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THE CHINESE REVIVAL OF AFRICAN RAILWAYS

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Abstract:	In recent decades China has become an important source of official finance for African countries, especially for infrastructure. Most railways in Africa, built largely in the colonial era, experienced poor performances and deteriorated since independence, due to road competition and to inefficiency of the state-owned railway companies. From the end of the last century, the assistance of international financial institutions and traditional donors in the railway sector promoted private concessions, but results were generally below expectations. Based on project level data about flows from the World Bank and from the Chinese government, the study shows that China is now the main foreign donor for the railway infrastructure in Africa and, based on panel data regressions on flows at country level, it points out that, as the World Bank withdrew from the sector, African countries resorted to Chinese funding. Allocation of funding by China doesn't even seem to be biased in favour of public or private management, nor to favour countries supported by the World Bank before the privatization phase. Chinese funding also doesn't seem to be driven by interest in natural resources of African countries.
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THE CHINESE REVIVAL OF AFRICAN RAILWAYS

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In recent decades China has become an important source of official finance for African countries, especially for infrastructure. Most railways in Africa, built largely in the colonial era, experienced poor performances and deteriorated since independence, due to road competition and to inefficiency of the state-owned railway companies. From the end of the last century, the assistance of international financial institutions and traditional donors in the railway sector promoted private concessions, but results were generally below expectations. Based on project level data about flows from the World Bank and from the Chinese government, the study shows that China is now the main foreign donor for the railway infrastructure in Africa and, based on panel data regressions on flows at country level, it points out that, as the World Bank withdrew from the sector, African countries resorted to Chinese funding. Allocation of funding by China doesn't even seem to be biased in favour of public or private management, nor to favour countries supported by the World Bank before the privatization phase. Chinese funding also doesn't seem to be driven by interest in natural resources of African countries.

Keywords: Rail infrastructure, Official Financial Flows, Developing Countries, new donors, traditional donors

JEL: O18; O20; R42

1. Introduction

Official financial flows from China to Africa have been growing in the recent years, making China a main donor for many African countries, particularly for the infrastructure sector where the amounts provided by China closely compare with those of all traditional donors taken together. Within the transport industry, railway is the first sector by value of the projects financed by China in Africa, and it is the second one when all infrastructural projects are considered, preceded only by the energy sector (Foster et al. 2009). Since the emergence of China as a main donor in Africa at the turn of the millennium, a vibrant debate on the interests and motivations behind its engagement in the continent has emerged. The study aims at assessing the determinants of Chinese funding for African railways, including the decreasing financial efforts by traditional donors.

Railways in Africa, such as most other infrastructure, were first set up by colonial powers, that were driven by economic and political interests. Rail transport initially was preferred to road transport and, jointly with ports, attracted huge investments, for its capacity to carry for long distances large quantities of heavy, bulky and low value-added commodities, like agricultural products and minerals. However, roads soon became more competitive, especially for passenger services and for all the time-sensitive goods. In fact, African railways were not designed to ensure speed and have high fixed costs (rarely under 70 percent of total costs, including capital and maintenance costs). Consequently, a low traffic density makes the railway transport less efficient and more expensive compared to road transport. Average traffic density in Sub-Saharan African railways achieved in 2010 was less than 1 million traffic units per rail-route-km, a very poor value, while the situation was better in North Africa (Olievschi 2013). Since independence of African nations and until the '90s, almost all African railways were publicly owned and operated, but they often failed to recover costs, and became burdensome for public finance. Despite support by international donors, maintenance tended to be poor, while rehabilitation and new investment works stalled. By 1990 most of the sub-

Saharan African railways were in virtual bankruptcy and needed large investments in infrastructure and rolling stock.

From the '90s, in line with the prevailing market orientation of policies, many concession contracts were signed, with governments remaining as the owner of infrastructure and transferring rolling stock, operation and maintenance of the railway to a concessionaire. This was often promoted and financed by bilateral and multilateral organizations, which blamed government inefficiencies and raised expectations on private sector performances. Observers agree that results were at best mixed while, as it will be shown, there is no consensus in literature about the interpretation of the trends which characterise the support of International Financial Institutions (IFI), of which the World Bank is an outstanding representative. Also, there is no consensus on the responsibility of international donors, versus African Governments, in neglecting railways.

The study proposes a comparison for the period 2000-2014 between funding in the railway sector from China and from the World Bank, and analyses previous trends for the latter which is taken as an outstanding representative of traditional donors. Moreover, we model Chinese funding to the railways sector in the period 2000-2014, to test the effect of different variables which might motivate China to assist African countries in this sector, including current and past funding by the World Bank. The analysis is based on data on official flows retrieved from two databases: World Bank operations dataset which provides basic information on all of World Bank's projects; AidData dataset, which records the overseas Chinese official finance between 2000 and 2014 and it based on an open-source methodology.

