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TRABAJO FIN DE GRADO EN
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CHINA AND THE INTERNATIONAL ECONOMY:
A GRAVITY MODEL OF THE BELT AND ROAD INITIATIVE

Economía Española, Internacional y Sectorial

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ABSTRACT

The Belt and Road Initiative aims to increase China’s integration with the world economy through infrastructure projects and investment. We want to assess whether the Belt and Road Initiative (BRI) has contributed to increase Chinese trade with Sub-Saharan Africa. While the literature has covered the trade effects of the BRI, most of the studies try to measure the gains of trade derived from decreased transportation costs. While this remains as one of the most important features of the BRI, we wanted to measure how countries receiving BRI related investments trade with China. To achieve this goal, we built a Gravity model of trade for Chinese exports to 16 Sub-Saharan countries. If BRI investments are effective, China should trade more with these countries.

KEY WORDS: Gravity model, international trade, Belt and Road Initiative, Africa, China

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1. INTRODUCTION

China's Belt and Road Initiative (BRI) has sparked the interest of journalists, analysts and policymakers. It has become the symbol of China's future ambitions of leading the world's economic and political spheres and one of the policies that makes the United States' leadership to be questioned by the international community. The BRI is seen by many as a megalomaniac plan to gain control of developing economies in order to provide a solution to China's economic overcapacity problem and provide with the resources China needs to fuel its transition into a consumer economy. Africa specifically has been one of the main targets of the BRI for this reason. Since these economies do not have the financial strength to undertake much needed massive infrastructure projects by themselves, Chinese investments from Exim Bank or the AIIB linked with the BRI have come to save the day. However, these countries may face difficulties paying back, which has raised concerns over China's growing political interests in the region. In addition, the strong presence of Chinese workers and officials in the region has triggered discontent over the local population. Zambia, for example, has seen how Chinese presence has become a part of their political discussion, with clashes and demonstrations around the issue becoming more pervasive. All this comes to show how a policy to foster growth and trade can have such a profound effect on a country's economic and political reality.

Our study intends to find out how trade between China and Africa works and to observe the effects of BRI membership and related investments on bilateral trade. To this end, the literature directed us towards building a Gravity model on Chinese exports to 16 African economies, for which, we built our own panel data set. Section 2 describes the BRI and its particularities in Africa. Section 3 analyses the existing political and economic connections between the two regions, going into foreign policy, bilateral trade and investments. Section 4 describes the methods and materials used to analyse bilateral trade for our specific case, based on a literature review on current studies about the BRI and China-Africa trade, to then present the Gravity model and describing the data sample. Section 5 lays out the expected results to be obtained from our empirical model. Then we develop the methodology used to obtain our regression model and present the results for each variable. Finally, Section 6 provides the conclusions drawn from our study.

2. THE BELT AND ROAD INITIATIVE

2.1. A worldwide project

Chinese President Xi Jinping announced the creation of the Belt and Road Initiative (BRI) in September 2013 during a speech in Kazakhstan. The program, aimed to increase economic ties between Eurasian countries, which also reaches Africa, is said to be the rebirth of the Silk Road, the ancient trade route that connected China with Europe through a series of trading posts and roads that made the exchange of goods at a transcontinental level possible.

The project aims to increase the economic ties of all the countries between Europe and China through economic development policies, increased connectivity via infrastructure investment, lower trade barriers, capital flows and worker mobility. The project is divided into two parallel strands, the Silk Road Economic Belt, dealing with roads, railroads and drydocks, and the Maritime Silk and Road, revolving around sea connectivity. (MFAPRC, 2017)

The Belt and Road initiative spans 65 countries, home to more than 60% of the World's population, which account to 75% of global GDP and hold up to 75% of total energy resources. Since 2015, when the Initiative was made official, 900 infrastructure projects have been initiated, valued at around \$1 trillion in total, and has prompted talks to enter free trade agreements with 25 BRI countries. (World Bank, 2019)

China aims to shift its economy through the BRI. For one, China's growth up to very recently has largely come from exports, which have originated from labour intensive industries, strengthened by heavy state-sponsored investment in its earlier stages and later by in-bound Foreign Direct Investment. Then, China wants to transform its economy into a services and technology economy, with consumption-led growth. The BRI aims to decrease China's overcapacity problem by increasing its exports to the rest of the world through the improvement of infrastructure overseas. This would allow for more trade through under-connected regions, like Central Asia or Africa, and increasing the capacity of currently existing sea routes. This would also help the ailing Chinese underdeveloped regions -namely, Xinjiang and Yunnan- to grow faster by linking them China's more industrialized regions and the rest of the World and to foster the use of the Chinese currency abroad. (Passi, 2019)

The unveiling of the BRI responds to a shift in Chinese foreign policy, which can be traced back to Chairman Hu Jintao (2002-2012). The increased accumulation of economic and political power brought by China's remarkable economic growth, prompted its leaders to engage in multilateral regional talks and to develop their own brand of foreign policy initiatives. Xi Jinping continued with their predecessors' habits and has integrated China in regional cooperation

agreements like ASEAN (Association of South-East Asian Nations) or the GMS (Greater Mekong Sub-region Economic Cooperation), which serve the goals of supporting the BRI by fostering infrastructure investment and economic cooperation and to maintain friendly relations with China's closest neighbours. (Yu, 2016)

China also created the Asian Infrastructure Investment Bank and the Silk Road Fund in 2013 in order to provide credit to finance BRI related infrastructure projects in Asia. Some commentators argue that this institution may be used to gain political leverage against developing countries, which are in need of investments. However, more than 60 countries have joined the AIIB, including the UK, Australia or South Korea, so it might be difficult to argue that China is going to favour some countries while excluding other members (Dollar, 2015). Institutions with longer standing in Chinese financing of projects abroad like the China Development Bank or the already mentioned EXIM still cover most of the financing needs of the BRI. Another objective pursued with these institutions is to Challenge the dominance of Western supranational institutions like the World Bank or the Asian Development Bank. These banks have financed projects like the China-Pakistan Economic Corridor, the Melaka Gateway Port to name a few. (Cai, 2018)

2.2. The Belt and Road Initiative in Africa

The increasing understanding between China and African countries has been materialised in the inclusion of Africa into the Belt and Road Initiative. During the Belt and Road Forum, held in Beijing in 2017 to sign economic and trade cooperation agreements with over 30 countries, Kenya and Ethiopia among them. These countries plus Egypt and South Africa have signed Memorandums of Understanding with China and all of them are either members or prospective members of the Chinese led AIIB, although the bulk of the financing is carried out by Exim Bank. The BRI projects in Africa play the role of strengthen the Maritime Silk Road, connecting the route that from Pakistan and South-East China with the Mediterranean Sea via the Suez Canal. The BRI's next operational objective in Africa is to connect the East and the West Coast through a network of rails and roads that would link Tanzania with Angola. (Breuer, 2017)

- Suez Canal corridor:

China has become the major contributor to the development of the Suez Canal Corridor. The project is reinforced with an improvement of Egypt's railroad network and an expansion of the Alexandria Port, all conducted by Chinese Firms. Since Egypt's role in the Maritime Silk Road is so crucial, China has made sure to have Egypt on their side by funding Egypt's Central Bank and providing loans to the National Bank of Egypt. (The Diplomat, 2016)

- Ethio-Djibouti Railway:

A railroad line is being built between Addis-Ababa and the Chinese built Red Sea Port (Doraleh) in Djibouti, with EXIM providing up to 70% of the funds needed for construction. China wants to give Ethiopia, a resource-rich country with solid production capabilities, an exit to the sea. The plan includes connecting these countries with the Kenyan port of Mombasa, which is also going to be connected via railway with inland countries like South Sudan, Uganda or Rwanda. (DLAPIPER, 2018). There are also plans in place to connect the aforementioned rail network with the Western African Coast (Daily China, 2016)

- TanZam Line:

China wants to revive the TanZam line, a project developed with the help of Chinese aid during the 70s that linked Tanzania with Zambia to give Zambia's copper an exit to the sea. This line is projected to be connected with the Lobito-Luau line (Angola), which was finished in 2014 and was built by China Railway Construction aiming to connect the mineral-rich interior with the coast (Global Construction Review, 2014). This project is a showcase of the duplicity of the BRI. While it serves a much-needed infrastructure gap, it is still focused on the extraction of resources from impoverished countries desperate for money.

