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Chinese FDI in Africa, natural resources and the energy transition challenges

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Abstract

In this study, we assess the effect of natural resources on FDI flows to Africa within the energy transition context. To do this, and given China's growing presence in Africa, we focus only on China as a main investor in Africa. We analyze its outward FDI flows, at micro and macro level to 30 African countries over a 19-year period (2000 to 2018). Our results show that not all natural resources are attractive factors for FDI. Mineral resources and natural gas were found to be key determinants of Chinese FDI while oil resources have a negative impact on Chinese FDI flows to Africa. These results might suggest an engagement in the energy transition process which requires specific mineral resources.

JEL Codes : F21 , L72 , O13

Keywords : FDI , Natural Resources , Energy Transition

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1 Introduction

The World Bank (2017) underlines that non-renewable mineral resources, most of which are necessary for energy transition, play a key role in 81 countries that collectively account for a quarter of global GDP, half of the world's population, and nearly 70 percent of people in extreme poverty Group [2017]. The climate issue and the energy transition therefore represent an opportunity, that could lead to significant inflows of foreign investment to these countries whose soils are rich in these metals. It is estimated that the producers of these metals, in the respective countries, could alone generate revenues similar to those of the oil sector over the next 20 years (approximately 13,000 billion dollars). We need to underline the importance of African countries in this perspective. Africa's wealth lies mainly in its subsoil, as it possesses one-third of the world's mineral reserves needed for the energy transition, such as 90 percent of platinum reserves, 80 percent of coltan, 60 percent of cobalt, 70 percent of tantalum, 46 percent of diamond reserves and 40 percent of gold reserves. The African continent is also rich in clean energy sources such as the river basins of Central Africa, uranium deposits (in Mali, Gabon, Niger or Namibia), sunlight in the Sahel countries and the geothermal potential in East Africa (Ethiopia, Kenya, Uganda, Rwanda, Burundi, Zambia, DRC). We then put a focus on the investment opportunities in Africa, and underline China's role.

To investigate the link between Chinese foreign direct investments and natural resources presence in Africa, we employ a multi-step econometric approach at macro and micro level. Specifically, we use firstly Panel Corrected Standard Errors (PCSE) to address cross-sectional dependence between panels. Secondly, we conduct further analysis using cross variable techniques with conflicts as well as, a gravity model to verify our baseline results. Finally, we employ the Generalized Method of Moments (GMM) system to control for unobserved heterogeneity and simultaneity bias related to an inverse causality between our applied variable and our variable of interest and micro level analysis using firms data. Using these techniques, we aim to produce robust and reliable estimates of the causal effect of natural resources on Chinese Foreign Direct Investment. A sample of 30 African countries over the period 2000 to 2018 is used and our results indicate that not all natural resources are attractive factors for FDI. Mineral resources and natural gas were found to be key determinants of FDI while oil resources have a negative impact on Chinese FDI flows to Africa. These results are in suggest an engagement in the energy transition process requiring specific mineral resources and a decreasing oil consumption.

The purpose of this research is therefore to firstly provide details and empirical evidence on a possible effect of energy transition's natural resources on FDI flows and secondly to analyze the main determinants of FDI in Sub-Saharan Africa. The following section presents a relevant literature review that illustrates the determinants of FDI in general and the impact of natural resources on FDI in particular. Section 3 presents some stylized facts, section 4 describes the methodology and data used, while Section 5 presents the empirical results, and Section 6 analyses the robustness of our results. Finally, Section 7 concludes the study and presents the main policy recommendations derived from the results.

2 Literature Review

The literature on the impact of natural resources on countries' economies is extensive and the results vary not only according to the type of FDI but also according to the category of countries studied[1]. Starting with studies that did not distinguish between the samples studied or the typology of FDI, the latter have been found to be negatively impacted by natural resources [Asiedu, 2013, Hayat, 2018]. This negative correlation persists even when controlling not only for institutional quality but also for other variables known to be determinants of FDI and the presence of natural resources dampen the positive effect of FDI on economic growth. FDI's determinants are not the same for developped and developing countries [Saini and Singhania, 2018]. In developed countries, FDI seeks policy-related determinants (GDP growth, trade openess, freedom index) and in developping countries, FDI shows a positive association with economic determinants (Gross fixed capital formation , trade openess and efficiency variable). Some studies have departed from those cited above by making a distinction between resource and non-resource FDI. Their results suggest that resource FDI is mainly vertical while other types of FDI are an export-fragmentation variety [Poelhekke and van der Ploeg, 2010] and also that discovery of natural resources in a country that was not a producer of them lead to a drop in non resource FDI of 16% in the resources in the short run and 68% in the long run [Poelhekke and Van Der Ploeg, 2013].

In the African context , resources revenues influence FDI [Bokpin et al., 2015]. Also, democracy promotes FDI if and only if the value of the share of minerals and oil in total exports is less than some critical value [Asiedu and Lien, 2011]. They identify 90 countries where an expansion of democracy may enhance FDI and 22 countries where an increase in democratization may reduce FDI and find that the effect of democracy on FDI depends on the size and not the type of natural resources. Natural resources can have an adverse effect on FDI and the FDI-resource curse persists even after controlling for the quality of institutions and other important determinants of FDI after considering six measures of institutional quality from two different sources, and two measures of natural resources [Asiedu, 2013].

Institutional factors show 3 different effects on attracting Chinese FDI [Shan et al., 2018]. Firstly, the study reveal surprising results that political stability and regulatory quality are negatively related to China OFDI. Secondly, the rule of law and control of corruption have no significant effect on China's OFDI. Thirdly, voice and accountability exerts a significant and positive impact on the inflow of China's FDI to Africa.

[1] The empirical research on the determinants of outward expansion of Chinese firms is based mainly on descriptive evidence (see among others Taylor, 2002; Wong and Chan, 2003; Deng, 2003, 2004), on company case studies (see among others Liu and Li, 2002; Warner et al, 2004; Zhang and Filippov, 2009), studies of specific host countries (e.g. on Germany Schüler-Zhou and Schüller, 2009; on Italy Pietrobelli et al., 2011; on the UK Cross and Voss, 2008; Liu and Tian, 2008) and particular industries (i.e. on the automotive sector Amighini and Franco, 2011)

Some empirical research has been carried out to examine the motives or ramifications of the presence of Chinese multinational corporations in foreign nations. Tuman and Shirali [2017] find that Chinese FDI is influenced by trade flows and natural resources in host economies, including oil resources and ores and metals, while also being directed to markets with lower per capita income. It has been observed that institutions and natural resources exert a combined influence on Chinese outward foreign direct investment [Kolstad and Wiig, 2012]. In instances where the institutional framework of a host country is suboptimal, Chinese FDI tends to be drawn towards the country's natural resource endowments. The presence of abundant natural resources is a key factor that attracts Chinese foreign direct investment, especially in countries with suboptimal institutional environments. However, this poses a challenge in terms of development impact, as such investment tends to exacerbate the institutional dysfunctions prevalent in resource-rich countries [Kolstad and Wiig, 2011].

Studying the dynamics of China's outward direct investment (ODI) by examining the changing roles of the host economy's financial development and natural resources in the choice of FDI destination, Feng et al. [2022] found that Chinese multinationals are increasingly inclined to seek natural resources in host economies, especially after the 2008 financial crisis, regardless of whether the host economy is a developed or developing economy. On the other hand, the financial development of the host economy is less important. Exploring the determinants of chinese FDI at sectoral level, Amighini et al. [2013] confirm the market-seeking hypothesis for the whole sample, in the sub-group of high income countries and in the OECD group. To test the resources-seeking motivation, the share of fuels in total exports is significant with a negative sign, only in the general model. The exchange rate level, market potential and openness of host countries are significantly positive determinants of Chinese outward FDI, while infrastructure facilities of host countries proved to be negatively associated with Chinese OFDI flow [Liu et al., 2018]. Moreover, Chinese OFDI in OBOR countries is not very responsive to exchange rate volatility, labor cost, natural resources, technology level and political environment. Results also suggests that motivation of China's OFDI in OBOR countries are different from those in countries outside. Oil/minerals and agricultural imports facilitate more FDI, and political instability spurs more FDI [Gold, 2022]

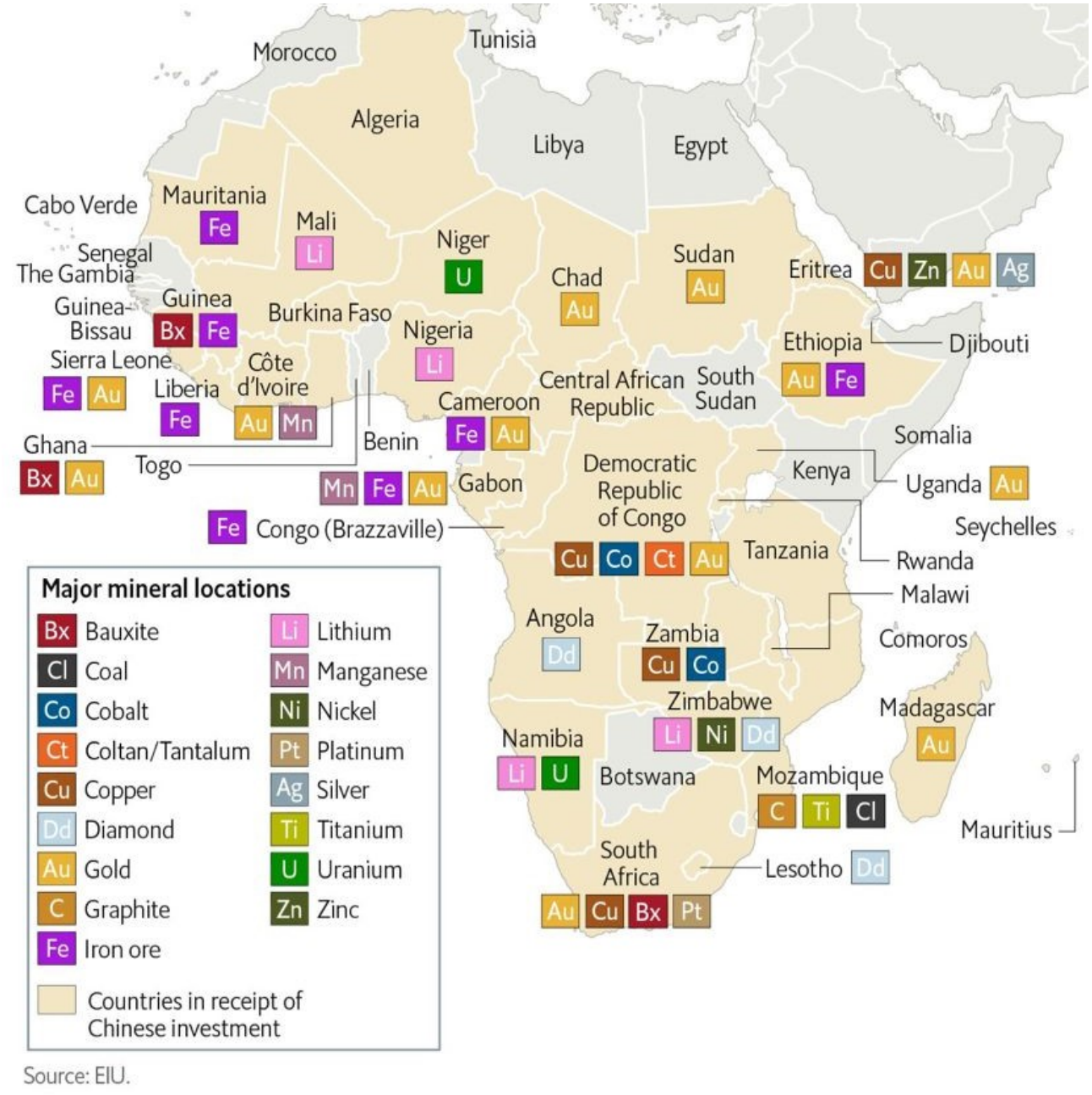
To our knowledge, we are the first to address this issue of FDI related to natural resources in the context of the energy transition and Chinese presence in Africa. We study the location of FDI in light of the natural resources presence (resources that are linked to the energy transition vs those that are not).