The study shows that China now represents the largest provider of official finance for African railway infrastructures. Between 2000 and 2014 China committed more than \$40 billion to the sector, while World Bank committed less than 1/10 of such amount. African railway infrastructure seems to be not a priority sector for the World Bank, possibly due to mixed results of its railway sector reform strategy. Funding from China is explained by the commercial interests of China, but also by the actual need of the recipient countries, as captured by income per capita and by the lack of assistance by the World Bank. We argue that China is filling the funding gap left by the withdrawal of traditional donors from the sector, supporting the renewed interest of African governments and institution in railways.

This paper is organized as follows. Section 2 reviews the available literature, while section 3 introduces the datasets and the methodology of the analysis. Results are discussed in section 4, while the last section draws some conclusions.

2. Literature review and hypotheses

The present literature review has a twofold aim. First, it covers the main contributions to the analysis of the trends which have characterised financial flows in African railway systems and the related policy orientations and assessments. Second, it covers the literature on the drivers of official funding from China, which recently attracted the interest of academia, but with a lack of specific sectorial focus, so far.

Bullock (2009) considers the reforms of the African railways sectors from the mid-nineties and their outcomes. Many Sub-Saharan railways experienced private concessions, but most of them have not lived up to their initial expectations. Improvements in labour and asset productivity can be observed in many cases, thanks to costs reduction, but the relations with governments, particularly about indexed passenger fares and spending commitments by the concessionaires, were very difficult.

Particularly concessions fell short of governments' expectations about the private sector's ability to generate investment for rehabilitation and extension, which remained an unsolved issue for most railway infrastructure in Africa. This analysis is confirmed by Olievski (2013) and Amadou et al. (2015) and there is also consensus that African railways suffered from road competition and were neglected in favour of road investment. However, there is a diversified emphasis on the responsibilities of governments and international donors in favouring road investment and opting for privatization later. Moreover, there seems to be no consensus about the recent trends observed in flows from the World Bank and in the priority given by the Bank and by African countries to the sector at present.

According to Olievski (2013), African governments are the ones which have invested mainly in road infrastructure improvement, neglecting railways. The liberalization in road transport and the slow response of railways to adapt to the new market conditions resulted in dramatic traffic decline in rail transport. To address the crisis, many governments have considered concessions as a solution, and between the mid-1990s and 2010 most of the railways were concessioned. The author emphasizes huge support to African railways by the World Bank Group as, since 1996, IDA has provided about 1 billion dollars to support the efforts of the governments in this process, through grants and loans. The report also stresses that Africa governments should prioritize the railways sector and develop consistent strategic plans.

Another recent report (Amadou et al. 2015) instead, stresses the fact that there is now a renewed interest by African governments and institutions in rail transport, which are seen as indispensable to foster development and take full advantage of the continent's natural wealth. Many African countries, as well as regional communities, are currently designing new railway schemes and several foreign players have become very active in promoting, lobbying government and even investing in railways; moreover, many African decision-makers put high expectations on the rail development. As opposed to this trend, the report points the wrong perception by International Financial Institution's that rail transport is a losing game. According to the authors, the number of operations funded by International Financial Institution's in Africa, in recent years, shows relatively little investment in railways as compared to other infrastructure such as roads or energy.

Coming to the assessment of China bilateral relations with African countries, there are both pros and cons. On the positive side, it is possible to notice that China non-interference policy in international cooperation excludes political conditionality attached to funding, like privatization requirements (Bräutigam 2011). This might ensure alignment with country priorities and for the development of strategic sector. On the negative side, non-interference can also translate into support to corrupted and authoritarian regimes (Halper 2010). Still on the negative side, China has engaged in "resources for infrastructure" loans to African countries, which imply the provision of infrastructure such as roads, bridges, and rails in payment for resources acquired from Africa. This model raises concerns about low-income countries long-term dependency on China and was blamed by critics suggesting that the main motivation of its assistance is to secure natural resources for its growing population and economy (Naim 2007, Kaplinsky et al. 2007).

Empirical literature on the drivers of official funding from China, however, challenges the ideas that Chinese funding targets regimes characterized by worse governance or aims at natural resources grabbing.

Dreher and Fuchs (2015) compared China with traditional donors and other new donors over the period 1996-2005, finding no evidence that Chinese targeting is biased by factors like corruption or

natural resource endowments. Based on data on Chinese projects, the study empirically tests to what extent self-interests shape China's aid allocation. Even if political considerations shape China's allocation of aid, China does not pay substantially more attention to politics compared to Western donors. China's aid allocation is found to be widely independent of recipients' endowment with natural resources and institutional characteristics. According to authors' results, export interests seem to be linked to China's aid allocation in the period 1996–2006. Geopolitical considerations are found to play an important role in all five phases of China's aid program: countries that vote in line with China in the United Nations General Assembly and do not recognize Taiwan as an independent country receive larger aid shares. The results also show some evidence that China follows recipient needs when deciding on its aid allocation, as it favours countries with low per-capita income. Finally, China's aid is, for the most part, independent of the recipients' institutional characteristics. Authors did not find that China's aid is biased towards autocratic or corrupt regimes, removing fears that Chinese aid would undermine the efforts of other donors to promote democracy and good governance.