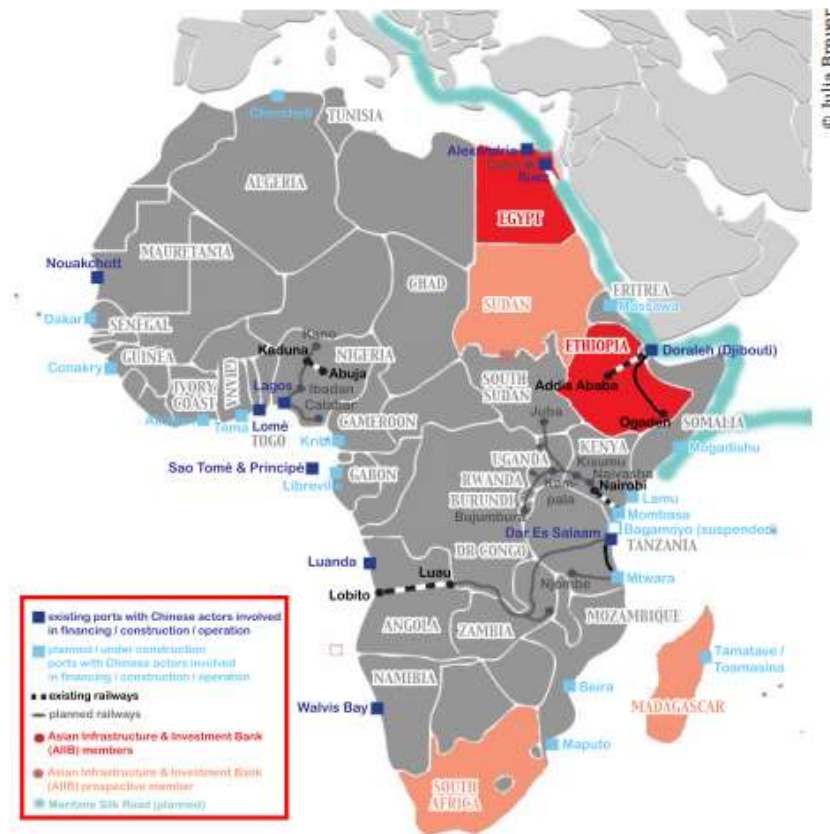


Figure 1. Breuer, J. (2017). One Belt, One Road? The role of Africa in China's Belt & Road initiative, page 3.

BRI projects have raised eyebrows in the international community due to the vulnerability of some recipient countries. By 2017, 23 out of 68 BRI recipient countries were identified in a potential debt-distress situation due to the financing of BRI projects. Among them were Djibouti, Egypt, Ethiopia and Kenya. Since China does not fully adhere to any international credit standard, their policy on countries which are not paying back can be unpredictable. While there is ample evidence that China usually agrees to either forgive or restructure-partially or totally- the debts of struggling countries, the fears of Chinese handling of debts comes from cases like Sri Lanka. This country incurred in debt with China to build the Hambantota Port but was unable to service the debt, so Chinese authorities proposed a debt-for-equity swap with a 99-year lease to manage the port by themselves. (Hurley et al, 2018)

3. CHINESE TIES TO AFRICA

3.1. From Mao to Xi

We can identify three stages in Chinese involvement in Africa. Prior to the 1980s, China's relation with Africa was largely ideological, and was centred in fostering political and military ties with countries opposing the Western bloc, while pursuing Chinese interests in the continent contrary to the Soviet Union, which was mainly achieved through development aid. This process came to a halt during the late 1970s, when Deng Xiaoping took the reins of the People's Republic of China and took a major policy shift towards economic development and modernisation. This approach, which had an emphasis on investment and trade relations, was contrary to the previous and defined Chinese foreign policy, as proved by its increasing ties with Japan and the United States. When we combine this approach with the so called "lost decade", a time of unrest and stagnation in the African continent, economic relations between the regions did not make sense any more, and thus, trade figures decreased quite remarkably while aid followed suit. (Taylor, 1998)

This situation came to a halt when the Tiananmen Square crisis in 1989 made Western leaders uncomfortable with investment and trade with China, and made threats to cut future economic ties conditional on the PRC's human rights record. Meanwhile, some African leaders sent outspoken support for the way China crushed dissent, which provides an example of how the two regions would grow to like each other in a political sense. This support came over African leader's anxiety over Western pressures to democratize their governments, resentment from the neo-colonial powers and the intention to jump-start the weak economic ties between the regions. To China, Africa became a source of diversification of their political and economic interests. If relations with the West had gone sour, at face value at least, China was able then to find new partners with which it could gain leverage in the international scene -as witnessed by some African countries' support of Chinese interests in the United Nations-, and new destinations for their exports. (Taylor, 1998)

Non-interference in domestic affairs play a key role in defining both China and Africa's foreign policy, as both regions have been heavily influenced by the intervention of Western imperialist powers in the past, and thus, both are wary of other countries meddling in internal affairs. This is further exemplified by China's Five Principles for Peaceful Co-existence, which have shaped Chinese foreign policy since the 1950s (Kerry, 2017). However, these principles seem to be currently invoked just when human rights, authoritarianism or corruption are brought up by Western powers (Taylor, 2006).

But China had further motivations for expanding its influence over Africa. One of the goals behind the rhetoric was to obtain oil supplies from oil-rich African countries in order to satisfy Chinese demand for energy to fuel its economic growth. For one China does not have the domestic capacity to rely on itself for its energy needs. In a year like 2004, oil use grew by 15% while domestic oil production just increased by a 2%. Second, China does not want to rely on the world’s oil market, it decided to reach African countries where Western oil interests were not as important as elsewhere, thus obtaining an upper hand over foreign competitors, in a finders-are-keepers manner. This expansion has been characterized by State Owned Enterprises, like CNOOC, CNPC or Sinopec conducting a vertical integration strategy by setting up assets in African countries and controlling its transport and focusing in China’s long term interests. Just in the early 2000s, said companies made multi-billion oil deals, ranging from prospection and barrel supplies to building refineries and pipes in countries like Angola, Nigeria, Kenya, Ivory Coast, Sudan or Ethiopia. (Taylor, 2006).

3.2. Trade and Resources

Chinese relations with Africa have changed over the last 2 decades. The economic ties of the two regions has increased during the last decades due to China’s role as an investor and an infrastructure provider. As per capita income has risen in both regions Africa has become a market for Chinese Exports and investments, which overtook aid flows in the latest decades. This evidences that Chinese relations with Africa are commercially motivated, as aid was only an important flow between the regions since the Cold War era (Wang, 2007). As we can observe in Figure 1, trade flows between China and Africa have increased notably over the last 2 decades.

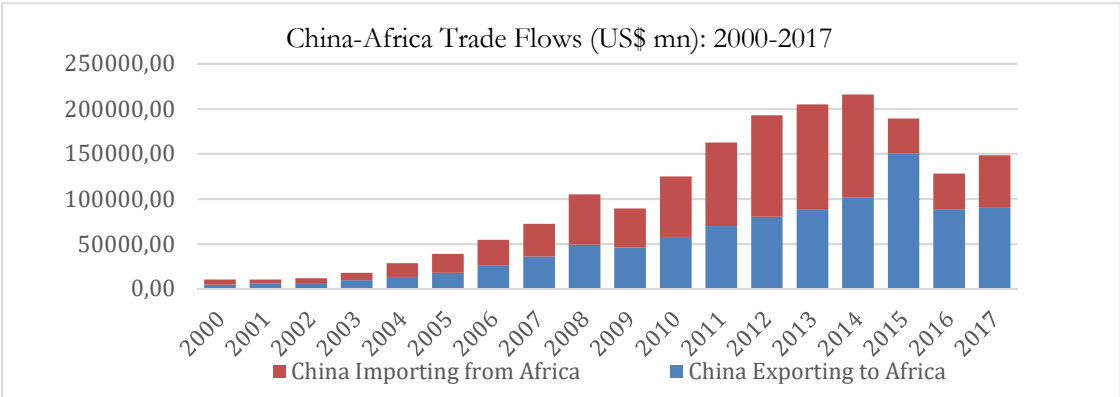


Figure 2. Johns-Hopkins University (2019). China-Africa Research Initiative. Data: China-Africa Trade.