3 Stylized fact

This section highlights several stylized facts about China's FDI destination, amount and the sectors in which these investments are made in in the world in general and in Africa in particular. We can notice that the dominant sectors are always those of energy, transport and metals. Figure 2 shows Chinese investment in Africa since 2010. We can see that the leading sectors are oil, natural gas, road and rail infrastructure and other mining.

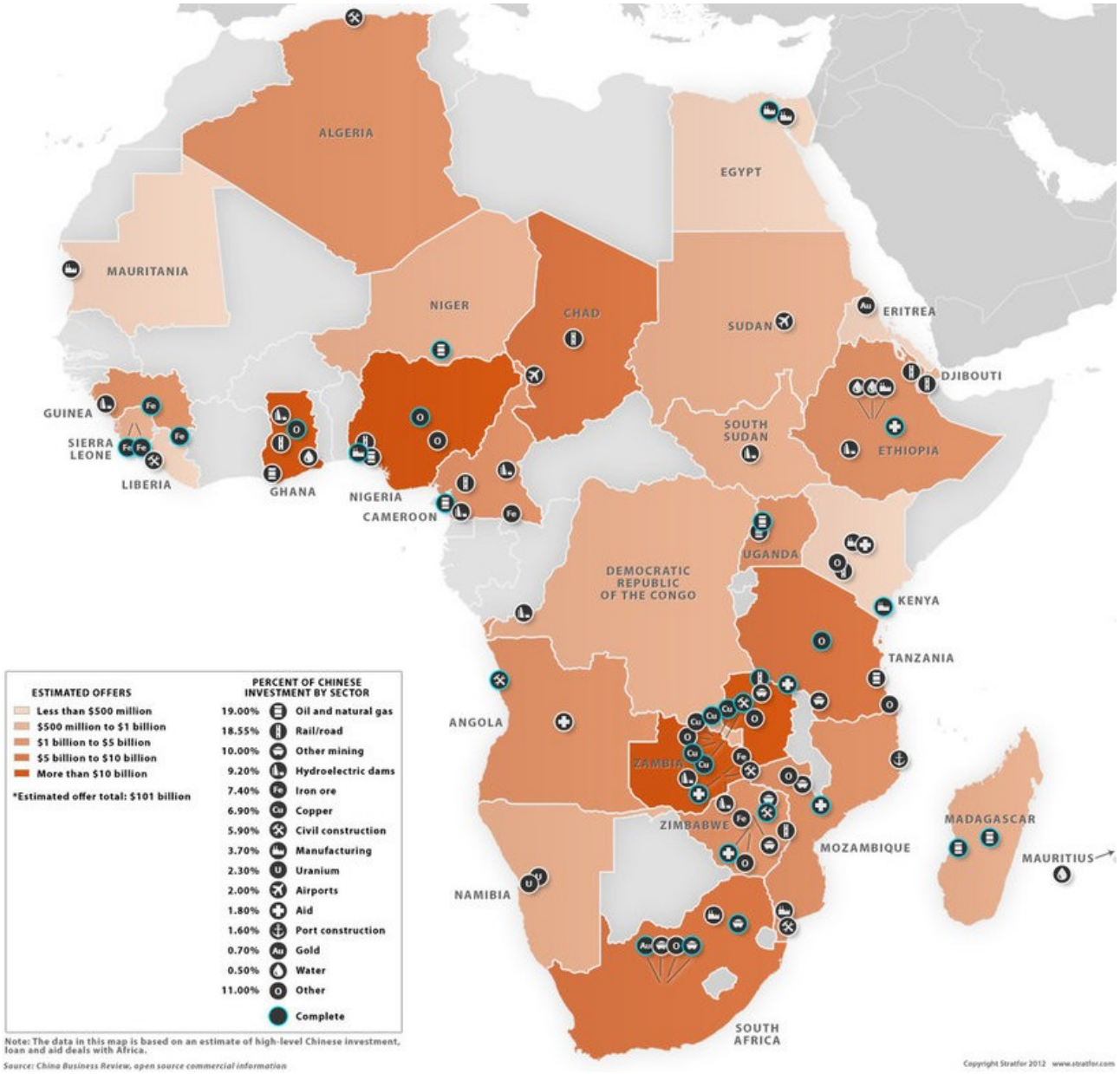
According to Economist Intelligence Unit (EIU) data Figure 1, China plays a significant role in Africa, with over 40% of the continent's mineral exports and one-third of its ore and metal exports being directed to China. China is investing heavily in the region, focusing on infrastructure development and numerous projects aimed at providing much-needed electricity access to the continent. This investment spans both traditional power plants and renewable energy projects. Notably, a report by the International Energy Agency (IEA) found that China is expected to participate in almost 70% of new sub-Saharan African hydropower capacity between now and 2030. While it is hoped that Africa will not only be a source of natural resources and raw materials, the continent's development represents a significant opportunity for trade and investment. In the coming years, approximately one out of every two people born on the planet will be African, and the region will soon become the most populous place in the world with over 2 billion inhabitants. Developing strong commercial relations and deep roots in Africa will be a strategically important positioning for any organization looking to be involved in the continent's rise.

Figure 1: **China investments in Africa during 2021**



Source : Economist Intelligence Unit (EIU)

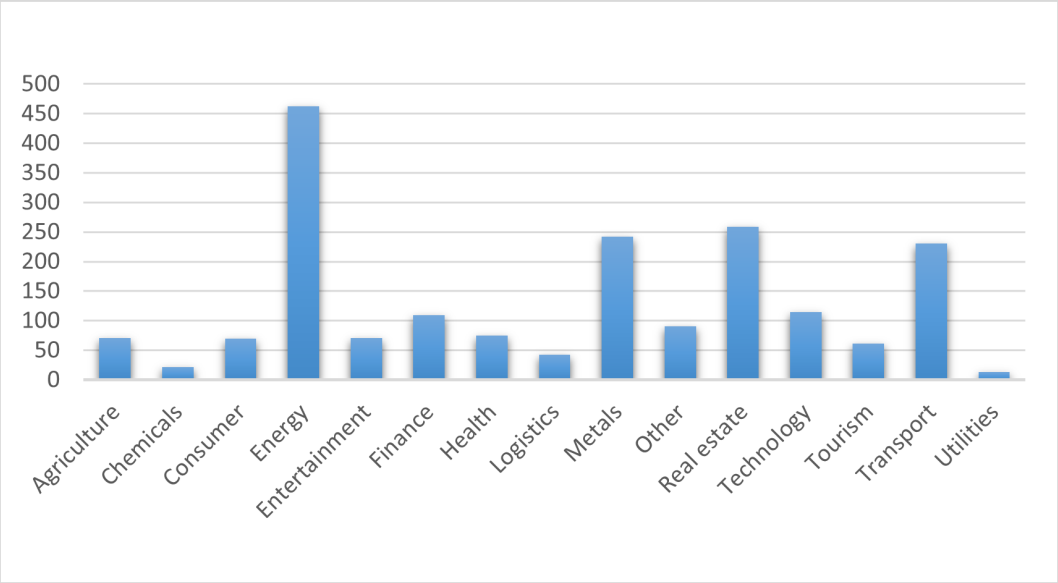
Figure 2: **China's investment b sectors in Africa since 2010**



Source : China Business Review [2]