Based on more than 2000 projects in 50 recipient countries in Africa over the 2000–2011 period, Broich (2017) uses OLS, FE, RE and instrumental variable estimation to shed light on China's development finance activities in Africa. His results suggest that Chinese development finance does not systematically flow to more authoritarian countries, controlling for strategic, economic, political, institutional and geographic factors. Oil rents in the recipient country, Taiwan recognition and per capita GDP are controlled for, and found to be significant. The author doesn't find evidence that Chinese official finance prefers countries with less democratic regimes and lower institution quality, even after changing the democracy indicator used.

Empirical studies however are not sector specific, so that they can't exclude that, since railways are well suited to transport bulky goods over long distances, Chinese funding to this particular sector can be biased by commercial objectives and by the need to import primary commodities for its growing economy.

Referring to the assessment of Chinese engagement in the railway sector particularly, the main contribution is by Blumenfeld et al. (2019). They point to the fact that resource-for-infrastructure loans from China include several railway projects across the continent. They also note that most projects consist of single track, non-electrified, standard gauge lines, both for freight and passenger traffic, but raise concerns over technical compatibility and standardisation of these projects (differences in track gauge, track structure, signalling systems, and incompatible rolling stock, maximum axle loads and speeds) and cost-effectiveness (technologies used in high-capacity networks applied to the low traffic volumes currently found). According to the authors, projects funded by China, particularly through resource-for-infrastructure loans, do not adhere to any shared vision of continent-wide efficient rail networks and are driven by international suppliers' preferences and by the available financing rather than as part of a coherent and coordinated development plan. The fact that China didn't play a role in promoting international standardization and coordination among African countries seem to be very much in line with its non-interference approach, while prioritizing of railway infrastructure and a vision of a continent-wide rail network to facilitate inter- and intra-regional connections were developed only very recently (African Union 2014, UIC 2013).

Based on the literature reviewed above and its gaps, in this paper we formulate and test the following hypothesis:

- hp 0: there is a withdrawal of the World Bank from the sector;
- hp1a: China allocates funding for the railway system to complement funding by the World Bank;
- hp1b: China allocates funding for the railway system to support African countries to substitute funding by the World Bank before the privatization phase;
- hp2: China allocates funding for the railway system to support its trading partners and particularly those exporting natural resources.

3. Data and methodology

Our analysis considers 51 African Countries for which data were available in the period 2000-2014, going back till 1970 for some explanatory lagged variables. Moreover, we retrieved data about countries' features which allow to control for the variables potentially influencing the amount of money made available by China to finance railway projects.

The analysis is based on data on official flows retrieved from two databases: AidData¹ dataset, which records the overseas Chinese official finance between 2000 and 2014 and the World Bank operations dataset which provides basic information on all of World Bank's projects. As regards the first one, the dataset collects official-financed Chinese projects all over the World (Dreher et al., 2017): the amount (in constant US dollars) spent by Chinese institutions (central, state or local government institutions, Export-Import Bank of China, Industrial and Commercial Bank of China, China Development Bank) to support railway projects in African countries. The dataset is based on an open-source methodology, called Tracking Underreported Financial Flows (TUFF), that provides a systematic, transparent and replicable way of tracking aid and other forms of state financing from governments, who do not publish comprehensive or detailed information about their overseas activities. TUFF synthesizes and standardizes unstructured information from governments, international organizations, civil society groups, the private sector, journalists, and researchers. A quality assurance procedure assures the elimination of duplicated records and a consistency check for the projects' classification.

As concern the second source of data, we retrieved data from the World Bank's Projects and Operations database, which publishes information on the World Bank financed projects. World Bank provides low-interest loans, credits, and grants to developing countries to support investments in many areas. Since projects are classified by sector, it was possible to identify railways projects and, in cases of multi-sector projects, the share targeting railways. Some of the projects are co-financed with governments, other institutions or private investors, but in our analysis only the World Bank part has been taken into consideration. In case of multi-country railway projects, total amount has been divided by the number of involved countries.

The country's need of external finance has been measured by GNI per capita, retrieved from World Development Indicators (WDIs). The importance and the nature of economic relationships with China has been measured using exports and imports of each country to and from China. The variable

¹ The data, at the project level, are available at www.aiddata.org. Our study is based on the version 1.3 of the dataset.

has been retrieved from UNCTAD and deflated to constant US dollars. In particular, we controlled for the exports of primary commodities by African countries and for their import of manufactured goods, in consideration of the asymmetry in the structural features of the countries considered: China is characterized by a huge industrial base and African countries are still relying on natural resources.

We included also two time-variant dummy variables: the first one considers whether the country recognizes Taiwan as a state independent from China and it is based on Rich and Banerjee (2015) and Wikipedia dedicated page.² The second one, that is retrieved from PPI database, indicates the presence of concessions and other Public-Private Partnerships (PPP) in African railways.

Finally, the degree of corruption in African countries is measured by the score for the dimension “control of corruption” from Worldwide Governance Indicators (WGI), developed by the World Bank, which measures the perceptions of the extent to which public power is exercised for private gain (e.g. corruption among public officials, diversion of public funds and public trust in politicians transparency, accountability, and corruption in public sector; anti-corruption policy) and it is based on a wide list sources.³

The complete list of the variables considered, jointly with details and technicalities about each of them are available in Appendix 1. Descriptive statistics are also available in Appendix 2.

