China´s Quest for Energy through FDI: New Empirical Evidence

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Abstract: China’s current economic development depends heavily on its access to energy resources, and it is increasingly shaping Chinese Outward Foreign Direct Investment (OFDI) in a quest for resources located abroad. The aim of this paper is to answer the two following questions: How much did the Chinese global quest for energy drive its OFDI between 2005 and 2012? And has the quest for energy been sensitive to the geographical location of the resources? We used data on Chinese OFDI from the China Global Investment Tracker, as well as diverse Host-Countries determinants of previously tested OFDI. We measured the impact of host country energy production in the allocation of investments. Using several multivariate regression models, we demonstrate that energy resources were the main driver of Chinese OFDI in 92 host countries during the studied period, and that there was no sensitivity to the geographical location of the resources.

Keywords: energy; China; Outward Foreign Direct Investments; natural resources.

JEL Codes: F21, Q48.

Number of words: 8401

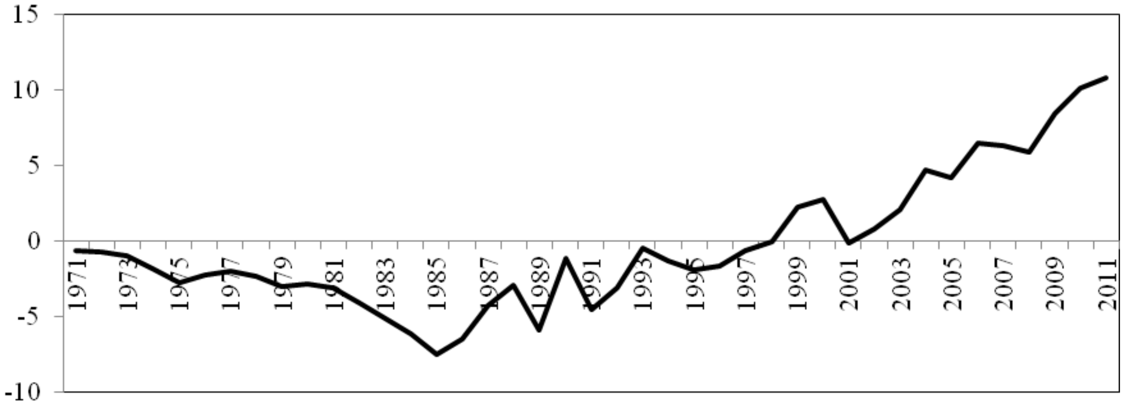
Introduction

With more than 1.34 billion people and an expanding economy, China’s current economic development depends heavily on its access to energy resources located abroad. Even though this is a central issue for China, previous studies of the international implications and domestic challenges involved are scarce (Ma & Oxley, 2012).

China’s quest for energy resources is said to be shaping its foreign policy (Zweig & Jinhai, 2005; Shaofeng, 2011) and the way it approaches foreign markets (Crompton & Wu, 2005; Leung, 2011). By mid-2013 it had overtaken the United States as the world’s top importer of crude oil (Hornby, 2013).

It is possible to identify three trends in the evolution of China's hunger for energy by observing empirical data which explains this phenomenon. First, since 2001 China has ceased to be a net exporter of energy resources and has become a net importer. We can see this trend in Figure 1, where net energy imports are estimated as energy use, less energy production, both measured in oil equivalents.

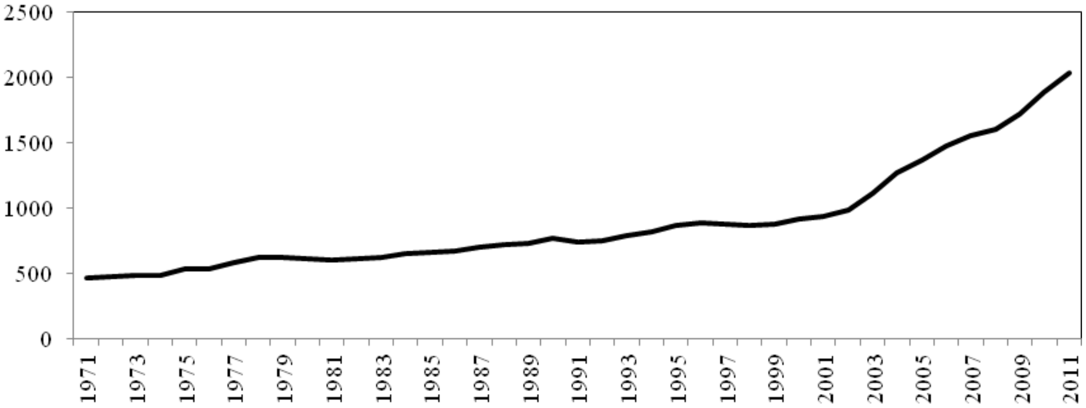
FIGURE 1: ENERGY IMPORTS, NET (% OF ENERGY USE)



Source: World Bank Data (2013)

Second, since 2001 the consumption of energy resources per capita in China has grown at a higher pace than the previous decades. While the consumption per capita grew at a rate of 3.25% between 1971 and 2000, it grew at a rate of 11.75% between 2001 and 2011, as shown in Figure 2.