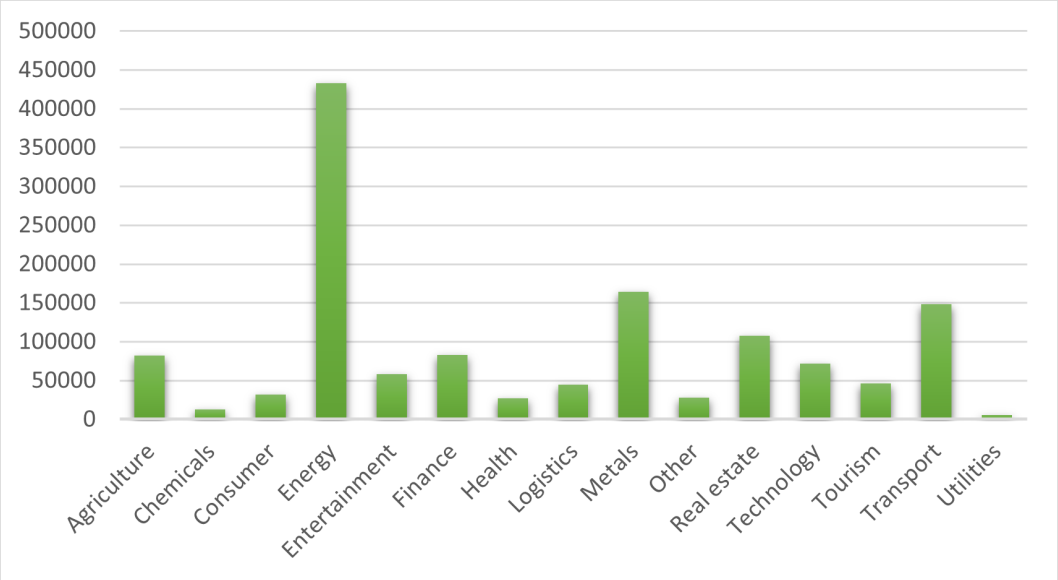
[2] https://africa-me.com/chinese-investment-funds-in-africa/prettyPhoto , open source commercial information

Figure 3: **Breakdown of Chinese firms investments number by sector between 2005 and 2022 in the world**



Source : Authors' calculation

Figure 4: **Total amount of China's investments by sectors between 2005 and 2022**



Source : Authors' own calculation

4 Methodology and Data

4.1 Methodology

This section highlights the empirical strategy adopted to determine the new determinants of Chinese FDI outflows in the actual energy transition's context. Based on several studies in the empirical literature, Cheng and Ma [2010] ; Kolstad and Wiig [2012] ; Kolstad and Wiig [2011] ; Neumayer and Spess [2005] and Kafilah and Rasiah [2019] who argue that the flow of FDI to the host country abroad is a better measure of investment flows , we specified our model, which is illustrated by equation 1 :

$$\boxed{FDI_{ijt} = \beta_1 \, Natural \; Resources_{jt} + \beta_2 \, GDP_{jt} + \beta_3 \, Openess_{jt} + \beta_5 \, X_{jt} + e_{it}} \tag{1}$$

Where **j** is the individual African country, **t** the time and **i** represent China. Our dependant variable FDI_{it} is then the natural logs of Chinese total outward Foreign Direct Investment flows in country j. $Natural \; Resources_{jt}$ which are the total natural resource rents of the host country, are used as a proxy to measure the natural resource wealth of these countries. We also used it at a disaggregated level to do a more in-depth analysis and to see which type of resource can attract Chinese FDI. It was thus decomposed by types of resources : Mineral resources rents, Oil rents and Natural gas rents. The others independent variables contained in our model are the standard ones existing in the literature. GDP_{jt} is the per capita GDP and is used as proxy for the market size hypotheses. $Trade_{jt}$ represent the openess of the host country i.e the ratio between the sum of its exports and imports on the GDP. X_{jt} which is a set of variable representing the control variables. These control variables are inflation, the consumers price index evolution of the host country. Infrastructure is the mobile cellular subscriptions per 100 people. This variable have been used as proxy to capture the level of developpement in terms of infrastructure of the host country. e_{it} is the error term of our model.

We first estimated our equation with a fixed effect panel model. But one problem when analysing panel data is high correlation among independent variables, as this may cause multicollinearity. Given the problems of heteroscedasticity and autocorrelation that we also may have in our simple OLS regression, we regress our equation with Panel Corrected standard errors model in order to avoid bias in our results coefficients. This panel regression model (PSCE) considers the possibility of contemporaneous correlations, accounting for the deviations from spherical errors and allowing for better inference from linear models. We finished our analysis with a robustness test using the Feasible Generalized Least Squares (FGLS) model. FGLS model allows estimation in the presence of AR(1) autocorrelation within panels and cross-sectional correlation and heteroskedasticity across panels.

4.2 Data

Data from several sources were used to verify whether there is a link between Chinese FDI in African countries and the natural resources endowment of these countries. Two data sets on Chinese FDI were used in this analysis. The first set, from the statistical bulletin of China's outward forward direct investment on the website of the Chinese Ministry of Commerce (MOFCOM) and the second from the American Enterprise Institute (AEI-China global investment tracker). The data from MOFCOM provides information on China's total FDI flows for 30 African countries over the period from 2000 to 2018, and the data from AEI provides specific details on the investment projects conducted by Chinese firms in African countries from 2005 to 2022. We used resource rents as a proxy to measure the natural resource wealth of countries. This variable comes from the World Bank's WDI database and is expressed as a percentage of GDP. It includes oil, natural gas and mineral rents. The latter is relevant for the energy transition side of our study since the minerals included in the calculation are for the most part those that are essential to the energy transition (tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate). Other variables were used in our study as control variables :

Openness to the outside world at the trade level, conceived by our trade variable, is the sum of exports and imports of goods and services measured as a share of GDP. The quality of an economy's infrastructure, including power and communications, is an important element in investment decisions for both domestic and foreign investors. So, the quality of China's FDI host country infrastructure was measured using an indicator often used in the literature, namely the number of mobile cell phone subscriptions (per 100 people). Our variable called inflation, which is a proxy for the macroeconomic stability of recipient countries, measured by the consumer price index, reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that can be fixed or changed at specified intervals. All these variables come from the World Development Indicator (WDI) database of the World Bank.

We also controlled for the quality of host countries' institutions via institutional quality variables from the ICRG database such as: Government stability, Corruption, Law, and Order. **Government stability** is an assessment both of the government's ability to carry out its declared program(s), and its ability to stay in office. **Corruption** is an assessment of corruption within the political system. **Law and order** form a single component, but its two elements are assessed separately: the "Law" dimension assesses the strength and impartiality of the legal system, while the "Order" dimension is an assessment of popular observance of the law. Due to a lack of data, not all African countries could be included in our analysis.

5 Results

5.1 Baseline results

We have regressed our equation with a panel model, by including fixed effects. Global results show us that the attractiveness of FDI by natural resources depends on the different type of resources (mineral, oil, natural gas). Indeed, when all the natural resources are taken into account in our regression, we have no significant results. On the other hand, the disaggregation of the total natural resource rent by type of resource shows us that the resources favorable to China's FDI are natural gas and mineral resources, while Oil resources tend to discourage them. These results are in line with the current context of energy transition in which the biggest polluters of the planet, including China, are engaged. The negative correlation between oil products and Chinese FDI on the one hand, and the positive correlation of natural gas and mineral resources with these investments on the other hand, can be explained by the environmental policy that China has been following since the beginning of the 2000s. Indeed, the latter being among the largest oil producers in the world, is gradually changing its production technology by shifting toward green technologies. And these latter require a significant amount of mineral resources, hence the positive correlation between mineral resources and Chinese FDI. However, this transition can only happen gradually, and China needs energy to continue their economic rise. This is where natural gas comes into play, as it is an energy source that can be substituted for oil and is about 40 to 50% less polluting than oil.Our results also revealed that trade openness and macroeconomic stability are also among the main determinants of Chinese FDI in Africa.

Table 2 : Panel regression with natural resources at the aggregated level

	(1)	(2)	(3)	(4)	(5)
	FDI	FDI	FDI	FDI	FDI
Resources rents	0.0255	-0.00420	-0.00903	-0.0119	-0.0193
	(0.60)	(-0.09)	(-0.20)	(-0.26)	(-0.42)
GDP	0.436	-0.943	-0.687	-1.383	-0.994
	(0.25)	(-0.47)	(-0.33)	(-0.65)	(-0.47)
Openness	2.907***	2.583***	2.546***	2.511***	2.612***
	(5.23)	(4.52)	(4.43)	(4.37)	(4.53)
Infrastructure	0.284*	0.198	0.231	0.265	0.230
	(1.91)	(1.13)	(1.26)	(1.43)	(1.24)
Inflation		0.510**	0.514**	0.457*	0.440*
		(2.07)	(2.09)	(1.83)	(1.76)
Government Stability			0.105	0.0624	0.0243
			(0.61)	(0.36)	(0.14)
Corruption				0.595	0.584
				(1.42)	(1.40)
Law and Order					1.307*
					(1.69)
N	512	461	461	461	461
R^2	0.085	0.060	0.061	0.066	0.072
Fixed effect	Yes	Yes	Yes	Yes	Yes

t statistics in parentheses

* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

Table 3 : Pannel regression with natural resources at a disaggregated level

	(1)	(2)	(3)	(4)	(5)
	FDI	FDI	FDI	FDI	FDI
Oil rents	-0.0979**	-0.117**	-0.130***	-0.133***	-0.151***
	(-2.21)	(-2.47)	(-2.69)	(-2.75)	(-3.12)
Natural gas rents	4.524***	5.004***	5.060***	5.040***	5.128***
	(9.47)	(7.37)	(7.45)	(7.42)	(7.59)
Mineral rents	0.249**	0.254**	0.240**	0.234**	0.245**
	(2.44)	(2.34)	(2.20)	(2.14)	(2.25)
GDP	-2.683*	-2.549	-2.033	-2.641	-2.069
	(-1.70)	(-1.35)	(-1.05)	(-1.34)	(-1.05)
Openness	2.826***	2.699***	2.635***	2.607***	2.775***
	(5.54)	(5.00)	(4.86)	(4.81)	(5.12)
Infrastructure	0.229*	0.139	0.205	0.236	0.180
	(1.65)	(0.84)	(1.18)	(1.36)	(1.03)
Inflation		0.580**	0.588**	0.536**	0.510**
		(2.52)	(2.56)	(2.30)	(2.20)
Government Stability			0.212	0.174	0.125
			(1.30)	(1.06)	(0.76)
Corruption				0.532	0.516
				(1.36)	(1.33)
Law and Order					1.885***
					(2.59)
N	512	461	461	461	461
R^2	0.240	0.182	0.185	0.189	0.202
Fixed effect	Yes	Yes	Yes	Yes	Yes