3.1 Regression analysis

Our regression analysis, whose results are presented in the next section, models official flows from China based on official flows from the World Bank and the explanatory and control variables introduced above.

For their nature, railways projects imply high expenses and long periods of time to be completed. Moreover, both the datasets used provide information on projects by year of commitment of funds, while actual disbursement can be expected to spread over the next years. Consequently, official finance flows are very lumpy, and, in each recipient country, many observations result to be zero, despite projects funded by donors are actually being implemented. To address this challenge, we cumulated official flows over 3 years⁴ for each of the donors, both for the dependent and for the explanatory variables. The dependent variable is shown in equation (1)

$$Y_{i,t} = \sum_{p=0}^2 CH_{i,t-p} \quad (1)$$

where $CH_{i,t}$ represents financial flows from China to country in year t . We formulated the following regression equation (2), where funding by the World Bank is computed in the same way.

² https://en.wikipedia.org/wiki/Foreign_relations_of_Taiwan

³ For an in-depth description of the methodology about Worldwide Governance Indicators’ construction see <http://info.worldbank.org/governance/wgi/Home/Documents>

⁴ Results do remain stable when financial flows are cumulated over 5 years.

$$Y_{i,t} = \alpha + \gamma_1 \sum_{p=3}^5 WB_{i,t-p} + \gamma_2 \sum_{p=25}^{27} WB_{i,t-p} + \gamma_3 X_{i,t-3} + \varepsilon_t \quad (2)$$

where $WB_{i,t}$ represents financial flows from the World Bank to country i in year t and $X_{i,t}$ is a set of controls, also referred to country i in year t . In the models presented, time t varies from 2000 to 2014.

To reduce potential reverse causality and endogeneity problems, we have considered the lagged values of all remaining explanatory variables ($X_{i,t-3}$). There are two variables about financial flows from the World Bank: one has the same lag as other explanatory variables⁵, the other has a lag of 25 years, as in equation (2), where the variable is expected to account for the flows of the pre-privatization period (i.e. from the 70s to the early 90s).

In the robustness check presented in Appendix 3, financial flows from the World Bank are used with a lag of 20 years, by cumulating from $t-20$ to $t-22$. Despite we cannot assume the variation across countries to be completely random and uncorrelated with our explanatory variables, our models were estimated using random effects. As it often happens, this estimator proved to be more efficient than fixed effects, and, more interestingly, its use was systematically supported by the results of the Hausman tests which are reported in Appendix 3 jointly with fixed effects results.

4. Analysis and results

First, we have examined the trends of World Bank official flows from 1970 to 2014, considering African countries as a whole. All the analysis is based on constant USD 2014 values. Figure 1 shows total flows from World Bank to finance railways projects in African countries, and the average percentage of recipient countries' GDP represented by the same flows.⁶

It is possible to notice that the World Bank financed railways projects in Africa more intensively in the first and last intervals of the period examined. More precisely, the World Bank assistance remained above the average of 103 million USD until early 90s (except for the years from 1982 to 1987). Then, flows from the World Bank remained almost always below the average for the next decades, during what we have called privatization period. With the new millennium, it is possible to appreciate an increase of the World Bank funding, picking in 2010 with 550 USD million⁷. Such increase nonetheless failed to keep pace with the economic growth experienced over the same time span by African recipient countries. When the intensity of the assistance provided by World Bank to the sector is considered by looking at the flows as percentage of GDP (right axis), it is possible to notice that the new millennium is only slightly above the first phase of the privatization period and dramatically below the levels of the 70s.

⁵ Results do remain stable when WB funding is taken with the same lag as the dependent variable.

⁶ To smooth the short-term fluctuations in the chart caused by the lump nature of the considered flows, a centred moving average has been used by averaging the value for each year with the preceding and with the following one.

⁷ The figure shows the average of 2009, 2010, and 2011, smoothing down the picks.

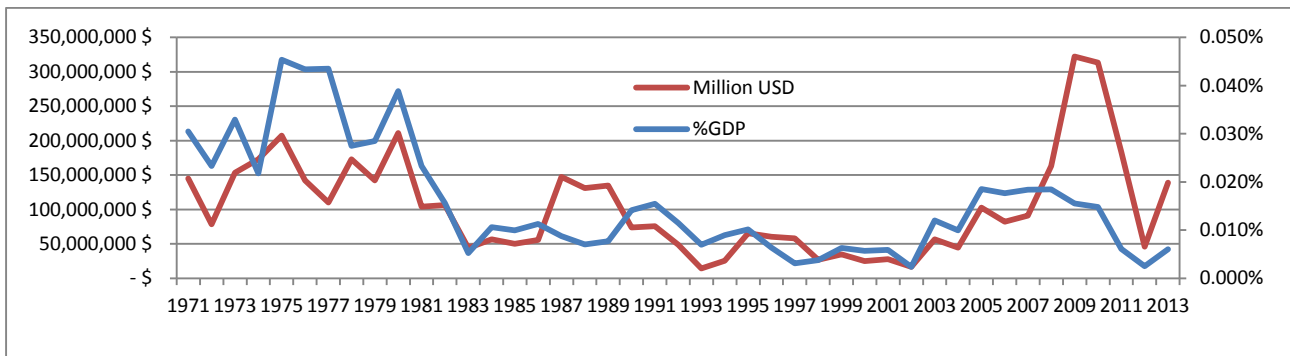


Figure 1 - Moving average of World Bank official flows in millions of USD and as a percentage of GDP; source: authors elaboration based on World Bank data.