If we observe the product mix of trade between China and Africa in Figure 1 and 2, we can observe a shift since the year 2000 up to 2017. China started the century exporting more than a

45% of consumer goods, followed in importance by intermediate goods and textiles, to the Sub-Saharan region. By 2017, the exports of consumer and intermediate goods showed a decreasing trend. Meanwhile, we can observe an increasing trend in exports of capital goods and machinery and electrical components, which were then the next most important exports after consumer goods. We can conclude that consumable goods had decreased in importance when compared to Capital goods. Increasing exports of capital goods and machinery should have a positive impact on African economies, which are in need for technology to improve their productive capabilities and get a foot into the initial stages of industrialization, as African economies currently rely on resources extraction and agriculture for their subsistence. However, studies on the impact of import-led Growth of African Economies seem to suggest that there is no such relation, which could be attributed to the inability of African economies to use imported technologies to improve their manufacturing capabilities and the bad praxis on procurement contracts caused by corruption (Ogbonna, 2011).



Figure 1-Source: WITS. China Product Export Product Share to Sub-Saharan Africa.

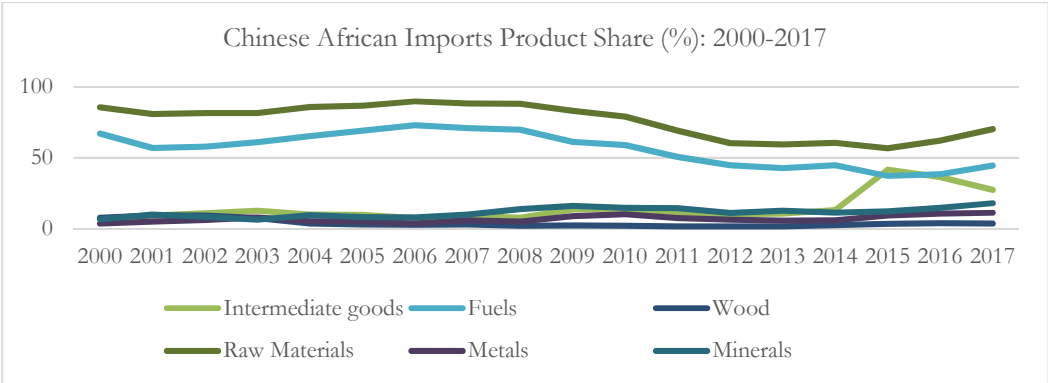


Figure 2- WITS: China Product Import Product Share to Sub-Saharan Africa.

On the Import side, China’s main imports from the region are raw materials and fuels, both of which have decreased in the period considered. We can observe that the next most important goods are raw materials too (wood and minerals). The importance of fuels is of such magnitude

that 5 African Oil exporting countries account for 85% of Chinese imports from the region (Broadman, 2007) From this, we can extract that raw materials are an essential part of trade between the regions. Jenkins and Edwards (2005) predicted that higher per capita income in China would increase food and clothing imports from Africa, but that has not happened, as these categories' import share are far below the rest as China's interest on the region lies on natural resources, which are used as inputs for both their industries and their consumers.

There is evidence that Chinese exports to Sub-Saharan Africa are hurting local export capabilities. Increases of Chinese exports to the region have been linked with lower levels of local exports. The sectors most affected by the crowding-out effect have been textiles, machinery and equipment. This effect has even displaced chemicals and minerals transformation industries, in which Africa could have an advantage due to its relative natural resources factor abundance. The effects go so far as to reduce intra-regional trade in Sub-Saharan Africa. These facts put into question the benefits of Chinese involvement on Africa (Giovannetti and Sanfilippo, 2016).

We can observe a product-based trade pattern. China imports fuels and natural resources from Africa, and, in turn, China exports technology and manufactured goods. This is quite telling of these regions factor endowments. While China lacks natural resources and labour is abundant, Africa lacks skilled labour and capital. Therefore, trade patterns between the regions could be explained by the relative abundance of factor endowments using the Heckscher-Ohlin Model (Wang, 2007). The relative abundance of infrastructure in China also helps to bring down costs and obtain a comparative advantage over developing nation by forcing domestic costs down, allowing for cheaper products that are demanded in lower income countries at the expense of these countries' manufacturing. Politics and institutions come to play an important role here, as Chinese infrastructures and industries are powered by domestic institutions. The role of institutions may obscure the role of comparative advantage to explain trade between the regions (Palley, 2008).

Economies of scale also provide an explanation for China's trade pattern with Sub-Saharan Africa. Chinese State heavy investment and the creation of Special Economic Zones have created mega cities that specialise in the production of both consumer goods, electronics and machinery up to be considered the World's factory of said products. These SZE's have achieved such economies of scale that constitute a barrier to entry to the Chinese market for least developed countries, which allows China to have a trade advantage over African countries in Manufactured goods (Eisenman, 2012).

3.3. Foreign investment and Aid

Chinese firms' involvement in Africa stems from its involvement in the political support of non-aligned, de-colonised countries since the mid-20th century. This support came in the form of military support and Aid. From the 1990s on, the increasing trade ties of both regions urged Chinese SOEs to act as investors and haulers for infrastructure and construction aid projects, with some of them turning afterwards into partially private companies which undertook export operations for the Chinese market. With these footholds, many small and medium private firms flocked to Africa (Kaplinsky and Morris, 2009)

According to data gathered by the John Hopkins University (Figures 3 and 4), Chinese outward FDI to Africa has steadily increased since the early 2000. Though it has remained under US levels, in 2013, coinciding with the official start of the Belt and Road Initiative, Chinese FDI has surpassed US levels, which started to undertake a considerable divestment in the African Continent. Chinese FDI on Africa between 2013 and 2017 has been mostly destined to construction and mining (roughly 25% each), followed by Financial facilitation and manufacturing.

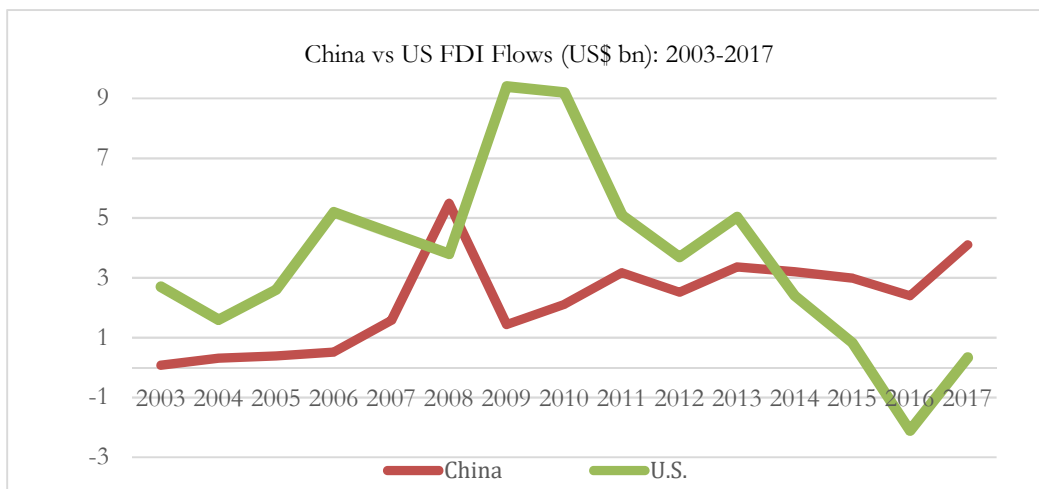


Figure 3- Johns-Hopkins University (2019). China-Africa Research Initiative. Data: Chinese and American FDI to Africa.

Nevertheless, Chinese figures for FDI may be misleading due to Chinese financial institutions definition of the indicator, which provides no clear definition between project financing and FDI proper. Additionally, Chinese firms use of retained earnings and bank loans instead of equity and the lack of transparency may lead to an underestimation of actual controlling investments carried out by Chinese firms on Africa (Wang, 2007).