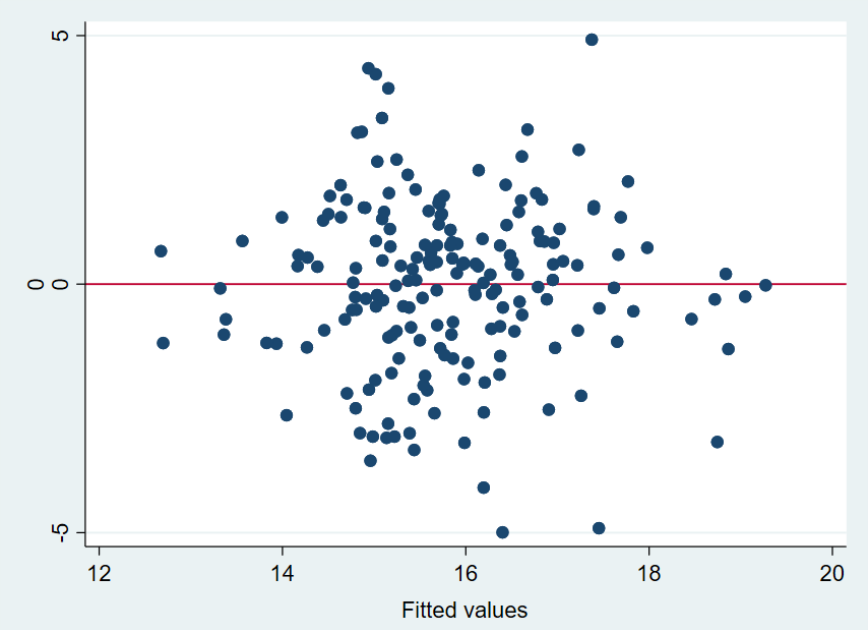
t statistics in parentheses

* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

5.2 Correction of potential cross-section dependance & heteroscedasticity

One problem when analysing panel data is high correlation among independent variables, as this may cause multicollinearity. The correlation matrix shows whether the variables are correlated with one another. According to Table 13, our independent variables used in this paper are not too highly correlated (<0.8). Therefore, multicollinearity should not be normally a problem. But the cross-sectional dependance test (Table 14) reject the null hypotheses of cross-section independence : There is then cross-section dependance in our data. In order to correct the potential problems of heteroscedasticity and autocorrelation, we have regressed our equation with the Panel Corrected Standard Error (PSCE) model. This panel regression model (PCSE) that considers the possibility of contemporaneous correlations, accounting for the deviations from spherical errors and allowing for better inference from linear models, was developed by Beck and Katz [1995]. PCSEs estimator suits best to small panels and accounts for finite sample bias while producing panel-corrected standard errors that allow heteroskedasticity and correlation within panels [Cameron and Trivedi, 2005]. Many empirical studies [3] have employed PSCEs and underlined that in these case, PCSEs offers a better fit and rather robust estimates than other alternative models. The results from our regression, taking into account country-fixed effects that capture the differences between countries, have shown no significant effect when natural resource rents are considered in their entirety. But taking resources into account at a disaggregated level reveals that mineral resources and natural gas are still resources that attract FDI while oil discourages FDI in Africa.

Figure 5: **Residuals versus fitted plot for heteroscedasticity test**



[3] See Halvorsen [2012] ; Herrerias et al. [2013] ; Hecock and Jepsen [2013] and Elheddad et al. [2018]

Table 4 : Regression with PCSEs model and total natural resources rents

	(1)	(2)	(3)	(4)	(5)
	FDI	FDI	FDI	FDI	FDI
Resources rents	-0.0456	-0.0529	-0.0586	-0.0608	-0.0610
	(-0.80)	(-0.90)	(-1.00)	(-1.04)	(-1.04)
GDP	-3.276*	-3.590**	-2.731	-2.956	-2.636
	(-1.91)	(-2.01)	(-1.45)	(-1.57)	(-1.33)
Openness	3.352***	3.051***	3.010***	3.047***	3.087***
	(4.94)	(4.70)	(4.63)	(4.63)	(4.58)
Infrastructure	0.305**	0.226	0.262*	0.269*	0.254
	(2.07)	(1.42)	(1.69)	(1.72)	(1.58)
Inflation		0.259	0.260	0.260	0.269*
		(1.64)	(1.63)	(1.62)	(1.68)
Government Stability			0.227*	0.200	0.177
			(1.94)	(1.61)	(1.39)
Corruption				0.328	0.318
				(1.03)	(1.00)
Law and Order					0.418
					(1.08)
N	512	461	461	461	461
R^2	0.231	0.258	0.263	0.268	0.269
Fixed effect	Yes	Yes	Yes	Yes	Yes

t statistics in parentheses

* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

Table 5 : Regression with PCSEs model and resource at a disaggregated level

	(1)	(2)	(3)	(4)	(5)
	FDI	FDI	FDI	FDI	FDI
Oil rents	-0.137**	-0.157**	-0.168**	-0.168**	-0.170**
	(-2.04)	(-2.22)	(-2.32)	(-2.35)	(-2.36)
Natural gas rents	2.081**	2.077*	2.158*	2.139*	2.207**
	(2.21)	(1.87)	(1.94)	(1.92)	(1.98)
Mineral rents	0.237***	0.238***	0.227**	0.225**	0.233**
	(2.76)	(2.70)	(2.54)	(2.48)	(2.55)
GDP	-3.652**	-3.778**	-2.868	-3.048	-2.469
	(-2.13)	(-2.03)	(-1.46)	(-1.53)	(-1.17)
Openness	3.207***	2.953***	2.870***	2.904***	2.935***
	(5.24)	(4.99)	(4.86)	(4.84)	(4.83)
Infrastructure	0.153	0.0841	0.134	0.138	0.109
	(1.09)	(0.55)	(0.90)	(0.93)	(0.71)
Inflation		0.304*	0.300*	0.302*	0.302*
		(1.94)	(1.90)	(1.90)	(1.91)
Government Stability			0.248**	0.231*	0.208
			(2.07)	(1.82)	(1.61)
Corruption				0.277	0.268
				(0.89)	(0.85)
Law and Order					0.618
					(1.48)
N	512	461	461	461	461
R^2	0.306	0.319	0.321	0.319	0.320
Fixed effect	Yes	Yes	Yes	Yes	Yes

t statistics in parentheses

* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

5.3 Temporal analysis

We conducted further analysis to confirm that Chinese FDI to Africa could be linked to natural resources in the context of energy transition. To do this, we divided our database into two groups. The first group includes data from 2000 to 2009 and the second group includes data from 2010 to 2018. The choice of this delimitation is explained by the fact that after the signature of the Millennium Development Goals[4] in 2000 by the governments, the environmental challenges have been placed as a priority following the redefinition of the main priorities of the Millennium Development Goals in 2010. Indeed The degradation of ecosystem services presents a significant obstacle to achieving targets related to improved health, maternal health, access to safe drinking water, and the eradication of hunger. The United Nations, in anticipation of the International Conference on Biological Diversity held in Nagoya in October 2010, recognizes the critical importance of restoring and preserving ecosystems as the primary challenge facing global efforts to meet these targets. Moreover, we can notice that the fall of the FDI of USA and the rise of China's one took place around 2010 (Figure 1). Our results show that there is a before and after effect of the environmental policy decision, because in our first group from 2000 to 2009, natural resources like Oil and Mineral don't have a significant correlation with Chinese FDI but Natural Gas is positively correlated to it and this correlation is significant. But from 2010 to 2019, the priority given to the environment has led to an attraction of Chinese investments by mineral and natural gas, which are necessary for the energy transition. Oil resources are negatively correlated to Chinese FDI since the energy transition policies.

Figure 6: **Chinese FDI net flow vs. US FDI net flow to Africa**

Source: Authors' own calculation

[4] https://documents-dds-ny.un.org/doc/UNDOC/GEN/N00/559/52/PDF/N0055952.pdf?OpenElement

Table 6 : Regression with splited data from 2000 to 2009

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	FDI	FDI	FDI	FDI	FDI	FDI	FDI	FDI	FDI	FDI
Oil rents	-0.162	-0.159	-0.159	-0.159	-0.168					
	(-1.44)	(-1.49)	(-1.48)	(-1.49)	(-1.54)					
Natural gas rents	0.592	2.869***	2.869***	2.870***	2.833***					
	(0.84)	(2.87)	(2.86)	(2.81)	(2.88)					
Mineral rents	0.0961	0.119	0.120	0.122	0.120					
	(1.16)	(1.22)	(1.22)	(1.22)	(1.21)					
GDP	-4.629**	-9.026***	-9.048***	-9.086***	-8.821**	-3.542**	-7.086**	-7.093**	-7.008**	-6.693**
	(-2.03)	(-2.61)	(-2.61)	(-2.60)	(-2.52)	(-2.03)	(-2.26)	(-2.26)	(-2.26)	(-2.12)
Openness	3.810***	3.459**	3.463**	3.484**	3.510**	4.356***	3.739**	3.731**	3.611**	3.683**
	(3.17)	(2.37)	(2.34)	(2.31)	(2.33)	(3.13)	(2.38)	(2.36)	(2.25)	(2.29)
Infrastructure	0.259**	0.451***	0.452***	0.453***	0.437***	0.276**	0.420***	0.418***	0.416***	0.402***
	(2.37)	(3.05)	(3.04)	(3.03)	(2.94)	(2.54)	(3.00)	(2.97)	(3.00)	(2.90)
Inflation		0.381**	0.381**	0.374*	0.385**		0.377**	0.377**	0.388**	0.395**
		(1.98)	(1.98)	(1.95)	(1.99)		(2.00)	(2.01)	(2.06)	(2.10)
Government Stability			0.00261	0.00287	-0.0144			-0.0209	-0.0523	-0.0680
			(0.02)	(0.02)	(-0.08)			(-0.13)	(-0.30)	(-0.39)
Corruption				-0.0161	0.0456				0.221	0.283
				(-0.05)	(0.15)				(0.74)	(0.91)
Law and Order					0.508					0.453
					(1.10)					(1.00)
Resources rents						-0.108	-0.108	-0.107	-0.109	-0.114
						(-1.20)	(-1.13)	(-1.13)	(-1.14)	(-1.17)
N	263	223	223	223	223	263	223	223	223	223
R^2	0.353	0.351	0.352	0.352	0.361	0.305	0.294	0.294	0.294	0.302
Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