Second, we have compared such flows with the average amount provided by China in the period 2000-2014, that 1.0373% of the GDP of the country, while for the World Bank the value is 0.0395%. In absolute terms, World Bank spent almost 5 billion USD financing 84 projects in 29 African countries from 1970 to 2014. A total amount of more than 40 billion USD has been provided by China to finance 34 railways projects among 17 African countries in the period 2000-2014, more than eight times the amount spent by the World Bank in a time period three times longer for averagely bigger projects. Figure 2 provides a comparison of flows for railways at country level in the period 2000-2014. It is important to notice that the vertical axis is in logarithmic scale, to make the World Bank contributions visible.

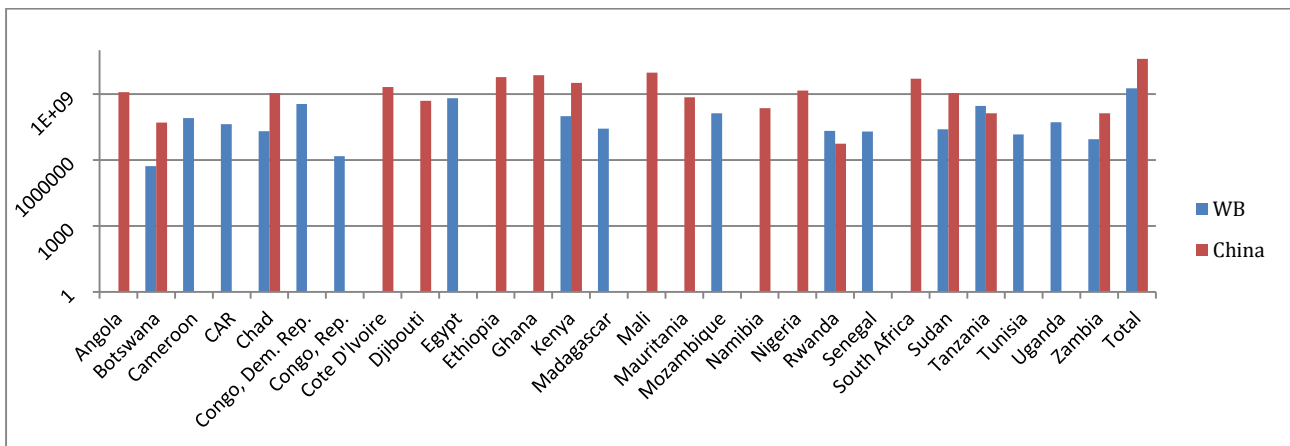


Figure 2 – Flows for railways at country level in the period 2000-2014 (y axis is in logarithmic scale); source: authors elaboration based on World

According to our hypothesis 1, China allocates funding to the railway system to support African countries that are not targeted by the World Bank and the lower assistance in railways projects of the World Bank have been substituted by the one coming from China. Moreover, China in the last decades might have supported particularly the public railways systems of countries abandoned by the World Bank in the privatization period. For this reason, we have compared African countries according to the three variables: average annual flows committed by the World Bank in the period 2000-2014, average annual flows committed by the World Bank in the period 1970-1999, and average annual flows committed by China in the period 2000-2014. The three variables have been divided in three categories: official flows equal to 0, official flows to the country between 0 and their annual mean, official flows greater than the annual mean. To compute the annual mean of each period, only countries who received at least one official flow directed to railways projects have been

taken into consideration. According to the category in which each country belongs for the three periods, African countries have been divided in 7 groups, which are illustrated in Figure 3. The map shows that 22 African countries did not receive any assistance for railways project neither from China or from World Bank; they are labelled as “Never supported” and coloured in light grey. A similar group is formed by the so called “Abandoned” countries that received low official flows in the period 1970-1999 and none from 2000; Algeria, Burkina Faso, Malawi, Morocco and Zimbabwe belong to this group and are coloured in darker grey. In yellow and orange there are 10 countries closer to World Bank; they have not received any support by China, while they were assisted by the World Bank in the period 2000-2014. Cameroon, Democratic Republic of Congo, Republic of Congo, Egypt, Madagascar, Mozambique, Senegal, Tunisia and Uganda are coloured in yellow and labelled as “Maintained”, since World Bank has been present also in the period 1970-1999; while, the Central African Republic is “Newly supported WB” because it did not receive official flows from the World Bank before 2000. Moreover, coloured in two shades of blue there are countries which have received official flows from China and none from World Bank in the more recent period. Angola, Cote D’Ivoire, Ghana, Mali and Nigeria are coloured in light blue and they are the so called “Substituted” countries, because their railways were supported by the World Bank before 2000, then China took its place. In darker blue there are the countries “newly supported by China”: Djibouti, Ethiopia, Mauritania, Namibia and South Africa, which were never supported by the World Bank. Finally, green countries are the ones in which the World Bank and China are both present. These are Botswana, Chad, Kenya, Rwanda, Sudan, Tanzania and Zambia, and are characterized by low official flows from China and by high or low the World Bank official flows in the period 2000-2014. It is important to note that Chinese official flows, that are considered low (because they are under the mean of the official flows from China), are still often greater than the World Bank official flows considered high; for this reason, countries with those characteristics have been grouped in the “Competition” class.