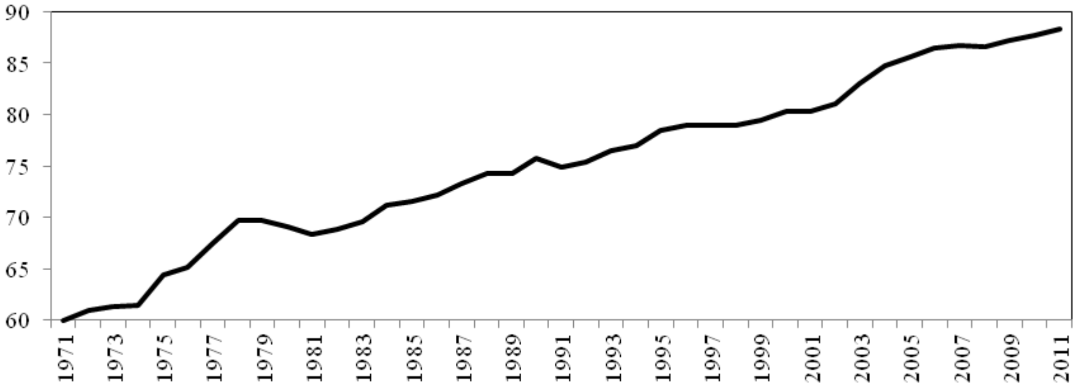
FIGURE 2: ENERGY USE (KG OF OIL EQUIVALENT PER CAPITA)



Source: World Bank Data (2013)

Finally, China's dependence on fossil fuels grew from 60% in 1971 to 88% in 2011, intensifying the dependence on one source of energy, as well as contributing heavily to global CO2 emissions (Figure 3). Fossil fuels include coal, oil, petroleum, and natural gas products. Due to environmental concerns and increasing extraction costs, as pointed by Fisher-Vanden et al. (2004) and Rui (2005) the decline in the use of coal will accelerate in the coming years, resulting in greater dependence on oil and gas.

FIGURE 3: FOSSIL FUEL ENERGY CONSUMPTION (% OF TOTAL)



Source: World Bank Data (2013)

Since China is no longer a mere recipient of Foreign Direct Investment (FDI) (Zheng et al., 2004, Buckey & Meng, 2005; Fu, 2008; Boermans et al. 2011), these three trends may have a strong influence on Chinese Outward Foreign Direct Investments (OFDI). In recent years, China has become an active global investor (Buckley et al, 2007). Investing abroad is a way of gaining access to foreign markets and natural resources, and these investments can be considered resource-seeking from the perspective of Behrman (1972) and Dunning (1998).

In 2013 three of the ten largest companies in the world were Chinese (Sinopec Group, China National Petroleum Corporation – CNPC, and State Grid). In the same year, the Forbes Global 500 included 73 Chinese companies, or approximately 15% of the list. The increasing presence of large Chinese energy corporations around the world suggests that these energy-hungry large companies are driving recent Chinese OFDI in a quest to gain access to resources, both in the developed and the developing world.

Considering the arguments above, using publicly available data on Chinese investments we test if the Chinese global quest for energy has been strong enough to be the main driver of its OFDI since 2005, first year for which data is available. Furthermore, assuming that China has tried to diversify energy sources as much as possible (Jakobson & Daojiong, 2006), we are assuming that the Chinese global quest for energy has not been sensitive to the geographical location of the resources (Bloningen, 2005; Rui & Yip, 2008; Anyanwu, 2012).

The structure of the paper is as follows: First we review recent studies on Chinese investments abroad and define the hypotheses of the paper. Second, we proceed with the data analysis and the model definition, where we analyze a sample of 92 recipient countries of Chinese OFDI from 2005 to 2012. Third, we present the results of our tests, and finally we conclude by discussing policy implications derived from the findings of the study.

Review of Recent Studies on Chinese Investments in Energy and Defining the Hypotheses

There are two central concepts to explain the International Political Economy of the Chinese quest for energy resources globally. One of them is the concept of *energy security*, and the other is the concept of *energy diplomacy*.

Authors refer to the concept of energy security to analyze China's international quest for resources as a national security issue that involves the notion of national power and the pursuit of national interest (Nolan et al. 2004; Downs, 2004; Lee, 2005; Daojiong, 2006; Jakobson & Daojiong, 2006; Yi-Chong, 2006; Ogle, 2010). Oil, more than any other commodity, is intimately intertwined with nationalism and national power, and is subject to political and military struggles for its control (Yergin, 1988).

One example that further demonstrates the extent of state involvement in the energy sector is the national political debate started in the USA after China National Offshore Oil Corporation (CNOOC) bid to acquire the American company Unocal in 2005. The company withdrew its $18.4 billion bid for Unocal due to a political backlash that highlighted the United States' growing apprehension about the economic rise of China. Another example that further enhances security concerns is the geopolitical dependence on the Strait of Malacca, through which is shipped around 75% of Chinese total oil consumption (Francisco & Baechler, 2013).

To avoid dependence on oil imports (see Figure 1), OFDI seeks to directly control the resources abroad by partnering with local companies or acquiring the rights to exploit the resources. China had to work out a national energy strategy to encourage the National Oil Companies (NOCs) to cooperate with host countries and other International Oil Companies (IOCs) (Xu, 2007).

CNPC, Sinopec, and CNOOC — the three largest NOCs — share a common set of origins, the former Ministry of Petroleum Industry and the former Ministry of Chemical Industry. In the early 1980s, the initial years of China's economic system reforms, the Chinese government decided to convert the productive assets of these and other ministries into state-owned enterprises (SOEs) (Lewis, 2007; Guo, 2007).

Chinese oil companies began investing abroad by acquiring concession rights in foreign oil fields in 1993, when a subsidiary of China National Petroleum Corporation (CNPC) bought the Talara Block in Peru for US $25m (Daojiong, 2006). Since then, Chinese oil companies have made an array of overseas oil investments. In late 1999, a national strategy was defined to pave the way for Chinese oil major companies to expand their businesses abroad. It consisted of using investment incentives for many Chinese companies to go global, including the gradual liberalization and reform of regulatory systems, including rules of the World Trade Organization (WTO) and other broadly applied international standards (Xu, 2007).