t statistics in parentheses

* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

Table 7 : Regression with splited data from 2010 to 2018

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	FDI	FDI	FDI	FDI	FDI	FDI	FDI	FDI	FDI	FDI
Oil rents	-0.187***	-0.265***	-0.302***	-0.320***	-0.318***					
	(-2.77)	(-3.87)	(-4.07)	(-4.45)	(-4.44)					
Natural gas rents	2.841*	3.128*	3.381*	3.476**	3.457**					
	(1.68)	(1.90)	(1.96)	(2.01)	(1.99)					
Mineral rents	0.513**	0.533**	0.521**	0.541**	0.551**					
	(2.34)	(2.23)	(2.25)	(2.31)	(2.33)					
GDP	7.882	8.608	9.433	8.725	8.711	3.929	4.304	4.287	4.154	4.156
	(1.14)	(1.20)	(1.32)	(1.19)	(1.20)	(0.59)	(0.62)	(0.62)	(0.58)	(0.58)
Openness	1.972***	2.171***	2.120***	2.136***	2.118***	1.947***	1.914***	1.895***	1.906***	1.893***
	(3.58)	(4.09)	(3.98)	(3.97)	(3.94)	(2.99)	(3.12)	(3.08)	(3.05)	(3.01)
Infrastructure	-3.596	-3.957*	-3.332	-3.009	-3.011	-4.157*	-4.265*	-3.794	-3.739	-3.751
	(-1.59)	(-1.69)	(-1.38)	(-1.19)	(-1.19)	(-1.83)	(-1.80)	(-1.54)	(-1.45)	(-1.45)
Inflation		-0.315	-0.216	-0.262	-0.268		-0.168	-0.0891	-0.0908	-0.0902
		(-0.75)	(-0.52)	(-0.62)	(-0.63)		(-0.33)	(-0.18)	(-0.18)	(-0.18)
Government Stability			0.509*	0.466*	0.474*			0.303	0.292	0.294
			(1.81)	(1.66)	(1.69)			(1.03)	(0.99)	(1.00)
Corruption				1.084	1.123				0.199	0.225
				(1.42)	(1.46)				(0.26)	(0.29)
Law and Order					-1.112					-0.570
					(-0.72)					(-0.41)
Resources rents						-0.0896	-0.135**	-0.152**	-0.155**	-0.153**
						(-1.53)	(-1.99)	(-2.10)	(-2.17)	(-2.13)
N	223	212	212	212	212	223	212	212	212	212
R^2	0.706	0.726	0.732	0.733	0.732	0.650	0.661	0.663	0.664	0.664
Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

t statistics in parentheses

* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

6 Further analyis

6.1 Natural resource and conflict

The link between natural resources and conflict has been extensively analysed by the empirical literature and natural resources have been discovered as a source of conflict. The vast body of literature devoted to analysing the relationship between resources and conflict can be broadly divided into two groups : studies which focus on resource scarcity and conflict, and studies that analyse the relationship between resource abundance and conflict. The data also show that resources are the predominant conflict item in Sub-Saharan Africa (32 of 85, 38 percent) far more than in other regions of the world. To confirm our results on the hypothesis that China seeks access to natural resources, especially mineral one, needed in the energy transition process, we cross-tabulated the total resource rent variable with internal and external conflict variables. This analysis is done in order to verify whether China's investments continue in resource-rich areas even during periods of conflict. We then regressed our equation with the crossed variables, with the PCSE model. The results (Table 5-6) confirm our hypothesis and our baseline results. The coefficient of total natural resources rents crossed with our conflict variables is negative and significant just for external conflict, and positive for ethnic tensions. At a disaggregated level, our Oil rents variable crossed with external conflicts and Natural Gas crossed with ethnic tensions present a negative and significant correlation. On the other hand, the variables mineral rents crossed with internal conflict and natural gas rents crossed with religious tension are positively correlated with Chinese FDI and the correlation is significant.

These results are in line with Driffield et al. [2013] who examine the determinants of a firm's strategy to invest in a conflict location. Their results suggest that firms from countries with weak institutions are more likely to invest in conflict locations. Thus, while existing literature that points out the extent to which internal conflict deters FDI may well be correct, it by no means deters all firms. These results suggest that ownership advantage is an important motivator for FDI in conflict zones, with the expectation that this will improve economic performance improvement in the host country. Potentially the most important findings from this research relate to the importance of ownership structures and institutions in the home country as determinants of this decision. Abdelzaher and Ramadan [2022] adopt a dynamic capability lens to examine the relationship between firm capabilities and the level of conflict in their FDI portfolio. The paper argues that conflict zones may be an attractive destination for a subset of firms, given their capability profile. The results confirm their hypotheses as they find that firms with greater international geographical diversification capabilities, as depicted by their geographic spread, and those with greater local stock management capability, as depicted by their initial public offering maturity, are more likely to launch subsidiaries in high ongoing conflict zones. Furthermore, the authors find that while it may be unprofitable for firms to seek FDI in high-conflict zones, firms that operate in strategic industries (manufacturing, infrastructure, natural resource extraction) experienced positive performance. This can be attributed to the fact that firms operating in these sectors are more likely to directly profit in

the reconstruction/rebuilding of such conflict-stricken markets. China would indeed seek to have access to natural resources that will allow it to ensure its energy transition.

Table 8 : Regression with cross variables (resources at the aggregated level and conflicts)

	(1)	(2)	(3)	(4)
	FDI	FDI	FDI	FDI
Resources rents	-0.0524	0.508*	-0.0396	-0.172*
	(-0.28)	(1.72)	(-0.51)	(-1.66)
GDP	-0.988***	-1.034***	-1.023***	-0.956***
	(-2.72)	(-2.98)	(-2.96)	(-2.86)
Openness	2.292***	2.057***	2.241***	2.463***
	(4.47)	(4.01)	(4.36)	(4.78)
Infrastructure	0.0261	0.0739	0.0436	0.0485
	(0.18)	(0.52)	(0.29)	(0.33)
Inflation	0.427***	0.353**	0.424***	0.464***
	(3.01)	(2.44)	(2.91)	(3.24)
Government Stability	0.242*	0.189	0.218	0.227*
	(1.75)	(1.35)	(1.57)	(1.69)
Corruption	-0.130	-0.249	-0.111	-0.128
	(-0.40)	(-0.76)	(-0.34)	(-0.40)
Law and Order	-0.244	-0.173	-0.280	-0.0638
	(-0.92)	(-0.68)	(-1.08)	(-0.25)
Internal Conflict	0.0819	0.135	0.126	0.131
	(0.37)	(0.85)	(0.78)	(0.85)
External Conflict	-0.541*	0.108	-0.498*	-0.473*
	(-1.88)	(0.30)	(-1.71)	(-1.65)
Religious Tensions	-0.0379	-0.0415	-0.165	-0.0843
	(-0.20)	(-0.23)	(-0.87)	(-0.49)
Ethnic Tensions	0.704*	0.716*	0.766**	0.0927
	(1.81)	(1.91)	(2.11)	(0.21)
Resource rents * Internal conflict	0.00732			
	(0.34)			
Resource rents * External conflict		-0.0496*		
		(-1.67)		
Resource rents * Religious tensions			0.0127	
			(0.73)	
Resource rents * Ethnic tensions				0.0526**
				(2.17)
N	461	461	461	461
R^2	0.190	0.204	0.191	0.200

t statistics in parentheses

* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

Table 9 : Regression with cross variables (resources at disaggregated level and conflicts)

	(1)	(2)	(3)
	FDI	FDI	FDI
Oil rents	0.369	-0.0349	-0.0303
	(1.25)	(-0.79)	(-0.72)
Natural gas rents	1.189	1.376	-1.457
	(1.39)	(1.63)	(-0.30)
Mineral rents	0.196**	-0.642	0.203***
	(2.56)	(-0.63)	(2.66)
GDP	-0.639	-0.586	-0.241
	(-1.62)	(-1.42)	(-0.64)
Openness	2.249***	2.210***	2.113***
	(4.33)	(4.26)	(4.37)
Infrastructure	-0.163	-0.0800	-0.169
	(-1.02)	(-0.53)	(-1.09)
Inflation	0.450***	0.346**	0.395***
	(3.23)	(2.39)	(2.76)
Government Stability	0.252*	0.321**	0.299**
	(1.82)	(2.36)	(2.27)
Corruption	-0.293	-0.293	-0.299
	(-0.85)	(-0.87)	(-0.87)
Law and Order	-0.0813	-0.168	-0.0931
	(-0.33)	(-0.66)	(-0.43)
Internal Conflict	-0.0347	-0.169	0.190
	(-0.21)	(-0.85)	(1.23)
External Conflict	-0.0520	-0.511*	-0.766***
	(-0.18)	(-1.72)	(-2.60)
Religious Tensions	-0.0932	0.191	-0.187
	(-0.42)	(0.85)	(-0.83)
Ethnic Tensions	0.428	0.822**	0.633*
	(1.15)	(1.98)	(1.86)
Oil rents * Internal conflict	0.0229		
	(0.68)		
Oil rents * External conflict	-0.0738*		
	(-1.95)		
Oil rents * Religious conflict	0.0123		
	(0.28)		
Oil rents * Ethnic tensions	0.0299		
	(0.60)		
Mineral rents * Internal conflict		0.115**	
		(2.04)	
Mineral rents * External conflict		0.0755	
		(0.49)	
Mineral rents * Religious conflict		-0.146	
		(-1.05)	
Mineral rents * Ethnic conflict		-0.0752	
		(-1.03)	
Naural gas rents * Internal conflict			-0.494
			(-1.50)
Naural gas rents * External conflict			0.617
			(1.45)
Naural gas rents * Religious tensions			1.513***
			(3.68)
Naural gas rents * Ethnic tensions			-1.335**
			(-2.36)
N	461	461	461
R^2	0.255	0.226	0.301

t statistics in parentheses

* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

6.2 Gravity model analysis

We further build an FDI gravity model. This is done in line with the literature that has analyzed bilateral trade and investment flows between countries (Talamo [2007] ; Kahouli and Maktouf [2015] ; Falk [2016] ; Zwinkels and Beugelsdijk [2010] ; Fratianni et al. [2011] ; Van Bergeijk and Brakman [2010] ; Morley et al. [2014]).

$$\boxed{Ln\ \ FDI_{ijt} = \alpha\ ln\ \ GDP_{it} + \lambda\ ln\ \ GDP_{jt} + \sigma ln\ \ X_{ijt} - \lambda\ ln\ \ D_{ij} + \epsilon_i} \tag{2}$$

FDI_{ij} represents the bilateral flows from i to j ; GDP_i the Gross Domestic Product of the origin country ; GDP_j the Gross Domestic Product of the destination country and D_{ij} the distance between country i and country j. X_{ij} is a set of control variable which are : inflation rate, total natural resource rents, oil rents, mineral rents, natural gas rents, trade, infrastructure, government stability. The data on the gravity model used in this analysis come from the CEPII database.