Development assistance has reached impressive heights in Africa during the last two decades. Even though figures in Chinese investment in the past are hard to reach, estimates show that

Chinese development aid to Africa reached \$5.7 billion by 2006, showing the largest growth rates among all Chinese aid destinations, with some 800 companies operating in Africa at the time. These money inflows have one very prominent source, the Chinese Export-Import Bank, better known as Exim. The bank has been found to finance the infrastructure projects needed for the extraction of energy and minerals from the region. This institution is also well known for extending debt on favourable terms to African governments and Chinese SOEs. (Bosshard, 2007)

However, the World Bank estimated that infrastructure investments reached up to \$12.5 billion by 2006, much more than what was reported by Chinese authorities, 80% of which was concentrated on Angola, Nigeria, Mozambique, Sudan and Zimbabwe. These estimates also reveal that up to 40% of investments went to the energy sector and the rest was concentrated on different infrastructure projects. (Bosshard, 2007)

Investment inflows into Africa come in mostly to exploit the increasing returns of getting first to extract resources. According to the African Development Bank as of 2018, Africa's infrastructure demand amounts to about \$150 billion per year, which would be directed to power, water and transport projects which would allow firms to thrive in the continent and achieve industrialization in order to end poverty. Then, the infrastructure needs of the African economies are not yet met. As Guillon et al. (2018) point out, between 2000 and 2014 Chinese Overseas Development Aid went primarily to the economic infrastructure and services sector, which is linked to natural resources acquisition, and was allocated more frequently in countries with weaker institutions. While Chinese infrastructure aid has had mixed effects on Africa's development, it has helped to the economic recovery of many African countries, but it must be stated that labour practices, local participation, debt sustainability and negative impacts on the environment by Chinese firms still represent an obstacle to development (Alves, 2013).

4. TRADE ANALYSIS METHODOLOGY

4.1. Trade Analysis Literature Review

The growth of the Chinese economy and its bid to become a dominant power in global trade has inclined many trade economists to study the trade effects of Chinese policy on the different regions of the world. Most recently, the Belt and Road Initiative has sparked the interest of analysts and the academia, which has resulted in a rich trade analysis literature on the issue. As we will observe in the following paragraphs, most of the analysed articles use the Gravity model to study the determinants of trade flows between regions. On the next lines, we are going to

analyse the literature on the Global effects on trade of the BRI and follow with a review on literature of China-Africa trade engagement.

4.1.1. China and Belt and Road Trade effects:

This section reviews papers dealing with the impacts of both China and the Belt and Road Initiative in various regions of the world.

Garcia-Herrero and Xu (2016) developed a Gravity model in order to measure the degree by which world economic integration and trade gains are achieved by programmes like the Belt and Road Initiative. They achieve this by controlling for the effects of transportation costs and tariffs. The model includes three different types of transportation costs, which are proxied with the distance between countries by sea, rail and air. In total, the model includes 16748 observations of bilateral trade from 129 countries and uses Pseudo Poisson Maximum Likelihood estimator to carry out the regression, as it deals well with zero trade issues and provides a robust estimator in presence of heteroskedasticity.

Garcia-Herrero and Xu simulate three different trade scenarios, namely, the reduction in transportation costs implied from Belt and Road Initiative estimates, the creation of a free trade area within Belt and Road countries and the combination of the previous two. The article shows that the European Union would gain trade in the three different scenarios, and that landlocked countries would benefit the most from a reduction in transportation costs, mainly from land transportation. The biggest losers would be countries outside of Europe and Asia, but these losses are close to the 0 per cent. This article is somewhat important among Belt and Road Initiative and Gravity model Literature, to state the effects of the different scenarios that the OBOR may entail, namely the modest increase in trade due to cost reductions (Passi, 2018; Pencea, 2016).

Ramasamy et al. (2017) use the Enabling Trade Index variables in a Gravity model, rather than develop their own Dataset. The article focuses on the effects of improvements in the quality of both soft and hard infrastructures to measure their effect in the amount of exports between countries, besides the "typical" Gravity model variables, adding three interaction variables and fixed time effects. This model uses 70000 bilateral trade observations from 139 country pairs in a mixed effects of panel data estimation. The model shows that improvements in border administration and information produce modest increases in exports.

Chu Ping Lol (2018) developed a gravity model that introduces an equilibrium condition with a demand function with time preferences on one side and the supply function with transportation costs to measure the trade generated between China and the EU through freight time reductions

due to the Belt and Road Initiative infrastructure improvements in Eurasia. The article concludes that additional trade of 8 to 32% might be expected between the regions, and predicts that land transportation might become the dominant transportation mode in the medium term. Choi et al. (2018) use a gravity model to compare the trade volumes originated by the Maritime and Inland silk and road respectively and to assess the state of several variables before and after the Belt and Road Initiative. Herrero and Xu (2016) were among the motivations of Hwan Choi et al. (2018), due to their findings about the impact of different forms of transportation on trade. Hwan Choi et al. (2018) find that GDP has a stronger effect on trade along the Maritime Silk Road than the Inland Silk Road. They also find that infrastructure has had a stronger effect on exports after the arrival of the Belt and Road Initiative. The author uses a Structural Gravity model to estimate the effects of the possible Free trade agreements that may arise from the Belt and Road initiative.

Kohl (2018) uses a gravity model includes value-added trade flows instead of the more typical total trade flows, to measure the effect of the Belt and Road initiative on trade and welfare. The model uses a general equilibrium model, which includes countries outside the BRI in order to take into account spill over effects. Kohl is quite critic with the use of gross trade flows between countries. According to several studies (Johnson, 2014; Johnson and Noguera, 2012), this practice creates biases that do not take into account the bidirectional linkages of a country's value added, but Gravity model literature still relies largely on gross trade flows to the best of our knowledge.

Shahriar et al. (2018) provides one of the first studies on the economic integration of China with the Greater Mekong Sub-region, which comprises Chinese Yunnan and Guansi, Laos, Cambodia, Myanmar, Thailand and Vietnam, and home to more than 250 million people. To measure the degree of economic integration, Shahriar et al. (2018) use a gravity model that includes dynamic factor variables to avoid omitting important factors such as historical trade relations. However, the authors still face a limit on the number of variables they can include due to the unavailability of data or variable selection, which keeps key issues on trade out of the model. Despite this, their model states that China is integrated with the Greater Mekong Subregion countries through economic ties and bilateral agreements.

Nguyen et al. (2015) attempted to assess the differences in the results of the gravity model by measuring the determinants of bilateral trade flows from Vietnam to 54 partners, which are grouped by income levels. The authors run two separate models. The first, which includes just time variant variables are run with fixed effects Ordinary Least Squares, and the second, which includes both time variant and time invariant variables, uses regular old OLS, as including fixed

effects would wipe out any effect of time fixed variables from the estimation. The authors conclude that Vietnam's trade follows the Heckscher-Ohlin model with richer countries, while following Linder's Hypothesis with lower income countries.

4.1.2. *China-Africa trade effects:*

This section concentrates on the review of papers that had dealt with the China-African trade effects.

Hu and van Marrewijk (2013) developed a Gravity model, using Zero-inflated Poisson regression, to analyse the trade relations between China and Africa. They estimated the trade pattern between the regions during the last decades of the late 00's in order to obtain, employing data from the next decade on the previous model to obtain a prediction that could be compared with actual data. They then include China's Preferential Trade Policies to assess their impact on trade with Africa. They employ data on 28 African exporters and 181 worldwide importers through 21 years (accruing 105840 bilateral trade observations). They conclude that China's promotion of trade in Africa through FDI, aid and cooperation is working to increase bilateral trade. However, they also state that tariff exemptions may not have as big of an impact as expected.

Johnston et al (2013) built a Gravity model consisting of 155 countries to assess the determinants behind the role of China as Africa's biggest trade partner. Countries outside of Africa were included to avoid product biases, as Africa mostly exports oil and raw materials. The researchers found that the recognition of the One China Policy had positive effects on trade and that China under traded with resource-poor countries. They use Pseudo-Poisson Maximum Likelihood to carry out the estimations, due to its benefits when dealing with heteroskedasticity.

Giovannetti and San Filippo (2005) assess the possible flood of cheap imports from the EU and China into Africa, hurting local producers by being crowded out and unable to compete.

They provide with a Gravity model which uses both OLS and the Generalized Method of Moments to carry out the estimations. They have observed that annual increases in Chinese Exports to Africa correspond with decreases in African Exports, concentrated in sectors dominated by China (textiles, clothing, machinery or equipment) and a decrease in intra-regional trade, especially in Sub-Saharan Africa, and consequently, they validate their hypotheses that Chinese exports crowd-out African Exports.