Figure 3 – African countries grouped according to official flows received from China and from the World Bank. Source: authors' elaboration of data from the World Bank and AidData.

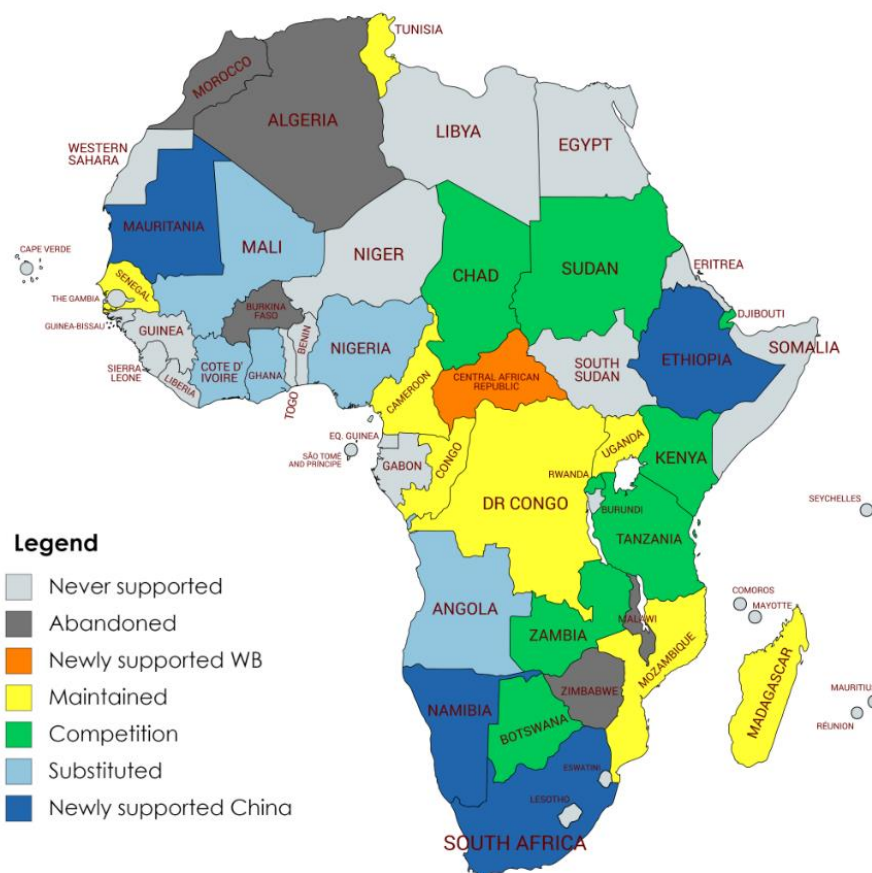


Table 1 – Results of the random effects models.

Official flows from China	A	B	C
Official flows from World Bank	-1.527661***	-1.515764***	-1.521189***
Official flows from World Bank lag25	-1.498664**	-1.468888**	-1.458363**
Taiwan recognition	-96400000**	-101000000*	-97200000*
GNI per capita	-25397.11**	-27182.4**	-27402.16**
Export of primary commodities	-2.068699	-0.4666063	-1.217425
Import of manufactured goods	226.9306***	226.3783***	229.9415***
Control of corruption		25200000	23200000
Public-Private Partnership			-25100000
Constant	112000000**	130000000	134000000
N obs	668	668	668
N groups	51	51	51
Wald chi2	23.27***	24.22***	24.5***

Note: *, ** and *** stand for 1%, 5%, and 10% significance level, respectively. All results are provided with cluster robust standard errors.