Equation 2 has been regressed with Panel Corrected Standard Errors model and the results still show a positive and significant correlation only for mineral resources. The other determinants that are positively correlated to Chinese FDI are trade openness, GDP per capita of the origin country, the distance between capital cities, inflation, the distance between most populated cities. To check the robustness of this result, we estimated the same equation with the FGLS method and the results are the same: Mineral resources play an important role in China's investment decisions

Table 10 : Gravity model analysis using PCS and FGLS

	(PCSE) FDI	(FGLS) FDI	(PCSE) FDI	(FGLS) FDI
Resources rents			0.0515*	-0.0193
			(1.88)	(-1.42)
Oil rents	-0.0215	-0.0303		
	(-0.57)	(-1.62)		
Natural gas rents	1.522	-0.0479		
	(1.54)	(-0.34)		
Mineral rents	0.194*	0.183**		
	(1.79)	(2.10)		
Openness	1.861***	0.536**	1.927***	0.591**
	(4.00)	(2.26)	(3.85)	(2.49)
GDP per capita of destination	-0.369	-0.0463	-0.563*	-0.320
	(-1.10)	(-0.17)	(-1.73)	(-1.42)
GDP per capita of origin	37.39**	8.934	43.92***	8.226
	(2.24)	(0.82)	(2.62)	(0.77)
Distance capital city	0.00157*	0.00170***	0.00132	0.00182***
	(1.71)	(4.18)	(1.58)	(4.82)
Inflation	0.364**	-0.0426	0.405**	-0.0421
	(2.16)	(-0.61)	(2.40)	(-0.61)
Infrastructure	-0.153	-0.184	-0.158	-0.134
	(-0.62)	(-1.20)	(-0.64)	(-0.91)
Distance most populated cities	-0.00156*	-0.00168***	-0.00123	-0.00181***
	(-1.80)	(-4.24)	(-1.56)	(-5.00)
Government Stability	0.327**	0.0984	0.302**	0.102
	(2.20)	(1.56)	(2.02)	(1.63)
N	374	374	374	374
R^2	0.216		0.187	

t statistics in parentheses

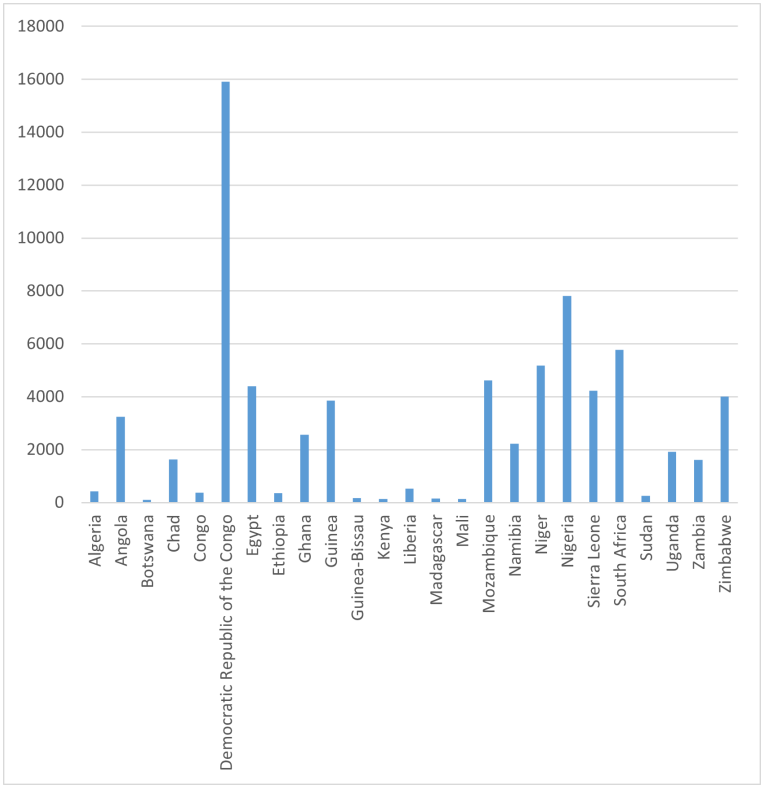
* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

7 Micro analysis

7.1 Data and Stylized fact

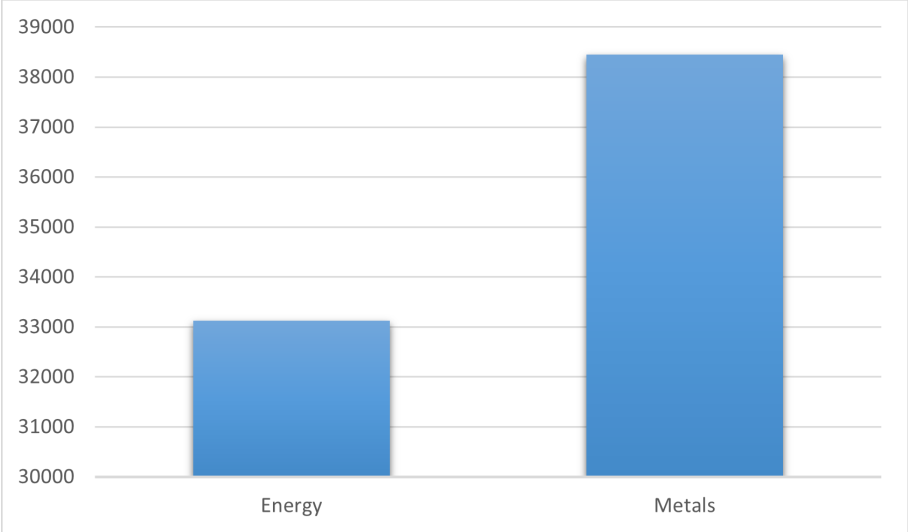
In addition, we performed a micro-level examination to evaluate the correlation between China's foreign direct investment (FDI) and natural resources in Africa in the current context of energy transition. For this purpose, we utilized company data sourced from the American Enterprise Institute (AEI)- China Global Investment Tracker, which encompasses investment information on 1,930 Chinese enterprises worldwide spanning the years 2005 to 2022. Nonetheless, for the purposes of our investigation, we selectively retained solely those investments registered within Africa. The micro data show us that the investments of Chinese firms in Africa are made only in 2 sectors : energy and metals (Figure 7) unlike the rest of the world (Figure 3). When considering the breakdown of countries, it is evident that Chinese firms have invested the most in the Democratic Republic of Congo (DRC), which can likely be attributed to its copper and cobalt mines (Figure 6). From a similar standpoint, the allocation of investments across sub-sectors (Figure 8) demonstrates the dominance of the oil sector, the copper sector, and other metals (including cobalt and molybdenum).

Figure 7: **Total amount of Chinese firms investment in Africa by country**



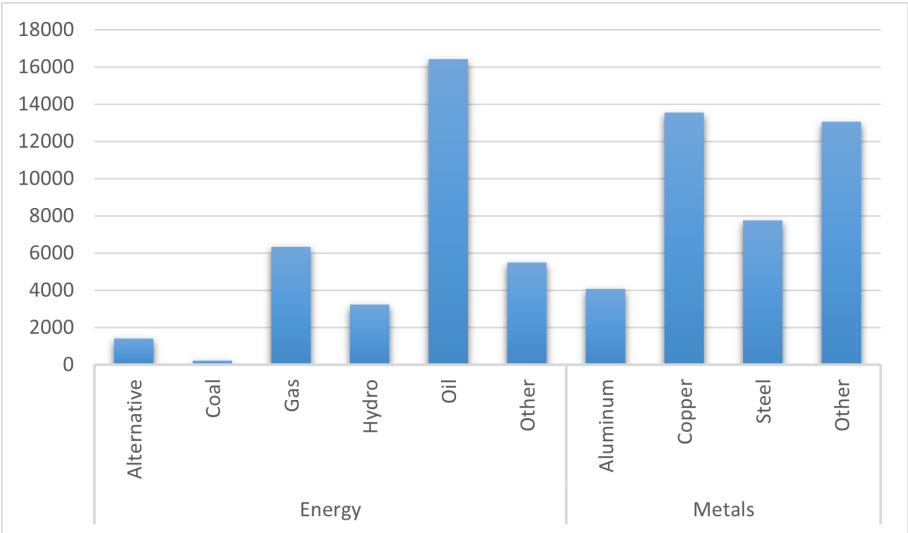
Source : Authors' own calculation

Figure 8: **Chinese firms investment in Africa by sectors**



Source : Authors' own calculation

Figure 9: **Chinese firms investment in Africa by sub-sector**



Source : Authors' own calculation

7.2 Methodology and results

We conducted a micro-level analysis using the China Global Investment Trackers database provided by the American Enterprise Institute (AEI). This database contains detailed information on the investment activities of 29 Chinese companies in Africa, including the sectors, sub-sectors, investment amounts, and destination countries (see Figure 9). Due to the limited availability of micro-level data on the determinants of foreign direct investment (FDI), as defined in the academic literature, we employed a straightforward model represented by the following equation :

$$\boxed{FDI_{ijt} = \beta_1 Oil_{jt} + \beta_2, Metals_{jt} + \beta_3 Gas_{jt} + \beta_4 Hydro_{jt} + \beta_5 Coal_{jt} + e_{it}} \quad (3)$$

Our dependent variable, FDI, represents the investment amount of Chinese firms in each country at time t, expressed in millions of dollars. The explanatory variables used in our analysis are qualitative variables, which we have transformed into binary variables (dummy variables). For instance, the Oil variable takes a value of 1 if the investment was made in the oil sector and 0 otherwise. Similarly, the Metals, Gas, Hydro, and Coal variables follow the same construction procedure, taking a value of 1 if investments were made in the corresponding sector and 0 otherwise. From our small sample of 101 observations regressed via simple OLS with Chinese firms fixed effect, the results of our micro-level analysis are consistent with those of the macro-level analysis conducted above. Strategic metals (Aluminum, Copper, steel) necessary for the energy transition and natural gas discovered to be 40% less polluting than oil would be the main determinants of Chinese foreign direct investment in Africa.