García-Herrero and Fung (2012) provide an analysis of FDI outflows from China and India to African countries. Through the use of Gravity model which runs weighted least squares and uses FDI outflows from each of these countries as a dependent variable. Besides the typical

gravity model variables (GDP, per capita GDP and Distance), they include quality of governance and public policy variables like the corruption, law and order or the capital control indexes of each target country. The authors conclude that Chinese investment is largely directed towards comparatively more corrupt countries with larger but poorer markets than India is. They explain this fact with the importance of Chinese SOEs as the major contributors to FDI outflows, which are involved in infrastructure projects in the region, often in exchange for oil or debt forgiveness, a practice more common in countries with comparatively worse rule of law. From this review of the literature it seems clear that the gravity model is the crucial method for the analysis of the BRI impact in several regions. Thus, the next section is devoted to present the gravity model's theoretical foundations and introduce our own model.

4.2. The Gravity Model:

The Gravity Model was first used by Ravenstein (1885) to study migration flows between countries. Later in the 1960s, that the Gravity model started to become a tool to study international trade when Tinbergen (1962) used Newton's Gravity equation to model trade flows between countries as a function of the sizes of their economies and the distance between them, that proxy existing trade costs. The Gravity Model started as a way to stylize trade between regions, merely as a metaphor, as it provides an intuitive explanation for a complex problem, which did not operate under any economic theoretical framework and remained out of mainstream economics until 1995

After this phase, trade theorists and economists have developed an extensive body of literature behind the model, which has allowed to bring light to the dynamics of international trade but were still perceived as an analogy to physics. Some of the first theoretical approximations were laid out by Linnemann (1966), who used the gravity model in a complex partial equilibrium model with exports on the supply side and imports on the demand-side. Later, many economists like Anderson (1979), who developed an economic approximation to the model assuming product differentiation by geographic origin and CES expenditures, or Bergstrand (1985), who used the model in a Heckscher-Ohlin framework, defined further theoretical foundations of the gravity model on empirical grounds, but were too complex to become part of economists' analysis toolkits.

While globalization was making the press and the general public feel that borders were no longer of use in the 1990s, McCallum (1995) developed a gravity model which refuted that notion. His piece showcased the entry of the Gravity model into mainstream economics due to the usefulness of his model to predict the outcomes of trade policies. Anderson and van Wincoop (2001) state the importance of including multilateral resistance terms into gravity equations, as

omitted variables can overestimate the negative effect of borders on trade (Head and Mayer, 2014). The Gravity model is now a standard procedure and a widely used model which, according to Yotov et al. (2016), is able to consistently provide a fit of between 60 and 90% of trade flows for both aggregate and sectoral data.

The most basic form of the gravity model is comprised of three variables that explain trade flows. X_{ij} represents trade flows -either total trade, imports, exports-. Y_i (Y_j) represents a measure countries i and j 's economies (most usually GDP). These are Country or Region's i and j 's GDP, (or other measures of economic size), and distance, a proxy for trade costs between target economies. β_1 and β_2 are expected to be greater than 0, while β_3 must be lower than 0 for the intuitions of the Gravity model to hold. The sign of these coefficients represents the proportional relation between the economies and trade flows and the inverse relation of distance with trade flows, respectively.

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} D_{ij}^{\beta_3} \quad (1)$$

The Gravity model can appear either as shown above, in its multiplicative form or in its logarithmic -linear form-, as shown below. The latter is the most widely used form of the Gravity model, according to the literature, even though Santos Silva and Teneyro (2006) point out that log-linearized forms of the Gravity equation can result in misleading conclusions.

$$\log(X_{ij}) = \alpha + \beta_1 \log(Y_i) + \beta_2 \log(Y_j) + \beta_3 \log(D_{ij}) \quad (2)$$

Expanded versions of the gravity model contain more variables in order to curb the omitted variable bias. Including just the previous variables to model trade flows may provide an over-estimation of their coefficients and these variables could be correlated to the error term, leading to endogenous variables. Anderson and van Wincoop (2001) introduced the concept of Multilateral resistance factors, which take into account trade flows are affected by trade between third parties. An expansion of the Gravity model could be the following:

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} D_{ij}^{\beta_3} L_i^{\beta_4} L_j^{\beta_5} A_{ij}^{\beta_6} \epsilon_{ij} \quad (3)$$

$$\log(X_{ij}) = \alpha + \beta_1 \log(Y_i) + \beta_2 \log(Y_j) + \beta_3 \log(D_{ij}) + \beta_4 \log(L_i) + \beta_5 \log(L_j) + \beta_6 \log(A_{ij}) + \epsilon_{ij} \quad (4)$$

In Equations 3 and 4 (the linearized form of equation 3), we have added variables for the population of countries i and j (P_i and P_j), which can affect trade flows -due to, for instance economies of scale or market potential- and a set of dummy variables in B_{ij} , which usually control for the existence of trade barriers between countries or special characteristics which may affect the nature of trade flows. (Baier and Bergstrand, 2009)

We are going to follow the methodology used by the most updated versions of the Gravity model, which appear in Nguyen et al (2016), Shahriar (2018), as reviewed above. These works include as their variables: Population, trade openness and the bilateral exchange rate besides the traditional gravity model variables. However, we have decided to drop bilateral exchange rate from our model since we considered that Chinese FDI outflows into African countries would provide a better understanding of trade flows between the regions. Adding FDI flows in the model as an explanatory variable has been previously used by Fonaigné and Pajot (1997). Even though Sheperd (2016) recommends adding both in and outside flows when adding bilateral variables, data on African outgoing FDI has been almost impossible to gather for all the countries in our model. To take into account past trade relations we introduce a lagged export variable, used by Greene (2008) and Irwin et al. (1998). The model also includes five dummy variables, Petrol Exporter, Transport Investment, Mining Investment, Landlocked and BRI Member, which aim to measure the effect of the Belt and Road in the model, as well as specific country characteristics. Similar use of dummy variables is used in the models in which we are taking inspiration for our study.

The following equation follows from our decisions:

$$\begin{aligned} \log(\text{Exports}_{ij}) = & \alpha + \beta_1 \log(\text{GDP}_i) + \beta_2 \log(\text{GDP}_j) + \beta_3 \log(\text{pcGDP}_i) + \beta_4 \log(\text{pcGDP}_j) + \beta_5 \log(\text{AdpcGDP}_{ij}) + \\ & + \beta_6 \log(\text{Openness}_j) + \beta_7 \log(\text{Pop}_j) + \beta_8 \log(\text{FDI}_{ij}) + \beta_9 \log(\text{Distcap}_{ij}) + \beta_{10} \log(\text{BRI}_j) \quad (5) \\ & + \beta_{11} \log(\text{PetrolExporter}_j) + \beta_{12} \log(\text{Landlocked}_j) + \beta_{13} \log(\text{exports}_{ij,t-1}) + \\ & \beta_{14} \log(\text{Transport}) + \beta_{15}(\text{Extraction}) + \varepsilon_{ij,t} \end{aligned}$$

Nguyen et al. (2016) subdivide equation 5 into three separate models in order to avoid inaccurate estimations and overfitting the model. Each different model shares the same variables but the economic size variables. Following this logic, Model I (6) contains the GDP variables, Model II (7) contains the per capita GDP variables, and Model III (8) contains the absolute difference in per capita GDP.

Model I:

(6)

$$\log(\text{Exports}_{ij}) = \alpha + \beta_1 \log(\text{GDPI}) + \beta_2 \log(\text{GDPj}) + \beta_3 \log(\text{Pop}_j) + \beta_4 \log(\text{Openness}_j) + \beta_5 \log(\text{Pop}_j) + \beta_6 \log(\text{FDI}_{ij}) + \beta_7 \log(\text{Distcap}_{ij}) + \beta_8 \text{BRI}_{ij} + \beta_9 \text{Petrol}_{ij} + \beta_{10} \text{Landlocked} + \beta_{11} \text{Transport} + \beta_{12} \text{Extraction} + \beta_{13} \log(\text{exports}_{ij,t-1}) + \varepsilon_{ij}$$

Model II: (7)

$$\log(\text{Exports}_{ij}) = \alpha + \beta_1 \log(\text{pcGDPI}) + \beta_2 \log(\text{pcGDPj}) + \beta_3 \log(\text{Pop}_j) + \beta_4 \log(\text{Openness}_j) + \beta_5 \log(\text{Pop}_j) + \beta_6 \log(\text{FDI}_{ij}) + \beta_7 \log(\text{Distcap}_{ij}) + \beta_8 \text{BRI}_{ij} + \beta_9 \text{Petrol}_{ij} + \beta_{10} \text{Landlocked} + \beta_{11} \text{Transport} + \beta_{12} \text{Extraction} + \beta_{13} \log(\text{exports}_{ij,t-1}) + \varepsilon_{ij}$$

Model III: (8)

$$\log(\text{Exports}_{ij}) = \alpha + \beta_4 \log(\text{AdpcGDP}_{ij}) + \beta_3 \log(\text{Pop}_j) + \beta_4 \log(\text{Openness}_j) + \beta_5 \log(\text{Pop}_j) + \log(\text{FDI}_{ij}) + \beta_6 \log(\text{Distcap}_{ij}) + \beta_7 \text{BRI}_{ij} + \beta_8 \text{Petrol}_{ij} + \beta_9 \text{Landlocked} + \log(\text{exports}_{ij,t-1}) + \beta_{11} \text{Transport} + \beta_{12} \text{Extraction} + \varepsilon_{ij}$$

4.3. Sample and data

The data sample used in our exercise covers the economic relations of eight African countries with China from the year 2000 to 2017. These specific countries -Angola, Ivory Coast, Ethiopia, Kenya, Nigeria, South Africa, Tanzania and Zambia- have been drawn from an intensive research carried out by the McKinsey institute carried out between 2016 and 2017 (Jarayam et al. 2017). This study aimed to uncover the business activity and investment linkages that were happening in Africa, due to the obscurity of existing data on Chinese business labour use, management, size or financing.