Results of random effects panel regression models are presented in Table 1. First, it is possible to see that, in the short run, the amount of money provided by the World Bank has a negative impact on Chinese official funding to the sector, and this relationship is highly significant in all the models considered. This means that, the lower the assistance provided by the World Bank to a country, the highest the assistance provided by China to the same country. Considering lagged values of this variable, World Bank assistance 25 years before has a negative significant impact on Chinese flows, but this result is not confirmed by robustness check presented in Appendix 3, where a lag of 20 years is considered. In any case no positive significant impact was found so that the hypothesis of China substituting World Bank in financing railways projects cannot be confirmed as a general pattern. This is also in line with Figure 3, where a dynamic of substitution regards only a minor part of African countries, namely Angola, Cote D'Ivoire, Ghana, Mali, and Nigeria. The recognition of Taiwan as an independent state has been found significant in all the models. China is less likely to finance railways projects in countries that consider the Republic of China as a sovereign entity and have diplomatic relations with it. Another independent variable which explains China official flows is GNI per capita, with negative coefficients and 5% significance in all models. This means that China supports countries with a higher need of external finance because of their low level of economic development, in line with good development funding practice. Another common characteristic of the models is the non-significance of export of primary commodities and the high significance with positive coefficients of the import of manufactured goods from China by the recipient African countries. This result stresses the importance of economic relationships as a factor influencing Chinese decisions to provide official finance for the development of the railway sector. The lack of significance of the export of primary commodities coefficient, instead, does not support the narrative according to which Chinese assistance aim at the acquisition of natural resources, which might be transported by the railways to the ports. China is more prone to finance projects in countries that import Chinese manufactured goods, considering African countries as outlet markets for its low-cost industrial products. Finally, in models B and C, control of corruption and presence of PPPs are used as control variables. Results indicate that, despite common thought, China decision to finance a country (at least with regards to railways projects) is not linked to its degree of corruption. Moreover, in line with the non-interference policy adopted by China in international cooperation and about internal affairs of partner countries, the coefficient for PPPs does not result to be significant, reflecting openness of China to both private and public management options. A robustness check is presented in Appendix 3, where different models are examined.

5. Conclusions

The African railways' funding by the World Bank, measured as a share of recipient countries GDPs decreased at the level of the continent and for countries from the 70s to the 90s and it was only partially recovered in the new millennium. Funding from China for African railways in the period 2000-2014 was much higher than funding from the World Bank in any period and mostly concentrated in Eastern and Southern Africa, with notable exceptions in West Africa, and North Africa systematically neglected. While in some countries funding from the two sources can now be observed, most countries fall in one of the following patterns: i) China substituting World Bank; ii)

World Bank confirming its commitment to countries railway; iii) World Bank abandoning the country and no substitution observed. This sketched classification inspired a model to explain Chinese funding for African railway, based on World Bank presence in the same sector, and on additional country level variables, namely: Taiwan recognition, per capita GNI, trade with China, privatization of the railway system, and control of corruption.

In line with Dreher and Fuchs (2015) and with Broich (2017), even in the railways sector China has no preference for corrupted countries. Moreover, we find that China has no bias in favour or against privatization and this is in line with its non-interference policy. We can also note that some projects which received financial assistance from China included the concessioning of the railway (Wissenbach and Wang 2017). Funding from China tends to favour its trade partners but, quite surprisingly, favoured countries are not those exporting primary commodities to China, rather those importing Chinese manufactured products. This is in line with Dreher et Fuchs (2015), and contributes to challenge the claim that China assistance aims at natural resources, grabbing in the context of a transport mode which is generally considered to be particularly suited for this kind of trade flows (i.e. bulky and non-perishable goods, like timber or minerals). Import of manufactured goods instead seem to be a driver of the analysed allocation. In line with Dreher and Fuchs (2015), we find that is also targeting Africa as an export market rather than to import natural resources. This is not necessarily negative if we consider literature emphasizing that low income consumers can benefit from low cost industrial products from China (Goldstein et al. 2006), including capital goods.

Funding from China is complementary to funding by the World Bank, in the sense that World Bank funding is a negative predictor of Chinese funding for the sectors. This confirms the prevailing pattern of substitution, already noticed in the descriptive analysis. Quite surprisingly past funding by the World Bank doesn't affect funding by China or, depending on the lag selected, also affects it negatively. This means that China doesn't only tend to favour countries where the Bank is not present at the same time, but also countries that were neglected over time, rather than substituting Bank's funding. Overall, in line with Blumenfeld et al (2019), the approach adopted by China seem to be simply demand driven, without efforts to promote a continent shared vision, nor preferences for private versus public model.

Summarizing our results with reference to research hypotheses, it is possible to observe that:

- Hypothesis 0 is supported, as the World Bank was found to give low priority to African railways, in line with Amadou et al. (2015).
- Hypothesis 1 is only partially supported, because China's allocation criteria show complementarity (1a supported), rather than substitution and no preference for countries without PPP was detected (1b rejected).
- Hypothesis 2 is rejected: export of resources doesn't result to be a main driver of allocation of financial flows to the African railways sector.

The findings contribute to better understand the allocation criteria of Chinese foreign assistance and provide insights on the railway sector particularly. Main limitations of the study are related to the availability of short time series for Chinese data and further research could benefit of longer time series, also to assess the actual development impacts of railways projects financed by China in Africa.

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Appendix 1

Table A – Data description: variable name, description, units of measure, source and period of availability of the variables used in the regression models.