Table 11 : Analysis of Chinese companies' investment drivers

	(1)	(2)	(3)	(4)	(5)	(6)
	FDI	FDI	FDI	FDI	FDI	FDI
Oil	-1.720		-1.720**	-0.166	-0.0871	-0.0813
	(-1.33)		(-2.14)	(-0.22)	(-0.12)	(-0.11)
Metals		4.608***	4.608***	5.221***	5.602***	5.630***
		(8.12)	(8.44)	(11.05)	(11.92)	(8.67)
Gas				4.291***	4.510***	4.526***
				(4.54)	(5.03)	(4.81)
Hydro					3.668**	3.636**
					(2.51)	(2.32)
Coal						-0.0605
						(-0.06)
N	101	101	101	101	101	101
R^2	0.952	0.980	0.982	0.988	0.990	0.990

t statistics in parentheses

* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

	(1)	(2)	(3)	(4)	(5)
	FDI	FDI	FDI	FDI	FDI
Oil rents	-0.0210	-0.0411	-0.0274	-0.0307	-0.0259
	(-0.82)	(-1.50)	(-1.01)	(-1.13)	(-0.96)
Natural gas rents	0.0852	0.146	0.162	0.161	0.113
	(0.32)	(0.49)	(0.56)	(0.56)	(0.39)
Mineral rents	0.103*	0.186***	0.172***	0.168***	0.149***
	(1.81)	(3.80)	(3.16)	(3.01)	(2.71)
GDP	-0.820***	-0.711***	-0.607***	-0.600***	-0.446**
	(-4.31)	(-4.19)	(-3.77)	(-3.44)	(-2.36)
Openess	1.162***	1.090***	0.983***	1.022***	0.718**
	(3.76)	(3.36)	(3.06)	(3.17)	(2.08)
Infrastructure	0.0317	-0.0574	-0.00614	0.000866	-0.00832
	(0.39)	(-0.70)	(-0.07)	(0.01)	(-0.09)
Inflation		0.197***	0.172**	0.174**	0.209***
		(2.90)	(2.43)	(2.47)	(2.93)
Government Stability			0.188***	0.186***	0.114
			(2.94)	(2.75)	(1.62)
Corruption				-0.0406	-0.145
				(-0.24)	(-0.83)
Law and Order					0.343***
					(3.23)
N	512	461	461	461	461

t statistics in parentheses

* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

7.3 Robustness Check

In order to test the robustness of our results, given the problems of heteroscedasticity and cross-section dependence we have been confronted with , we have used the Feasible Generalized Least Squares (FGLS) model. This model allows estimation in the presence of AR(1) autocorrelation within panels, cross-sectional correlation and heteroskedasticity across panels. The results from our regression, taking into account country fixed effects that capture the differences between countries, have shown no significant effect when natural resources rents are considered in their entirety. But taking resources into account at a disaggregated level reveals that mineral resources and natural gas are still resources that attract FDI while oil discourages FDI in Africa.

Table 11 : Robustness test with FGLS and total natural resources rents

	(1)	(2)	(3)	(4)	(5)
	FDI	FDI	FDI	FDI	FDI
Resources rents	-0.00113	0.00290	0.00110	0.00214	0.0144
	(-0.08)	(0.17)	(0.07)	(0.13)	(0.87)
GDP	-0.983***	-0.900***	-0.818***	-0.831***	-0.646***
	(-5.46)	(-5.03)	(-4.63)	(-4.58)	(-3.24)
Openess	1.461***	1.363***	1.339***	1.303***	0.993***
	(5.92)	(4.56)	(5.00)	(4.71)	(3.35)
Infrastructure	0.0936	0.0305	0.102	0.0986	0.0840
	(1.49)	(0.41)	(1.45)	(1.38)	(1.24)
Inflation		0.170***	0.149**	0.150**	0.187***
		(2.65)	(2.26)	(2.27)	(2.82)
Government Stability			0.172***	0.162***	0.0976
			(2.87)	(2.61)	(1.52)
Corruption				0.0818	-0.0292
				(0.51)	(-0.18)
Law and Order					0.352***
					(3.35)
N	512	461	461	461	461

t statistics in parentheses

* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

Table 12 : Robustness test with FGLS and resources at desagregated level

	(1)	(2)	(3)	(4)	(5)
	FDI	FDI	FDI	FDI	FDI
Oil rents	-0.0210	-0.0411	-0.0274	-0.0307	-0.0259
	(-0.82)	(-1.50)	(-1.01)	(-1.13)	(-0.96)
Natural gas rents	0.0852	0.146	0.162	0.161	0.113
	(0.32)	(0.49)	(0.56)	(0.56)	(0.39)
Mineral rents	0.103*	0.186***	0.172***	0.168***	0.149***
	(1.81)	(3.80)	(3.16)	(3.01)	(2.71)
GDP	-0.820***	-0.711***	-0.607***	-0.600***	-0.446**
	(-4.31)	(-4.19)	(-3.77)	(-3.44)	(-2.36)
Openess	1.162***	1.090***	0.983***	1.022***	0.718**
	(3.76)	(3.36)	(3.06)	(3.17)	(2.08)
Infrastructure	0.0317	-0.0574	-0.00614	0.000866	-0.00832
	(0.39)	(-0.70)	(-0.07)	(0.01)	(-0.09)
Inflation		0.197***	0.172**	0.174**	0.209***
		(2.90)	(2.43)	(2.47)	(2.93)
Government Stability			0.188***	0.186***	0.114
			(2.94)	(2.75)	(1.62)
Corruption				-0.0406	-0.145
				(-0.24)	(-0.83)
Law and Order					0.343***
					(3.23)
N	512	461	461	461	461

t statistics in parentheses

* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

8 Conclusion

Climate change has forced countries to change their production systems, and they have been looking for ways to achieve this energy transition, especially for critical metals. The new technologies called green, having been discovered more intensive in natural resources than those traditional. These resources are mostly found in developing countries. In this context, we have examined Chinese FDI to determine whether Chinese FDI in Africa is attracted by the natural resources needed for the energy transition. To do this, we used a database of the Chinese Ministry of Commerce over a period of 19 years (2000-2018) and data sourced from the American Enterprise Institute (AEI) - China Global Investment Tracker from 2005 to 2022.

The results revealed China's interest in certain types of resources, namely natural gas and mineral resources. Indeed, our results show that natural gas and mineral resources are positively correlated to FDI flows from China to Africa while oil resources show a negative correlation. These results are in line with the current context of energy transition in which the biggest polluters, including China, are engaged. The negative correlation between oil products and Chinese FDI on the one hand, and the positive correlation of natural gas and mineral resources with these investments on the other hand, can be explained by the environmental policy that China has been following since the beginning of the 2010s.

Indeed, the latter being among the largest oil producers in the world, is gradually changing its production technology by shifting toward green technologies. And these latter require a significant amount of mineral resources, hence the positive correlation between mineral resources and Chinese FDI. However, this transition can only happen gradually, and energy is needed to strengthen further the economic rise of the Chinese economy. This is where natural gas comes into play, as it is an energy source that can substitute oil and is about 40 to 50% less polluting than oil. Our results also reveal that trade openness and macroeconomic stability are among the main determinants of Chinese FDI in Africa.

References

Dina Abdelzaher and Nora Ramadan. Dynamic capabilities and fdi in conflict zones: the role of diversification and stock management capabilities. *Review of International Business and Strategy*, (ahead-of-print), 2022.

Alessia Amighini, Roberta Rabellotti, and Marco Sanfilippo. China's outward fdi: An industry-level analysis of host-country determinants. *Frontiers of Economics in China*, 8(3):309–336, 2013.

Elizabeth Asiedu. Foreign direct investment, natural resources and institutions. *International Growth Centre*, 47, 2013.

Elizabeth Asiedu and Donald Lien. Democracy, foreign direct investment and natural resources. *Journal of international economics*, 84(1):99–111, 2011.

Nathaniel Beck and Jonathan N Katz. What to do (and not to do) with time-series cross-section data. *American political science review*, 89(3):634–647, 1995.

Godfred Alufar Bokpin, Lord Mensah, and Michael E Asamoah. Foreign direct investment and natural resources in africa. *Journal of Economic Studies*, 2015.

A Colin Cameron and Pravin K Trivedi. *Microeconometrics: methods and applications*. Cambridge university press, 2005.

Leonard K Cheng and Zihui Ma. China's outward foreign direct investment. In *China's growing role in world trade*, pages 545–578. University of Chicago press, 2010.

Nigel Driffield, Chris Jones, and Jo Crotty. International business research and risky investments, an analysis of fdi in conflict zones. *International business review*, 22(1):140–155, 2013.

Mohamed M Elheddad et al. What determines fdi inflow to mena countries? empirical study on gulf countries: Sectoral level analysis. *Research in International Business and Finance*, 44(C):332–339, 2018.

Martin Falk. A gravity model of foreign direct investment in the hospitality industry. *Tourism Management*, 55:225–237, 2016.

Ling Feng, Lulan Ge, Zhiyuan Li, and Ching-Yi Lin. Financial development and natural resources: The dynamics of china's outward fdi. *The World Economy*, 45(3):739–762, 2022.

Michele U Fratianni, Francesco Marchionne, and Chang Hoon Oh. A commentary on the gravity equation in international business research. *Multinational Business Review*, 19(1):36–46, 2011.

Kafilah Lola Gold. The determinant of chinese foreign direct investments in oil exporting african countries. *Contemporary Economic Policy*, 40(3):476–490, 2022.

World Bank Group. *The growing role of minerals and metals for a low carbon future*. World Bank, 2017.