Although the country sample is small, there is strong variability among them due to their different levels of strategic relations to China. For one, robust partners, like Ethiopia and South Africa have aligned their development strategies with Chinese international projects like the Belt and Road Initiative and there are plenty Chinese firms in the different sectors of their economies. Others, like, Kenya, Nigeria or Tanzania have ample presence of Chinese businesses on their economies but their economic engagement results from a passive approach, that is, China recognizes these countries' market potential. Angola's relationship with China is mostly explained by Angolan oil exports in exchange for infrastructure investment. Zambia on the other hand is a recipient of Chinese private sector investment, which has reportedly resulted in a looming debt crisis (The Economist, 2018). Finally, Ivory Coast is the least engaged of the 8 countries, with few Chinese investors and businesses.

We also decided to include 8 additional countries to increase the size of our sample so that we better capture the determinants of trade between the regions. We gathered data on Botswana, Cameroon, the Democratic Republic of the Congo, Congo, Mozambique, Gabon, Namibia and

Zimbabwe. We chose these countries on the basis of data availability, since we aim to build a balanced data panel.

4.4. Why panel data

Panel data has many advantages over cross-sectional data. Both kinds of data are widely used in the estimation of Gravity Model, though the use of panel data has grown in importance during the last 30 years. Panel data usually has more degrees of freedom than cross-sectional or time series, leading to more efficient estimates and it deals better with heterogeneity than cross-sectional data. Panel data is also able to capture more complexity than other series, as panel data covers several individuals over a defined period of time ($T > 1$, $N > 1$), while cross sectional data can only cover one period ($T = 1$) and time-series can cover just one individual ($N = 1$). It has also been proven that, under certain circumstances, computations and inferences are simpler (Hsiao, 2007).

4.5. Variables and data sources

Figure 6 provides a brief summary of the variables included in our model, including the mean, minimum and maximum value and number of observations. Additionally, we have added an appendix to our work containing the gravity model panel dataset, which will be uploaded alongside our study.

Our Gravity model contains the variables of its most basic form. That comprises economic size, income and distance. GDP i and j represents the Gross Domestic Product of country $i(j)$ in millions of US dollars at current prices. PcGDP $i(j)$ is the per Capita Gross Domestic product of Country $i(j)$, also expressed at current prices in millions of US Dollars have been obtained through UNCTAD. Exports $_{ij}$, that is, exports from China (i) to partner country (j) have been obtained from the IMF Direction of trade statistics database.

The lagged export variable aims to represent the influence of previous trade flows on the current, making any results conditional on the countries' past trade relations (Greene, 2008). According to Irwin (1998), omitting past trade relations on a Gravity Model can result in omitted variable bias showing up in our estimations.

FDI $_{out}$ has been obtained from the Africa-China research initiative -developed by the Johns Hopkins University-, a database that also contains information on loans, agricultural investments, construction, workforce and aid carried out by China on African territory from 2000 to 2017. FDI data provided by the China Research Initiative comes from the China Statistical Yearbook and the Statistical Bulletin of China's Outward Foreign Direct Investment

and covers the years 2003 through 2017, as Chinese FDI was recorded according to a different definition in the previous Chinese statistical yearbooks, which covered data up to 2005, and hence, both pieces of data are not consistent. To overcome the missing values, we have taken the median value of every country for the years 2000 to 2002.

The Distance variable has been obtained from CEPII's GeoDist distance database, which contains data on several measures of distance between all the countries in the world, which is valid for country pairs. Distance is a time fixed variable, which measures the distance between the capital cities of China and its trade partners covered in the sample

Landlocked, which gives a value of 1 if a country is landlocked and 0 when a country is not, is a time fixed dummy variable has too been obtained from CEPII's GeoDist geographic database. This database contains information about several geographic variables like common language or common colonizers for 225 countries around the world.

Petrol Exporter equals 1 when country j exports oil raw products to China. The variable has been developed by the authors by observing which sample countries exported Petroleum during the period we cover and has been retrieved from UNCTAD.

BRI is a dummy variable that equals 1 when country j was engaged in China's Belt and Road Initiative and 0 for the opposite. All countries received BRI investments from 2013 to 2017, as reported in the Global Chinese Investment Tracker database. This database provides disaggregated data on 3100 transactions of Chinese investments by sector, country and year. It also attempts to pinpoint the sources of investments, that is, whether they come from Chinese banks, SOEs or the private sector and whether or not these investments belong to larger programs like the Belt and Road Initiative.

The Global Chinese Investment tracker also includes the sector to which BRI investments are directed towards. We initially wanted to include the flow of Chinese investments to African countries 2000 through 2017. However, there were too many missing values and many countries did not receive any investment over the period. Instead we decided to include of 2 additional dummy variables, both of which account for whether a country received BRI investments related to the Transport and Minerals and Metals sectors.

Figure 6: Data Description. Author's calculations

	Min.	Max.	Mean
Exports _{ij}	4,703	16832,7170	1629,6516
GDP _i	1211331,2	12237781,8	5708455,306
GDP _j	2914,926	568498,7882	56344,3579
pcGDP _i	943,9932	8682,24956	4157,9705
pcGDP _j	109,0972	10716,2241	2286,6983
AdPCGDP	21,92385	8255,8114	2833,4613
pop _j	1231,122	190886,311	34976,4714
Openness _j	0,6800	141,5569	44,9893
FDI _{out}	0,0019	1440,8467	95,3979
Distance	8315,988	12372,95	10961,1117
LandLocked	0	1	0,25
BRI	0	1	0,4375
PetrolExp	0	1	0,5
Transport	7	1	0,5625
Metals	0	1	0,375

N. of observations per variables: 288

N. of Countries: 16

N. of observations per country: 18

Source: Author's own calculations

5. RESULTS

5.1. Expected results

The Gravity model works according to a set of theoretical foundations, which have been explained above. Empirical Gravity models, then, must show a set of results so that they are consistent with their fundamentals and with the literature. We are going to point out the expected results to be obtained from our regression and divide them into time-variant and time-fixed variables.

- Time-variant variables:

According to the basic assumptions of the gravity model both GDP and GDP per capita, that is, the size of an economy are expected to show positive effects on the amount of trade between two countries. The effect of the difference in income between two countries may have ambiguous effects. For one, if the Heckscher-Ohlin model holds, income disparities may have positive effects on the amount of trade. Conversely, if the Linder Hypothesis holds, the more similar two countries are, that is, if the difference in income is lower, the more trade will happen between both countries, showing a negative sign.

The lagged export variable, which represents the trade history between countries, is expected to have positive effects on trade. The more two countries have traded in the past, the more trade will happen between them. The lagged export variable aims to represent the influence of previous trade flows on the current, making any results conditional on the countries' past trade

relations (Greene, 2008). According to Irwin (1998), omitting past trade relations on a Gravity Model can result in biased estimations.