In recent years, the four major Chinese NOCs — CNPC, Sinopec, CNOOC, and Sinochem — have been learning a great deal about doing business globally, and have emerged as significant players in global mergers and acquisitions in upstream oil and natural gas (Jiang & Sinton, 2011). Some examples of their big acquisitions can be seen at Appendix A, which offers a full list of these four NOCs' investments abroad since 2005.

As shown in Table 1, since 2005 these companies have grown considerably and currently two of them are among the 10 largest companies in the world. Sinopec reported an annual revenue of US $428 billion and profits of US $8.2 billion in 2013. CNPC, the largest of the four, boasts 1.6 million employees, equal to the population of Trinidad and Tobago (Trinidad & Tobago Census Result, 2011).

TABLE 1: CHINA'S NOCS IN SELECTED FIGURES

	Global Ranking	Ranking change since 2005	Revenue 2013 (U$S billions)	Revenue % change from 2011	Number of employees
Sinopec	4	+27	428	14.1	1015000
CNPC	5	+41	408	16	1660000
CNOOC	93	Not listed	83	10.5	102500
Sinochem	119	+168	71.8	1.2	142000

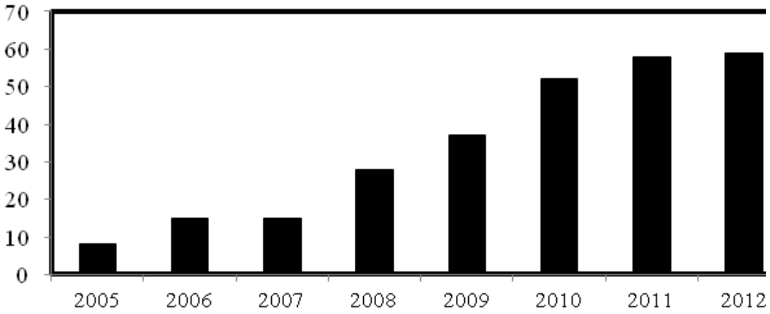
Source: 2013 and 2005 Fortune Global 500 Ranking.

Considering the above discussion, the first hypothesis of this paper is that:

H1: The Chinese global quest for energy has driven its OFDI between 2005 and 2012.

Intuitively, this hypothesis is supported by Figure 4, which shows the growth in the number of yearly energy investments abroad by Chinese NOCs.

FIGURE 4: NUMBER OF ANNUAL INVESTMENTS MADE BY THE FOUR MAIN NOCs



Source: China Global Investment Tracker

Accompanying the strategy of energy security, the concept of energy diplomacy (Myers, Jaffe & Lewis, 2002; Zweig & Jinhai, 2005; Taylor, 2007) refers to the policy of developing close ties with energy producers in order to diversify investments geographically — putting the “eggs in several baskets”. This is demonstrated by the fact that Chinese NOCs have looked for opportunities all around the globe.

Initially focusing on the Middle East, China’s first initiative in the 1990s sought to increase imports from the largest oil producing countries. In 1995, Southeast Asia and the Middle East were the two dominant sources of oil imports for China. By 2000, however, the Middle East’s share had increased to 54%, whereas the share from Southeast Asia fell to 15%. With Saudi-US ties strained in the wake of 9/11, Saudi oil shipments to the USA declined in 2004. In contrast, Saudi oil exports to China increased and China-Saudi energy cooperation deepened (Lai, 2007).

However, due to concern about political instability in the Middle East, as well as US dominance of the region, after 9/11 China set its sights on Africa, especially Nigeria, Tanzania, Ethiopia, and Ghana (Brautigam, 2009; Anyanwu, 2012). The USA and the European Union have distanced themselves from these African states because of concerns over human rights violations and violence. In contrast, China’s ties with the region are free of ideological or security obstacles, as well as historical resentments (Lai, 2007; Biggeri & Sanfilippo, 2009).

In Central Asia, the construction of an oil pipeline linking Kazakhstan and China was initially thought to carry geopolitical ramifications, binding the interests of the two countries in seeking autonomy from Russian dominance of the regional oil supply (Daojiong, 2006). However, while European demand for Russian oil decreased, China has increasingly become Russia's priority market. In 2013, Russian state-owned oil major Rosneft tripled supplies to China to 1 million barrels a day, and signed a deal to supply China with U$S 270 billion worth of oil over the next 25 years (Weaver & Buckley, 2013).

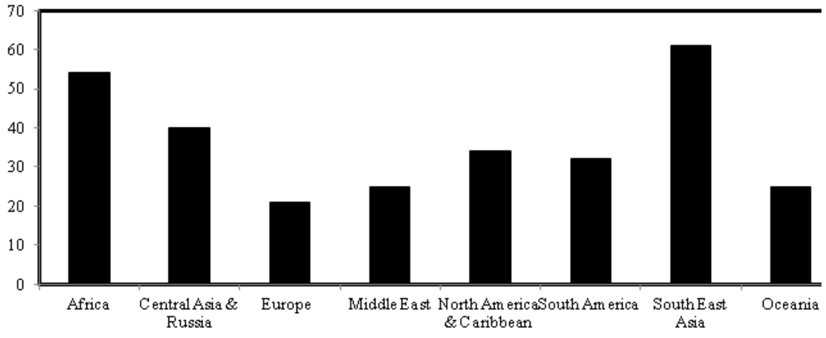
Recently, China has focused on Latin American countries. Gallagher et al. (2012) estimated that since 2005 China has provided loan commitments upwards of $75 billion to Latin American countries, two thirds being "loans-for-oil". A loan-for-oil generally combines a loan agreement and oil-sale agreement that involves two countries' state-owned banks and oil companies. Venezuela has negotiated four such loans, totaling $32 billion, since 2008. Brazil signed one for $10 billion in commitments in 2009. Ecuador signed a $3 billion loan-for-oil in between 2009 and 2011.

