for Cambodia National Road No. 78
32128	China provides export credits for the enlargement of Cambodian National Road No. 6 (linked to ID #32199)
32153	EXIMbank loan USD51.9M for construction of Cambodia National Road No. 76 (Linked to Project ID#32113 & ID#32155)
32155	EXIM China concessional loan for extension of Cambodia National Road No. 76 (Linked to #32160)
32169	EXIMbank concessional loan for Construction of National Road No 59 (Linked to project ID#32201)
32180	Construction Project of the National Road No. 3762 (Linked to Project ID#32201)
32180	Construction Project of the National Road No. 3762 (Linked to Project ID#32201)
32195	China EXIMbank gives US$53,563,120 as part of a concessional loan for Rehabilitation of Cambodia National Road No.62 (South Section: Kampong Thom MeanChey) (Linked to Project ID#38647)
32249	EXIMbank Concessional Loan Worth 26.75 Million USD for 5th Cambodia-China Friendship (New Chroy Changvar) Bridge
33061	China Donates Security Equipment to Cambodia (linked to Project ID#32086, ID#33076)

Project number	Project title
33064	EXIMbank concessional loan for expansion of Cambodia National Road No. 5
33064	EXIMbank concessional loan for expansion of Cambodia National Road No. 5
33064	EXIMbank concessional loan for expansion of Cambodia National Road No. 5
33092	Concessional Loan for Construction of National Road No. 41 in Cambodia
35687	Concessional Loan for 4th China-Cambodia Friendship (Takhmao) Bridge (Linked to Project ID#32105)
38647	China provides $14.8 million loan to Cambodia for construction of National Road 8.1 and 8.2 (Linked to Project ID #32239)
38647	China provides $14.8 million loan to Cambodia for construction of National Road 8.1 and 8.2 (Linked to Project ID #32239)
38647	China provides $14.8 million loan to Cambodia for construction of National Road 8.1 and 8.2 (Linked to Project ID #32239)
38722	China provides concessional loan for the Rehabilitation Project of the Cambodia National Road No.61
38722	China provides concessional loan for the Rehabilitation Project of the Cambodia National Road No.61
38780	7th Cambodia-China Friendship (Koh Thom) Bridge
38785	EXIM Bank concessional loan for Rehabilitation of NR62 (Tbeng Meanchey __ Preas Vihear) & NR210
38785	EXIM Bank concessional loan for Rehabilitation of NR62 (Tbeng Meanchey __ Preas Vihear) & NR210
38785	EXIM Bank concessional loan for Rehabilitation of NR62 (Tbeng Meanchey __ Preas Vihear) & NR210
38785	EXIM Bank concessional loan for Rehabilitation of NR62 (Tbeng Meanchey __ Preas Vihear) & NR210
38785	EXIM Bank concessional loan for Rehabilitation of NR62 (Tbeng Meanchey __ Preas Vihear) & NR210
38851	1st Cambodia-China Friendship (Sekong) Bridge (linked to #32077)