Trade openness in African countries is expected to have a positive sign, as the more important trade flows are to GDP in a country, the more it is expected to trade. The more a country's economic size is explained by trade flows, the more it is expected to trade

Population can have either a positive or a negative sign depending on whether the importer countries trades less when their populations are bigger, due to the absorption effect- or more, whenever the economy benefits from economies of scale (Martínez-Zarzoso and Novak-Lehman, 2001)

According to Fonaigné and Pajot (1997) outward FDI can either reduce or increase exports to the receiving country. Chinese investments on African countries can create a trade imbalance with China -i.e. China exports more to target country- due to the improved competitiveness of the investors. Conversely, investments can follow a "relocation" strategy, where the aim is for the investing country to increase their imports from abroad, having a negative effect on the investing country's exports.

- Time-Fixed Variables:

The distance between countries is expected to have a negative effect on trade. This has been some of the most solid results in international economics. As we have previously mentioned, McCallum (1995), through a Gravity model, was able to state that borders and distance had a negative effect on trade, giving the Gravity model some of its current academic recognition as a method to explain trade flows.

The BRI dummy variable is expected to have a positive effect on Chinese outward trade. This may happen for two reasons. For one, the reduced trade costs linked with the program's investments on transport and infrastructure are expected to increase Chinese trade with its partners. Additionally, as previously mentioned, one motives behind the Belt and Road Initiative is to ease its overcapacity by expanding into new markets and, thus, increasing exports to the rest of the World. Transport is expected to have a positive though small, as Egger et al. (2007) found with their own Gravity model. Since minerals and metals' extraction are so essential to African economies, comprising most of their exports, improved extraction capabilities via investments is expected to increase bilateral trade flows. Since Minerals and Metals are essential to understand Chinese trade flows with Africa, we expect a positive sign on this variable. The dummy variable for Petroleum exports to China is expected to have a positive effect on trade, since we have found petrol to be the most important exports of the region to China, which

China receives in exchange of consumer and capital goods. The control of oil sources in Africa appears to be a driving force behind Chinese foreign and trade policy.

Finally, landlocked countries are expected to trade less with the exterior, since most of today's trade is carried out by water and they rely on land, and marginally air, infrastructure. The situation of Landlocked countries is especially dire in Africa, where the lack of land infrastructure, trade and economic growth (García-Herrero and Xu, 2016).

5.2. Unit roots test:

In order to properly estimate the proposed equations, we need to ascertain whether our panel data has unit roots or not. To determine the presence of panel unit roots we have to test every time dependent variable for stationarity. If there is no panel unit root, we will be able to use standard estimation techniques. If not, we will test our models for cointegration.

We have decided to use the Levin-Lin-Chu (2002) panel unit roots test, as it is the method used by Shahriar (2016) and is widely used in panel root models. This method, “tests the null hypotheses that each time-series has a unit root, against the alternative hypothesis that each time series is stationary”. The method works under the assumption that there is independence across individuals and assumes common cross-country auto-regressive parameters. (Levin et al., 2002). We are going to apply the LLC test both at Level and at First difference series for each variable. If a variable has a Unit root at Level, we will transform the variable with first differences to make it stationary. Then, if all variables have no unit root, the Null Hypothesis of LLC will be rejected, and we'll be able to use standard estimation methods.

As observed in Figure 7, at Level, Exports_{ij}, GDP_j, pcGDP_j, AdpcGDP, FDI_{out} Pop_j and Openness_j are found to be stationary at less than 1% significance level. At First Differences, Exports_{ij} (-1), GDP_i, pcGDP_i, pop_i, and Openness_i are found to be stationary. Since all our variables have no unit root, we reject the Null Hypothesis of the LLC test and conclude that there is no panel unit root.

Figure 7: Levin-Lin-Chu Test

Variable	Level		1st-Difference	
	LLC	p-value	LLC	p-value
Exports _{ij}	-5,7269***	0,0000	-4,2797***	0,0000
Exports _{ij} (-1)	5,7251	1,0000	-17,4765***	0,0000
GDP _i	7,2603	1,0000	-5,79736***	0,0000
GDP _j	-3,1414***	0,0008	-8,69727***	0,0000
pcGDP _i	5,6214	1,0000	-5,6850***	0,0000
pcGDP _j	-2,7140***	0,0033	-8,66416***	0,0000
AdPCGDP	-5,4399***	0,0049	-7,57469***	0,0000
pop _j	-11,3533***	0,0000	-9,98469***	0,0000
Openness _j	-5,2032***	0,0000	0,0436	0,5174
FDI _{out}	-2,1654***	0,0152	-4,8554***	0,0000

*, **, *** indicates significant LLC test at 10%, 5% and 1%

Source: Author's own calculations

5.3. Fixed effects vs Random Effects: The Hausman Test

We have carried out a panel analysis to estimate the determinants of trade between China and the chosen African countries with EViews 10. Following Shahriar (2018), we are going to use either Random or Fixed effects Ordinary Least Squares estimation to obtain an estimation of the isolated effects of Time-variant variables, a short-term model so to speak. Then, we are going to follow with Panel Least Squares estimation on Models I through III, which takes into account long-term fixed variables like whether a country is landlocked or the distance between countries. To assess which one of them we are using, we will perform the Hausman test on the Random effect's regression of Time-Variant variables. Fixed effects estimators are consistent and are a good answer to endogeneity issues, besides, the effects of time-fixed variables are controlled with time-variant variables. Random effects estimators are more efficient, but consider unobserved variables to be uncorrelated with observed variables, which can sometimes be wrong, (Williams, 2018). The Hausman test is then used to solve this problem, as it detects endogenous variables in a model, that is, when they are correlated with the error term. The null hypothesis states that the Random effects model is preferred and the covariance between variables and the error term is zero. With the alternative hypothesis, the fixed effects model is preferred since variables are correlated with the error term and there is endogeneity. (Chmelarova, 2007).

Our results for the Hausman test, laid out in Figure 8 report that the null hypothesis is rejected at less than 1% level of significance for all three models, which implies that the covariance between the regressors and the error term is different from zero, signalling the presence of endogeneity in our model. Therefore, in order to obtain consistent estimators, we are going to use the fixed effects estimates in our model, as its estimates are consistent even in presence of endogeneity.

Figure 8: Fixed Effects vs. Random Effects; Hausman Test.

Variable	Model I			
	Fixed Effects		Random Effects	
	Coeff.	p-value	Coeff.	p-value
C	-98,7456***	0,0000	-139,8386***	0,0000
Exports _{ij} (-1) *	0,2558***	0,0000	0,2762***	0,0000
GDP _i *	2,8689***	0,0000	2,0558***	0,0000
GDP _j	0,4624***	0,0002	0,8173***	0,0000
pcGDP _i *				
pcGDP _j				
AdpcGDP				
Openness	0,0001***	0,0000	0,0002***	0,0000
FDI _{out}	0,0019***	0,8507	-0,002353	0,823
Pop _j	4,4625***	0,0000	0,294077***	0,0007
R2		0,9658		0,9135
Hausman Test			Chi2	p-value
			35,2666***	0,0000

Model II				
Variable	Coeff.	p-value	Coeff.	p-value
C	-99,8956***	0,0000	-142,08***	0,0000
Exports _{ij} (-1) *	0,2560***	0,0000	0,2764***	0,0000
GDP _i *				
GDP _j				
pcGDP _i *	2,8625***	0,0000	2,0522***	0,0000
pcGDP _j	0,4647***	0,0001	0,8182***	0,0000
AdpcGDP				
Openness	0,0001***	0,0000	0,0002***	0,0000
FDI _{out}	0,001902	0,8573	-0,0024	0,8185
Pop _j	4,9186***	0,0000	1,1116***	0,0000
R2		0,9658		0,9134
Hausman Test			Chi2	p-value
			35,1593***	0,0000
Model III				
Variable	Coeff.	p-value	Coeff.	p-value
C	-106,2541***	0,0000	-181,0933***	0,0000
Exports _{ij} (-1) *	0,3448***	0,0000	0,3546***	0,0000
GDP _i *				
GDP _j				
pcGDP _i *				
pcGDP _j				
AdpcGDP	-0,0123	0,7376	0,0536	0,1051
Openness	0,0001***	0,0000	0,0002***	0,0000
FDI _{out}	-0,0252**	0,0453	-0,0269**	0,0318
Pop _j	5,3817***	0,0000	0,7508***	0,0000
R2		0,9477		0,8574
Hausman Test			Chi2	p-value
			52,0887***	0,0000

* represents First Different

Note: *, **, *** on coefficient represents 10%, 5% and 1% level of significance

Source: Author's own calculations

5.4. Regression

Our models provide a good measure of fit to the real data. As we can see in Figure 9, Models I and II explain 93.66% of Chinese exports to African Countries, while the adjusted R2 measure is very similar, which tells us that the independent variables that actually affect Chinese Exports explain 93% of both models. Model III provides a worse performance measure as the model explains 75.25% of trade flows, a fifth less than our first two models. If we resort to the F-statistic test, all our three models' p-values are statistically significant at less than 1%, which allows us to reject the null hypothesis that our model has no overall predictive capabilities, and thus results have not happened by chance.