Considering these facts, we propose the following hypothesis:

H2: The Chinese global quest for energy has not been sensitive to the geographical location of these resources.

In Figure 5 we perceive that the big four Chinese NOCs have invested all around the world since 2005, supporting the idea of diversifying the investments geographically as much as possible. This can be further visualized in Appendix A.

FIGURE 5: IDENTIFIED PROJECTS PER REGION BETWEEN 2005 AND 2012 BY THE MAIN FOUR NOCS



Source: China Global Investment Tracker

Data Analysis and Model Definition

Data on Chinese OFDI was retrieved from the China Global Investment Tracker, organized by the Heritage Foundation (Scissors, 2011). The sample period studied (2005 to 2012) was determined by the availability of data from this source. This is the only publicly available Chinese OFDI database, and offers the advantage over other databases on Chinese investments of allowing other scholars to replicate its information.

Another advantage of this database is that it includes transaction information on both failed and successful Chinese investments, so we can distinguish and select only the successful investments. In this paper, failed projects have not been taken into account. Furthermore, as recently outlined by Liao & Tsui (2012), the China Global Investment Tracker excludes tax havens such as Hong Kong, the British Virgin Islands, and the Cayman Islands, and so only considers final destinations rather than transit points of OFDI. This has a significant impact on the results, as more than seventy percent of China's outward direct investment goes to tax havens. One caveat of the database is that it only registers transactions valued at more than $100 million, so small projects are overlooked.

To test our first hypothesis we consider the nine sectors of investments in the database: Agriculture, Chemicals, Energy, Finance, Metals, Real Estate, Technology, Transport, and Other. We use diverse Host-Countries determinants of OFDI which have been previously tested (Liu et al. 2005; Buckley et al. 2007; Morck et al. 2008; Cui & Jiang, 2010; Luo et al. 2010; Ramasamy et al. 2012; De Beule & Duanmu, 2012) and measure the impact of Host-Country energy production on the allocation of investments.

We constructed two dependent variables: the first is the sum of Chinese OFDI received per country between 2005 and 2012. The second variable is the number of investment projects in each country in the same period. The main independent variable was constructed using data from World

Bank Indicators, and measures the host country's energy production in thousand kilotonnes of oil or equivalents for the year 2004.

Other independent variables consider host-countries determinants of Chinese OFDI that have been tested by other authors.[1] Liu et al. (2005) found that the level of economic development, proxied by GDP per capita plus human capital, is still the main factor explaining China's rate of OFDI. They also found OFDI to be positively influenced by the value of local investments in human capital, proxied by education indicators.

Buckley et al. (2007) found Chinese OFDI to be associated with the host country's natural resource endowments, proxied by data on the host country's exports of ores and minerals. Other indicators such as land under cereal production, iron and steel production, and forested area, can also be used to proxy for natural resources. The authors also found Chinese OFDI to be associated with high levels of political risk in, and cultural proximity to, host countries throughout, and with host market size and geographic proximity. In the same direction, Ramasamy et al. (2012) found that Chinese state-controlled firms are attracted to countries with large sources of natural resources and risky political environments.

De Beule and Duanmu (2012) analyze how country-specific determinants affect Chinese and Indian acquisitions and test eleven home-country specific advantages: Market Size, Market Wealth (GDP per capita), Market Openness, Resources (percentage of ores and metals exports to total merchandise exports by country), Number of Patents, Political Stability (Rule of Law, Control of Corruption), Regulatory Quality, and Geographical Distance. While better rule of law, regulatory quality, and control of corruption are found to be important only for Indian firms, political stability proves to be a negative estimator for China.

Finally, Anyanwu (2012) studies Chinese OFDI in Africa and finds that market size and openness to trade are positively related with the levels of OFDI received by each country. Natural

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[1] The indicators used to test the model for our first hypothesis are detailed in Appendix B.

resource endowment and exploitation (such as oil) attracts huge OFDI, and higher financial development has a negative effect on OFDI, a reflection of China’s preference to invest in countries with poor and risky financial markets. Appendix B offers detailed information about all the variables.

We defined two versions of the model. The first one is an OLS (Ordinary Least Squares) with robust standard errors. In it we control for possible heteroskedasticity problems, while Appendix C show no multicollinearity among variables. The second version is a 2SLS (Two Stage Least Squares) that controls for possible endogeneity problems. One possible cause of endogeneity is simultaneity, sometimes referred to as reverse causation, which can be applied to the relation between FDI and energy production. We want to control for the possibility that previous levels of FDI could influence the level of energy production in our sample.

To do so, we defined an instrument for the energy production variable. The instrument must have two characteristics. First, it must be uncorrelated with the error; and second, it must be correlated (preferably highly so) with the regressor for which it is to serve as an instrument. Thus, we chose as instrument methane emissions in the energy sector.[2] The correlation with energy production is 0.87, and there is no reason to believe that this instrument can be correlated with our dependent variables.

When using the number of investment projects as dependent variable, we tested with both OLS and a Poisson model, which offers better estimates. The reason is that there are several serious problems in using event count data with the OLS model. First, OLS assumes a linear relationship, which is an implausible functional form for two reasons: (1) it often results in predicted event counts that are less than zero and therefore meaningless. Moreover, a "truncated linear" model, where negative fitted values are forced to zero, makes unrealistic assumptions at and near the cutoff point. Furthermore, (2) it makes the unrealistic assumption that the difference between zero and one event occurring in a particular time interval is the same as the difference between, say, 20 and 21 events.

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[2] Thousand metric tons of CO_2 equivalent, average 2005-2010, retrieved form World Bank Data.

Thus, the true relationship is not linear, and a linear approximation would not in most cases even be a reasonable working assumption (King 1988, p.845).