Variable	Description	Unit of measure	Source	Years available
Official flows from World Bank	Official flows from World Bank to finance railways projects. Values have been divided by the country's GDP.	USD	https://projects.worldbank.org	1970-2014
Official flows from China	Official flows from China to finance railways projects. Values have been divided by the country's GDP.	USD	https://china.aiddata.org	2000-2014
GNI per capita	GNI per capita is the gross national income, converted to U.S. dollars using the World Bank Atlas method, divided by the midyear population. Values have been deflated to 2014 by using WDI GDP deflator for the US.	USD	https://datacatalog.worldbank.org	1990-2014
Export of primary commodities	Annual exports of primary commodities to China. According to the Standard international trade classification (SITC), products classified as primary commodities are: food and live animals; beverages and tobacco; crude materials, inedible, mineral fuels, lubricants and related materials; animal and vegetable oils, fats and waxes; non-ferrous metals (SITC 0 + 1 + 2 + 3 + 4 + 68).	USD Thousands	https://unctadstat.unctad.org	1995-2014
Import of manufactured goods	Annual imports of manufactured goods from China. According to SITC, products classified as manufactured goods are the ones belonging to the following categories: chemicals and related products; manufactured goods classified chiefly by material; machinery and transport equipment; miscellaneous manufactured articles; products excluded: pearls and precious or semiprecious stones, unworked or worked; non-ferrous metals; (SITC 5 to 8 less 667 and 68).	USD Thousands	https://unctadstat.unctad.org	1995-2014
Control of corruption	It reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.	from -2.5 (weak) to 2.5 (strong).	www.govindicators.org	1996-2014
Public-Private Partnership	Existence of at least one Public-Private Partnership in railways projects between World Bank and the country in the year.	Binary variable	https://ppi.worldbank.org	1995-2014
Taiwan recognition	Country's recognition of Taiwan as a state independent from China in the year	Binary variable	https://en.wikipedia.org/wiki/Foreign_relations_of_Taiwan	1970-2014

Appendix 2: descriptive statistics

Table B – Correlation matrix for the variables used in regression models.

	Official flows from China (cumulated sum)	Official flows from World Bank (cumulated sum)	Taiwan recognition	GNI per capita	Export of primary commodities	Import of manufactured goods	Control of corruption	Public-Private Partnership
Official flows from China (cumulated sum)	1							
Official flows from World Bank (cumulated sum)	-0.02	1						
Taiwan recognition	-0.05	-0.03	1					
GNI per capita	-0.00	-0.03	-0.14	1				
Export of primary commodities	0.08	0.01	-0.07	0.18	1			
Import of manufactured goods	0.28	0.16	-0.10	0.22	0.37	1		
Control of corruption	0.02	-0.04	0.08	0.30	-0.17	0.02	1	
Public-Private Partnership	0.04	0.00	0.09	-0.09	-0.02	0.20	-0.09	1

Table C – Summary statistics: number of observations, means, standard deviation, minimum and maximum values of variables used in regression models.

Variable	Obs	Mean	Std. Dev.	Min	Max
Official flows from China (cumulated sum)	594	2.85E+07	3.23E+08	0	7.42E+09
Official flows from World Bank (cumulated sum)	702	4492633	3.07E+07	0	6.51E+08
Taiwan recognition	702	0.108262	0.310933	0	1
GNI per capita	650	1805.68	2554.299	138.144	15669.98
Export of primary commodities	610	362787.5	1647021	0	2.28E+07
Import of manufactured goods	687	320481.6	927364.9	1.847282	1.01E+07
Control of corruption	690	-0.60999	0.594333	-1.86871	1.216737
Public-Private Partnership	702	0.226496	0.418862	0	1

Appendix 3: Robustness checks

Table D – Robustness check of the models tested.

Official flows from China	A	B	C
Official flows from World Bank	-1.463114***	-1.448511***	-1.455105***
Official flows from World Bank lag20	0.3205944	0.3626377	0.3593421
Taiwan recognition	-89400000**	-96200000*	-91500000*
GNI per capita	-23735.66**	-26079.68**	-26356.66**
Export of primary commodities	-1.363551	0.7033303	-0.1497522
Import of manufactured goods	222.4981***	221.7959***	225.8239***
Control of corruption		32700000	30300000
Public-Private Partnership			-28700000
Constant	95200000**	119000000	124000000
N obs	668	668	668
N groups	51	51	51
Wald	23.42***	24.12***	24.03***

Table E – Robustness check of the models tested: comparison between models presented in the text and the same models computed using fixed effects.

Official flows from China	A fe	B fe	C fe
Official flows from World Bank	-1.350843*	-1.353369*	-1.38667*
Official flows from World Bank lag25	-1.586515	-1.592848	-1.605526
Taiwan recognition	-71600000	-72500000	-86400000
GNI per capita	-15699.51	-15678.66	-15211.18
Export of primary commodities	-11.55792	-11.54253	-12.87377
Import of manufactured goods	268.3118***	268.4965***	279.2603***
Control of corruption		10300000	20400000
Public-Private Partnership			-75800000
Constant	78900000	85200000	108000000
N obs			668
N groups			51
F(6/7/8,609)	9.26***	7.92***	6.98***
	<i>a vs a fe</i>	<i>b vs b fe</i>	<i>c vs c fe</i>
Hausman test (chi ²)	0.18	0.29	0.61

Note: *, ** and *** stand for 1%, 5%, and 10% significance level, respectively.