Figure 9: Panel Regression Results

Variables	Model I			Model II		Model III	
	Coeff.	p-Value	Coeff.	p-Value	Coeff.	p-Value	
C	-126,3969***	0.0000	-129,0762***	0.0000	-202,0191***	0.0000	
EXPORTS _{ij} (-1)*	0,2813***	0.0000	0,2814***	0.0000	0,262829**	0,0218	
GDP _i *	1,7319***	0.0004					
GDP _j	0.9326***	0.0000					
pcGDP _i *			1,7306***	0,0005			
pcGDP _j			0,9326***	0.0000			
AdpcGDP					-0,1246**	0,0464	
OPENNESS _j	0,0002***	0.0000	0,0002***	0.0000	0,0003***	0.0000	
FDIOUT	-0,0173	0.2030	-0,0173	0,2020	-0,0822***	0,0015	
POP _j	-0,0335	0.4495	0,8991***	0.0000	0,5504***	0.0000	
DistCap	-2,1910***	0.0000	-2,1908***	0.0000	-0,839314	0,3047	
Transport	0,2089***	0.0000	0,2089***	0.0000	0,11843	0,1516	
PetrolExp	0,1689***	0.0000	0,1689***	0.0000	0,1779***	0,0036	
Landlocked	-0,0990**	0.0135	-0,0989**	0,0136	-0,2131***	0,0068	
Bri Member	0,1401***	0.0000	0,1401***	0.0000	0,2776***	0.0000	
Metals	0,2572***	0.0000	0,2572***	0.0000	0,1119	0,1036	
R2		0,9366		0,9366		0,7525	
Adjusted r2		0,9333		0,9333		0,7408	
	F-statistic	p-value	F-statistic	p-value	F-statistic	p-value	
	28,42775***	0.0000	28,42025***	0.0000	64,12173***	0.0000	

Source: Author's own calculations

We are going to start the analysis of our results with the cornerstone variables of the Gravity Model, that is, all five economic size variables, and distance, which results are reported in Figure 8. The economic size variables in Models I and II, GDP_{i,j} and pcGDP_{i,j} are all significant at less than 1% and have a positive effect on Chinese Exports to Africa, as expected. For Chinese GDP and pcGDP, a 1% increase leads to a 1.7% increase in exports. The African counterpart is less than proportionate, as a 1% increase leads to about a 0.93% increase in Chinese exports. The effect of the difference in Incomes between regions (Model III) was predicted to be ambiguous, depending on whether the H-O model or Linder's Hypothesis is more prevalent. The variable is statistically significant at less than 5% significance level and has a negative impact on Chinese exports to Africa, as a 1% increase in income difference leads to a 0.12% decrease in exports, which is a weak effect. This result implies that, in this case, Linder's Hypothesis is more prevalent, as the two regions trade less when their economic sizes tend to a wider difference. Finally, distance shows a strong negative effect on exports in Models I and II, with a percent increase in distance lowering Exports by 2%, being both statistically significant at less than 1%. Nevertheless, in Model III, distance has a much lower negative effect on trade which is not statistically significant.

Chinese Outward FDI has not been as powerful as we had expected. It is not statistically significant in models I and II in either the short-run or the long-run, but it is in models III, with a negative effect of 0.08% by an additional 1% FDI flow. As the Johns-Hopkins University's China Research Initiative stated, Chinese outward FDI figures may not represent the true

picture, as the amount of Chinese companies setting shop in the last two decades have been increasing.

The trade history variable has had, as expected, a positive and statistically significant effect, increasing Chinese exports to Africa by 0.3% with stronger past trade flows. This result goes in line with the work Greene (2018) and Irwin (1998), as the lagged trade variable helps explain the determinants of trade flows.

African countries' trade openness appears to be statistically significant across the three models, but its effect on Chinese exports to Africa is negligible, as a percent increase in African trade openness translates into an almost 0% percent increase in Exports. This result could derive from the fact that most of these economies rely on resource or raw materials' exports at a similar level. Since the most of the countries considered had a similar level of openness to trade, save for Nigeria and South Africa, its effect on trade flows might not show as powerful as others despite being an important factor.

African population is statistically significant in Models I and II, showing positive but less than proportionate effects on Chinese exports to the area. The positive sign implies that economies of scale shape China's exports to Africa, that is, the more populous a country is, the more exports are directed to it to benefit from a larger market size. As we observed in the first chapters of this work, most of Chinese exports to Africa come in the form of consumer goods, with intermediate and capital goods following closely. It makes sense then that the larger the population, the more needs Chinese products can serve. However, we have observed that population has increases trade by a 5% with a 1% increase in population in the short-run model, much more powerful than the long run model. The fact that the second model includes distance, may be the reason for this change, since some of the trade that was happening because of population alone, has been countered with the negative effect of distance and has been disseminated in the remaining fixed variables and the errors.

Being a BRI member has had a positive effect on trade. This affected bilateral trade flows by an increase of 0.14% in models I and II and 0.26% in model III, being statistically significant across all models. This tells us that Chinese policy is achieving its objectives, trading more for instance, though more time is needed to observe the longer-term effect of the BRI.

Oil exporting countries have been proven to receive more Chinese Exports by about a 0.2% more than those who are not, being statistically significant at less than 5% in all three models.

This result confirms our intuition since oil is one of the cornerstones of trade flows between African Countries and China. Additionally, countries that received Chinese investments to the minerals and metals' extraction sector also tend to trade more with China, up to a 0.25% more.

Countries that received transport infrastructure investments, most of them linked to the BRI, also tend to trade more with China. Finally, being a landlocked country had a negative effect on trade, with locked countries trading up to a 0.2% less with China.

6. CONCLUSION

Our work aimed to achieve an understanding of the main factors that explain Chinese relationship with Africa. In our model, we chose a sample of 16 African sub-Saharan countries trading with China, in which the main projects of the Belt and Road Initiative were happening and their neighbours and we analysed how the Belt and Road Initiative might have an effect on trade between the regions.

Our model has behaved as expected by its theoretical backgrounds, laid previously. Bigger economies, like Nigeria or South Africa tend to trade more with China, and the wider the income gap between China and Africa the less trade happens. The main intuition from the gravity model also holds, since distance has a very significant negative effect on trade. The Belt and Road Initiative aims to reduce this negative effect, since improving transport infrastructure brings countries closer. However, as Garcia-Herrero et al. (2016) point out that most of the improvements on infrastructure can be done in land infrastructure. From this, we can expect that land BRI projects on Africa will have a positive effect on inter-African trade. Countries receiving BRI investments on transport or metals and minerals sectors traded more with China than those who did not, which comes to show how the BRI is working towards increasing large-scale integration, and how Africa is becoming more relevant in the international economy.

Projected BRI related investments may contribute in closing the infrastructure gap, since the 35% of Sub-Saharan African population does not have access to electricity and 51% does not have access to water (World Bank, 2017). Since local governments do not devote enough resources to this end, the BRI energy related infrastructure investments could help closing this gap. However, these projects are taken by countries through loans to Chinese institutions, which have raised concerns over developing nations' debt sustainability and the possibility that the Chinese government may use this to obtain political leverage and control over these countries. Overall, the effects of the BRI on African development are ambiguous. We have also proven that petrol is an essential part of Chinese trade with African countries. Our results confirm that those countries which export crude oil or derivatives to China receive more Chinese exports than those which do not. The same applies to countries receiving investments to the transport and mining sectors. Africa has become one of the main suppliers for the Chinese demand of

natural resources. The lack of infrastructure in Africa has allowed Chinese contractors and policy makers to step in and gain an edge in obtaining these resources on a larger scale than current operations. As we noted in the first chapter of this work, projects like the Tan-Zam Line or the Lobito-Luau line, both of which want to link coastal areas with the mineral and resource rich sectors in the interior.

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8. APPENDIX

The Excel file containing the Gravity model panel database will be uploaded alongside the TFG documents in MiAulario. Due to formatting problems and its large size, we deemed it better to upload the database as an additional file.