To test our second hypothesis we used as a dependent variable only investments in the energy sector on the China Global Investment Tracker. We used dummies per region, and an interactive term (energy production$_i$ × region$_i$) to test for the existence of strategic regions in Chinese investments. Such dummy variables (continents) will essentially fit separate intercepts for different geographical regions, thereby taking into account fixed mean differences in the dependent variable $\mathbf{y}$ across discrete regions.

This is by far the most common approach for addressing regional heterogeneity in applied work, and social science is replete with models in which region categories are included as dummy variables (Ward & Gleditsch, 2008). However, the regional dummy variable specification may not generally be an adequate alternative to the spatially lagged $\mathbf{y}$ model and entails assumptions that can be overly restrictive.

For this reason, we also use Moran's I to test for the existence of clusters of Chinese investment around the globe (see Appendix D). There are a number of theoretical reasons why FDI into a host country may depend on the FDI in proximate countries, for example when a parent country invests in a particular host country with the intention of serving third markets with exports of final goods from the affiliate in the host country (Bloningen et al. 2007). Somewhat analogous to a lagged dependent variable in time series analysis, the estimated "spatial lag" coefficient characterizes the contemporaneous correlation between one country's FDI and other geographically-proximate countries' FDIs.

Our weights matrix was built considering the dyadic distance between countries' capital cities (a 92 × 92 matrix in our case). Through this matrix we can detect if a country's sum of Chinese investments co-varies with the sum of Chinese investments received among its geographical neighbors, contributing to our hypothesis that the Chinese global quest for energy has not been sensitive to the geographical location of those resources.

There are several studies on spatial determinants of FDI to China (Chen, 1996; Wei et al. 1999; Coughlin & Segev, 2000) but we did not find studies on geographical determinants of Chinese OFDI, except for Anyanwu (2012). This author studied regional determinants of Chinese OFDI in Africa and found that East and Southern African sub-regions appear positively disposed to obtain higher levels of inward FDI.

Empirical Results

Table 2 presents the results for two different specifications of Chinese OFDI, and the impact of energy resources, along with a set of political and economic control variables dictated by the theoretical framework outlined above. All models include the same set of independent variables, and both show high R^2.

TABLE 2: REGRESSION RESULTS

	Sum of FDI		*Number of projects*	
	OLS	2SLS	OLS	Poisson
Cereal yield	-0.84	-1.25*	-0.0006	-0.000
	(-1.94)	(-2.09)	(-1.46)	(-1.12)
Land under cereal production	0.190*	0.05	0.0001	0.000
	(2.09)	(0.27)	(1.62)	(1.9)
Forest area	0.78	-1.17	0.0004	0.0002***
	(0.8)	(-0.56)	(0.43)	(3.57)
Energy production	23.4***	41*	0.03***	0.0014***
	(4.28)	(2.15)	(5.6)	(4.77)
Iron and steel production	-0.34***	-0.39***	-0.0003***	-0.00004***
	(-4.95)	(-4.74)	(-4.57)	(-8.51)
Chinese imports from country $_i$	213.0***	243.7*	0.204***	0.02***
	(3.82)	(2.59)	(4.00)	(6.11)
Electricity and telephony infrastructure	677.3	502.1	0.14	-0.08
	(0.55)	(0.33)	(0.13)	(-0.83)
Trustworthiness and confidence	1621.1	2345.8	1.75	0.19
	(1.24)	(1.42)	(1.46)	(1.81)
Macroeconomic environment	-2215.6**	-2255.4*	-2.27**	-0.24***
	(-2.69)	(-2.27)	(-3.01)	(-3.64)
Roads, paved (%)	-44.5	-52.8	-0.04	-0.004
	(-1.49)	(-1.47)	(-1.55)	(-1.77)
Ease of doing business rank	-6.675	-7.541	-0.006	0.002
	(-0.24)	(-0.23)	(-0.22)	(1.15)

Domestic market size	482.7	343.5	0.44	0.53***
	(0.48)	(0.25)	(0.49)	(6.43)
GDP per capita	0.164*	0.15	0.0001	-0.0000001
	(2.56)	(1.9)	(1.43)	(-0.02)
Inflation, consumer prices	-0.385	-0.48	-0.0002	0.00003
	(-0.51)	(-0.55)	(-0.27)	(0.54)
Health	1109	2537.3	1.9	0.23*
	(0.79)	(1.24)	(1.5)	(1.98)
Public institutions	-715	-1123	-0.47	0.046
	(-0.48)	(-0.57)	(-0.35)	(0.39)
Total tax rate	-0.988	37.6	-0.0116	-0.00323
	(-0.03)	(0.5)	(-0.38)	(-0.91)
Time to prepare and pay taxes	5.9*	9.2*	0.006*	0.0002
	(2.17)	(2.06)	(2.3)	(1.03)
Time required to enforce a contract	-1.16	-0.12	-0.00003	-0.0004
	(-0.45)	(-0.03)	(-0.01)	(-1.85)
Distance in km between capitals	0.17	0.01	0.00003	-0.000003
	(0.79)	(0.04)	(0.18)	(-0.16)
Observations	92	82	92	92
R-sq	0.70	0.67	0.74	-
adj. R-sq	0.61	0.56	0.66	-
pseudo R-sq	-	-	-	0.57

Note: t statistics in parentheses * $p<0.05$, ** $p<0.01$, *** $p<0.001$

In both specifications, the energy production of the host country showed coefficients with high statistical significance. A unit increase in the independent variable (an increase in the host country's energy production of 1,000 kilotonnes of oil or equivalents) is predicted to increase Chinese OFDI by US $23 million with OLS and by US $41 million with 2SLS. It also heightens the likelihood of increasing the number of projects by 0.1%, as shown by the Poisson model.[3] These findings have a large impact on the dependent variables, considering that the average energetic production in our sample is of 98,000 kilotonnes. This means that a country with 98,000 kilotonnes of energy production was expected to receive US $4.02 billion, plus or minus US $1.860 billion, in Chinese investments, solely for these resources. This is an important figure considering that the average sum of investment on all nine sectors of the database was US $5.3 billion. No other coefficient showed such a large effect. In standard deviations, an increase in one unit in this independent variable increases by one standard deviation the sum of OFDI, which demonstrates that

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[3] We included the OLS results in the table to show how it magnifies the coefficients.

the host country energy production was a main determinant of Chinese OFDI during our period of study.