Thomas Halvorsen. Size, location and agglomeration of inward foreign direct investment (fdi) in the united states. *Regional studies*, 46(5):669–682, 2012.

Arshad Hayat. Fdi and economic growth: the role of natural resources? *Journal of Economic Studies*, 2018.

R Douglas Hecock and Eric M Jepsen. Should countries engage in a race to the bottom? the effect of social spending on fdi. *World Development*, 44:156–164, 2013.

Maria Jesus Herrerias, Ana Cuadros, and Vicente Orts. Energy intensity and investment ownership across chinese provinces. *Energy economics*, 36:286–298, 2013.

Gold Kafilah and Rajah Rasiah. Econometric analysis of the determinants of china's fdi in oil/minerals exporting countries in africa. *Gold, KL, Rasiah, R., Kian Teng, K*, pages 454–467, 2019.

Bassem Kahouli and Samir Maktouf. The determinants of fdi and the impact of the economic crisis on the implementation of rtas: A static and dynamic gravity model. *International Business Review*, 24 (3):518–529, 2015.

Ivar Kolstad and Arne Wiig. Better the devil you know? chinese foreign direct investment in africa. *Journal of African Business*, 12(1):31–50, 2011.

Ivar Kolstad and Arne Wiig. What determines chinese outward fdi? *Journal of world business*, 47(1): 26–34, 2012.

Haiyue Liu, Xiaolan Chen, and Ying Wu. Political environment and chinese ofdi under rmb appreciation: A panel data analysis. *Emerging Markets Finance and Trade*, 54(15):3470–3484, 2018.

Clive Morley, Jaume Rosselló, and Maria Santana-Gallego. Gravity models for tourism demand: theory and use. *Annals of tourism research*, 48:1–10, 2014.

Eric Neumayer and Laura Spess. Do bilateral investment treaties increase foreign direct investment to developing countries? *World development*, 33(10):1567–1585, 2005.

Steven Poelhekke and Frederick Van Der Ploeg. Do natural resources attract nonresource fdi? *Review of Economics and Statistics*, 95(3):1047–1065, 2013.

Steven Poelhekke and Rick van der Ploeg. Do natural resources attract fdi? evidence from non-stationary sector level data. 2010.

Neha Saini and Monica Singhania. Determinants of fdi in developed and developing countries: A quantitative analysis using gmm. *Journal of Economic Studies*, 2018.

Shan Shan, Zhibin Lin, Yulei Li, and Yan Zeng. Attracting chinese fdi in africa: The role of natural resources, market size and institutional quality. *Critical perspectives on international business*, 2018.

Giuseppina Talamo. Institutions, fdi, and the gravity model. Technical report, Working Paper, Universita de Palermo, 2007.

John P Tuman and Majid Shirali. The political economy of chinese foreign direct investment in developing areas. *Foreign Policy Analysis*, 13(1):154–167, 2017.

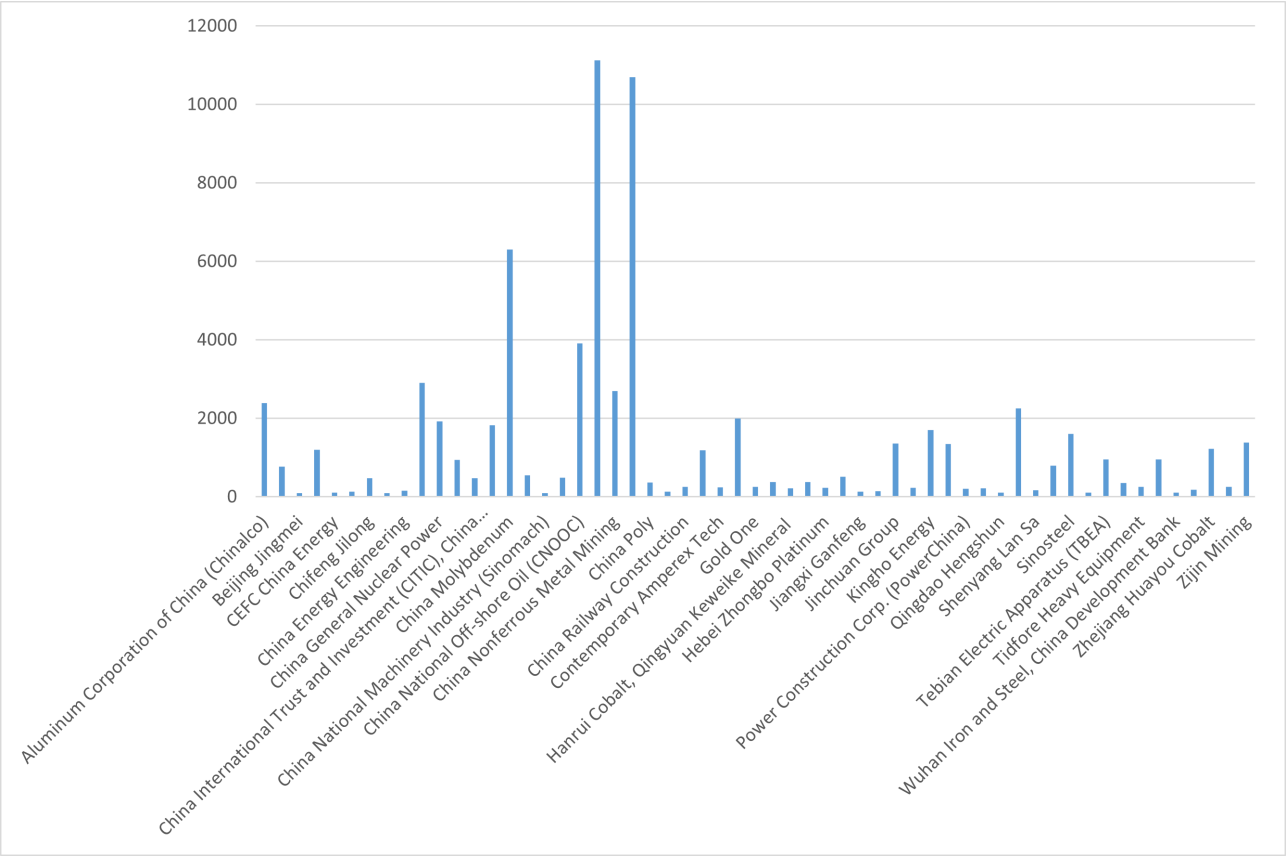
Peter AG Van Bergeijk and Steven Brakman. The gravity model in international trade: Advances and applications. 2010.

Remco CJ Zwinkels and Sjoerd Beugelsdijk. Gravity equations: Workhorse or trojan horse in explaining trade and fdi patterns across time and space? *International Business Review*, 19(1):102–115, 2010.

9 Appendix

9.1 Figure

Figure 10: **Chinese firms investment from American Enterprise Institute (2005 to 2022)**



Source : Authors' own calculation

Table 1 : Descriptives statistics

	count	mean	sd	min	max
Total natural resources rents	570	11.02834	9.018541	.1928631	55.87479
Oil rents	570	3.83006	9.086983	0	55.40683
Natural gas rents	570	.2519055	.7487941	0	4.381657
GDP	570	7.138294	.8873148	5.555394	8.973105
Trade	521	4.068638	.5121357	.2585521	5.027473
Inflation	513	1.651052	1.128079	-3.305445	5.783815
Infrastructure	560	3.012281	1.848508	-4.012312	5.099105
Government Stability	570	8.316009	1.507131	4.458333	11.58333
Internal Conflict	570	8.375044	1.420909	2.958333	12
External Conflict	570	9.768056	1.306093	3.958333	12
Corruption	570	2.035673	.7405679	0	4
Religious Tensions	570	4.015936	1.375871	0	6
Ethnic Tensions	570	3.284722	1.007652	0	5
N	570				

Table 10 : List of countries

Algeria	Mozambique
Angola	Malawi
Botswana	Namibia
Cote d'Ivoire	Niger
Cameroon	Nigeria
Ethiopia	Sudan
Gabon	Senegal
Ghana	Sierra Leone
Guinea	Togo
Guinea-Bissau	Tunisia
Kenya	Tanzania
Liberia	Uganda
Morocco	South Africa
Madagascar	Zambia
Mali	Zimbabwe

Table 12 : Pesaran's CD-test for cross-sectional dependence

Variable	CD-test	p-value	average joint T	mean	mean abs()
FDI	3.844	0.000	19.00	0.04	0.27
Inflation	6.376	0.000	15.51	0.08	0.29
Infrastructure	86.401	0.000	18.34	0.97	0.97
Government Stability	48.998	0.000	19.00	0.54	0.55
Internal Conflict	11.694	0.000	19.00	0.13	0.35
External Conflict	10.652	0.000	19.00	0.12	0.45
Corruption	4.719	0.000	19.00	0.05	0.40
Law and Order	2.171	0.030	19.00	0.02	0.23
Ethnic Conflict	2.673	0.008	19.00	0.03	0.24
Resources rents	18.111	0.000	19.00	0.20	0.33
Oil rents	6.9	0.000	19.00	0.08	0.13
Natural gas rents	6.803	0.000	19.00	0.07	0.09
Mineral rents	27.075	0.000	19.00	0.30	0.33

Table 11 : Correlation table

Variables	Resources rents	Oil rents	Natural gas rents	Mineral rents	GDP	Trade	Inflation	Infrastructure	FDI	Government Stability	Corruption
Resources rent	1.000										
Oil rents	0.780	1.000									
Natural gas rents	0.255	0.303	1.000								
Mineral rents	0.059	-0.207	-0.165	1.000							
GDP	0.053	0.452	0.150	-0.054	1.000						
Trade	0.178	0.156	0.101	0.172	0.202	1.000					
Inflation	0.202	0.093	-0.045	0.051	-0.091	-0.080	1.000				
Infrastructure	-0.098	0.032	0.088	0.192	0.437	0.127	-0.135	1.000			
FDI	0.168	-0.070	0.108	0.181	-0.142	0.209	0.112	0.051	1.000		
Government Stability	0.007	0.114	0.003	-0.103	0.070	0.183	-0.060	-0.363	0.042	1.000	
Corruption	-0.215	-0.202	-0.086	0.104	0.100	0.287	0.027	0.037	0.085	0.252	1.000