With respect to the other independent variables, our results can be divided into three categories. First, the results on natural resources do not coincide exactly with the results of Buckley et al (2007) and Ramasamy (2012), and downplay the claim that all natural resources are very attractive to Chinese companies. Cereal yield shows a statistically significant negative effect on the sum of OFDI. One standard deviation increase in this variable produces a drop of .25 standard deviations in the sum of OFDI. Forested area shows a very small but statistically significant positive effect on the number of projects. Iron and steel production, surprisingly, is negatively related to Chinese OFDI, suggesting that industrial production was not a strong determinant of Chinese investments during the period studied. Its impact on the sum of OFDI is large, considering that one standard deviation increase in this variable produces a drop of .8 standard deviations in the total OFDI.

Second, with respect to international trade indicators, our results were similar to those found by Anyanwu (2012). Chinese imports from the host country showed positive statistical significance, suggesting that investments are being made in countries with which China has strong commercial ties and economic interest. Measured in standard deviations, its impact in the dependent variable is .49. Domestic market size is also positively associated with the number of projects, but not with the sum of investments, suggesting market-seeking strategies from Chinese companies attempting to penetrate new consumer markets. In standard deviations, its impact in the dependent variable is of .06. According to Buckley et al. (2007), market size is generally recognized as a significant determinant of FDI flows: as markets increase in size, so do opportunities for the efficient utilization of resources and the exploitation of economies of scale and scope via FDI. Numerous studies (surveyed by Chakrabarti, 2001) show that FDI flow and market size are positively associated.

Third, regarding domestic institutional characteristics, the macroeconomic environment is negatively associated with both the size and the quantity of investment projects (in standard deviations produces a drop of .22 and .02 in the dependent variable, respectively). This finding coincides with those of Buckley et al (2007) and De Beule and Duanmu (2012). The reason could be that higher-risk host countries also offer higher returns, and Chinese companies have invested assuming those risks. This is why Chinese companies have intensively invested in African, Latin American, and Middle Eastern countries. For the same reason, time to prepare and pay taxes is positively associated with the sum of OFDI (.31 standard deviations in the sum of Chinese OFDI) because this variable can be considered a proxy for public's sector efficiency. It has been empirically demonstrated that oil and gas producing countries are more prone to inefficient public sectors and volatile macroeconomic environments (Ross, 2012).

Table 3 presents the predicted investments in the energy sector for each region, following our baseline model in Table 2. It also presents the predicted investments after considering the interactive term (energy production$_i$ × region$_i$) to test for the existence of strategic regions in Chinese investments during the studied period of time. In the regression we included eight macro-regions (Africa, Central Asia & Russia, Europe, North America & Caribbean, Middle East, South America, Southeast Asia, and Oceania), and none of them showed statistical significance. These findings match our second hypothesis. When considering the interactive term, Oceania had a positive effect, and Central Asia & Russia had a negative effect, which means that all the regions have the same exact intercept and the same slope, except for Oceania which has the same intercept but a steeper slope, and Central Asia & Russia which has the same intercept but a less steep slope. This means that the former received more investments, and the latter fewer, in the energy sector than expected considering their resources.

TABLE 3: PREDICTED INVESTMENTS IN THE ENERGETIC SECTOR BY REGION

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Energy production	35.6	93.73	-596.9	219.1*	41.73	27.63	104.2	368.9
	(1.26)	(1.04)	(-0.08)	(2.3)	(1.01)	(1.37)	(0.65)	(0.24)

Constant	-6900.6	-949.5	67871	-10616.8	2155.8	2877.6	1054.2	-88428.5
	(-0.29)	(-0.06)	(0.08)	(-0.56)	(0.21)	(0.28)	(0.08)	(-0.20)
Regions								
North America	-	2417.5	-90431.5	13270.7	2165.9	4973.2	-312.1	36328.3
	-	(0.49)	(-0.08)	(1.06)	(0.59)	(1.06)	(-0.06)	(0.2)
Africa	1253.5	-	-62035.8	12919.5	2115.4	4465	-338	45710
	(0.3)	-	(-0.08)	(1.05)	(0.64)	(1.23)	(-0.08)	(0.2)
Central Asia & Russia	3813.2	5358.7	-	15310.5	4410.3	6125.1	2833	74867.7
	(0.58)	(0.73)	-	(1.14)	(1.19)	(1.75)	(0.5)	(0.21)
Oceania	-4533.3	-4347.9	-40070.3	-	-3651.7	-1829.9	-6091.5	36303.5
	(-0.67)	(-0.67)	(-0.10)	-	(-0.69)	(-0.32)	(-0.90)	(0.17)
Europe	1315.3	2370.5	-61593.1	11468.8	-	3006.2	-1167.3	56045.2
	(0.2)	(0.31)	(-0.08)	(0.93)	-	(0.88)	(-0.24)	(0.2)
Middle East	-793	275.8	-59144.8	9992.7	-412	-	-3145.8	58903.7
	(-0.13)	(0.04)	(-0.08)	(0.79)	(-0.13)	-	(-0.73)	(0.19)
South America	2722.7	4609	-26264.8	15300.6	4468	6305.9	-	72619.4
	(0.5)	(0.75)	(-0.08)	(1.15)	(1.2)	(1.7)	-	(0.21)
Southeast Asia	5062.8	5844.6	-87109.5	16207.8	4981.1	8878.2	3468.8	-
	(1)	(0.96)	(-0.07)	(1.31)	(0.98)	(1.33)	(0.48)	-
Interactive terms								
North America × Energy production	-	-73.04	443.3	-196.5*	-21.22	-7.719	-81.71	-321.1
	-	(-0.83)	(0.08)	(-2.18)	(-0.52)	(-0.37)	(-0.52)	(-0.23)
Africa × Energy production	10.65	-	675.2	-173.8	4.434	17.01	-57.55	-295.4
	(0.37)	-	(0.08)	(-1.87)	(0.11)	(0.7)	(-0.37)	(-0.21)
Central Asia & Russia × Energy production	-36.23**	-114.9	-	-234.4*	-62.26	-47.99*	-125	-349.3
	(-3.30)	(-1.24)	-	(-2.68)	(-1.42)	(-2.05)	(-0.77)	(-0.26)
Oceania × Energy production	149.8***	75.34	445.2	-	124.2*	141.2***	67.99	-96.01
	(5.16)	(0.87)	(0.13)	-	(2.64)	(4.87)	(0.46)	(-0.09)
Europe × Energy production	-12.26	-69.26	650.2	-199.4*	-	-9.189	-82.74	-315.4
	(-0.47)	(-0.86)	(0.08)	(-2.12)	-	(-0.35)	(-0.53)	(-0.23)
Middle East × Energy production	-18.72	-75.69	627	-200.5*	-25.31	-	-85.1	-346.9
	(-0.65)	(-0.87)	(0.08)	(-2.19)	(-0.60)	-	(-0.55)	(-0.23)
Southeast Asia × Energy production	25.1	-62.95	759.4	-188.1*	-21.45	-2.786	-	-189.8
	(0.31)	(-0.78)	(0.08)	(-2.28)	(-0.36)	(-0.05)	-	(-0.25)
South America × Energy production	18.7	-50.29	431.2	-172.6*	-0.579	11.43	-60.68	-
	(1.01)	(-0.61)	(0.09)	(-2.09)	(-0.01)	(0.44)	(-0.40)	-
Observations	82	82	82	82	82	82	82	82

Note: t statistics in parentheses * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Appendix D provides a table with diagnostic statistics for spatial autocorrelation, and a stylized plot illustrating the Moran I statistic. The spatial lag is shown on the vertical axis, while the horizontal axis portrays the value of each observation, standardized to have means of 0 and variances of 1.[4]

Moran’s I compares the relationship between the deviations from the mean across all neighbors i , adjusted for the variation in y and the number of neighbors for each observation. Higher values of a Moran’s I indicate stronger positive geographical clustering; that is, values for neighboring units are similar to one another. We found an almost null effect, which also had no statistical significance.

Table 4 depicts Spatial Lagged Models and Spatial Error Models for both the sum of investments and number of projects in energy. We found no statistically significant results on the existence of spatial autocorrelation among countries, which can be interpreted as the non-existence of investment clusters. We can affirm that investments made in a country did not influence investment in its neighbors. These results give us considerable information about the geographical distribution of Chinese OFDI in its quest for energy.

TABLE 4: SPATIAL LAGGED MODELS AND SPATIAL ERROR MODELS

	Sum of FDI in energy			*Number of projects in energy*		
	2SLS	Spatial Lagged Model	Spatial Error Model	2SLS	Spatial Lagged Model	Spatial Error Model
Energy production	16.19***	10.19***	10.18***	0.012***	0.009***	0.009***
	(4.53)	(3.31)	(3.36)	(4.81)	(5.84)	(5.88)
Constant	1190.9	3366.8*	1695.0***	1.35**	2.72*	1.56***
	(1.74)	(2.46)	(6.27)	(2.96)	(2.28)	(7.94)
rho	-	-0.61	-	-	-0.47	-
	-	(-1.42)	-	-	(-1.08)	-
lambda	-	-	-0.49	-	-	-0.35
	-	-	(-1.28)	-	-	(-0.92)
Observations	83	94	94	83	94	94

Note: t statistics in parentheses * p<0.05, ** p<0.01, *** p<0.001

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[4] Similar results were found when using the number of projects as dependent variable.

Policy Implications Derived from the Findings

The aim of this paper is to provide new evidence for the Chinese global quest for energy through data on Chinese OFDI. The expectation was that the Chinese global quest for energy drove OFDI between 2005 and 2012, and that investments have not been sensitive to the geographical location of those resources. The results confirmed both hypotheses. These findings are in line with Mayer & Wübbeke (2013), who argue that Chinese energy policy is based on pragmatism, fostering integration into existing supply systems and market institutions, thus strongly relying on world markets to satisfy the growing energy demand.

This paper shows that host country energy production has been a main determinant of Chinese OFDI. In recent years, this assumption has been shown in works studying home determinants of Chinese OFDI (Buckey et al. 2007 and Anyanwu, 2012). However, this paper is the first to focus on the policy implications of Chinese OFDI in energy resources considering *energy security* and *energy diplomacy* concepts, and to study it using the only publicly available database on Chinese investments. In addition, the findings for our second hypothesis are suggestive and open an unexplored topic. The policy implications of our findings are relevant for three main reasons.

First, China has already emerged as the world’s top importer of crude oil. As urbanization in China continues into the future (Shen et al., 2005), it will be inevitably accompanied by dramatic increases in energy consumption. Furthermore, from the empirical findings we can expect that in years to come Chinese investments will be made in countries that can supply this increasing demand for energy.

Second, even though we could find neither geographical clusters of investments, nor spatial autocorrelation among countries on energy investments, the findings show that Australia and Indonesia are predicted to receive important energy investments, probably because they are located in a region where China has a vested interest in promoting a stable security environment, which enables it to maintain stable economic growth and technological modernization without major interruptions or foreign impediments. Australia is predicted to receive the largest amount of money on energy projects, behind only the USA.

Third, investments will probably continue to be made in countries that lack stable economic environments. Thus, we expect the largest number of energy investments in Africa and South America in the years to come. In the use of energy diplomacy, it is likely that "loans-for-oil" will continue to grow as a way of conducting business in these unstable markets.

As one of the first papers to study the relation between OFDI and energy hunger in China, there is much more to be said on this issue. Future work should elaborate on the role of the main NOCs, and the political links between these companies and the national government. Also, there is evidence that joint-ventures perform better than wholly foreign-owned firms (Greenway et al., 2012), and this fact should be taken into account. Furthermore, the econometric model should be improved in future studies, by including the temporal dimension to work with panel models and adding more countries to the sample. Due to missing data this paper offers a first approach to the matter, and sets an agenda to closely follow Chinese OFDI in the energy sector.

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Appendix A

Year	Month	Investor	Amount (US $ million)	Partner/ Target	Country
2005	April	CNOOC	$130	MEG Energy	Canada
2005	May	CNPC	$390	SONATRACH	Algeria
2005	June	Sinopec	$120	Synenco	Canada
2005	August	CNPC	$4200	PetroKazakhstan	Kazakhstan
2005	September	Sinopec	$350	Aker Kvaerner	Saudi Arabia
2005	September	CNPC and Sinopec	$1420	EnCana	Ecuador
2005	December	CNPC	$290	Petro-Canada	Syria
2006	January	CNOOC	$2270	South African Petroleum	Nigeria
2006	April	Sinopec	$1290	Petrobras	Brazil
2006	May	Sinopec	$730	Sonangol	Angola
2006	June	Sinopec	$3490	Rosneft	Russian Federation
2006	July	Sinopec	$2800	North West Shelf Partners	Iran
2006	July	CNPC	$500	Rosneft	Russian Federation
2006	September	Sinopec	$430	Omimex	Colombia
2007	January	CNPC	$200	EnCana	Chad
2007	February	Sinopec	$100	Syntroleum	USA
2007	December	Sinopec	$2010	National Iranian Oil	Iran
2008	February	Sinochem	$470	Soco	Yemen
2008	March	Sinopec	$560	AED	Australia
2008	April	CNOOC	$130	Husky Energy	Indonesia
2008	June	CNPC	$4990	-	Niger
2008	July	CNOOC	$2490	Awilco Offshore	Norway
2008	July	Sinochem	$200	GMG Global	Singapore
2008	September	Sinopec	$1990	Tanganyika Oil	Syria
2008	Novermber	CNPC	$3020	-	Iraq
2008	December	CNPC	$3290	International Petroleum Investment	UAE
2009	January	CNPC	$1760	National Iranian Oil	Iran
2009	April	Sinopec	$350	Kuwait Oil	Kuwait
2009	April	CNPC	$2600	Central Asia Petroleum	Kazakhstan
2009	May	CNOOC and Sinopec	$320	Talisman Energy	Trinidad-Tobago
2009	May	CNPC	$1.020	Singapore Petroleum	Singapore
2009	June	CNPC	$1240	-	Myanmar
2009	June	Sinopec	$7200	Addax Petroleum	Switzerland
2009	August	CNPC	$1740	Athabasca Oil Sands	Canada
2009	August	CNOOC	$100	Qatar Petroleum	Qatar
2009	August	Sinochem	$880	Emerald Energy	Britain
2009	September	CNPC	$1160	Singapore Petroleum	Singapore
2009	September	CNPC	$2250	National Iranian Oil	Iran
2009	November	CNOOC	$100	Statoil	USA
2009	December	CNPC	$240	State Oil Marketing Organization and South Oil Company	Iraq

2009	December	CNPC	$3130		Turkmenistan
2010	March	Sinopec	$1700	Kazakhstan Petrochemical	Kazakhstan
2010	March	CNPC	$180	INOVA Geophysical Equipment	USA
2010	March	CNOOC	$3100	Bridas	Argentina
2010	March	CNPC	$1580	Arrow Energy	Australia
2010	March	Sinochem	$500	-	Sudan
2010	April	CNOOC	$180	Chevron	Australia
2010	April	Sinopec	$4650	ConocoPhillip	Canada
2010	April	CNOOC	$270	BG	Australia
2010	April	CNPC	$900	PDVSA	Venezuela
2010	May	CNPC	$1480	Shell	Syria
2010	May	Sinochem	$3070	Statoil	Brazil
2010	May	CNPC	$150	-	Indonesia
2010	October	Sinopec	$7100	Repsol	Brazil
2010	October	CNOOC	$2370	Chesapeake Energy	USA
2010	October	Sinochem	$1440	Makhteshim-Agan	Israel
2010	November	CNPC	$4500	Cuvenpetrol	Cuba
2010	November	CNPC and Sinopec	$610	-	Ecuador
2010	December	Sinochem	$270	DSM	Netherlands
2010	December	Sinopec	$2470	Occidental Petroleum	Argentina
2010	December	Sinopec	$680	Chevron	Indonesia
2011	January	CNPC	$510	INEOS Britain	Britain
2011	January	CNPC	$510	INEOS France	France
2011	February	Sinopec	$1520	Origin Energy-ConocoPhillips	Australia
2011	February	CNOOC	$330	ExxonMobil	Argentina
2011	March	CNOOC	$1450	Tullow	Uganda
2011	March	Sinopec	$3300	SABC	Saudi Arabia
2011	May	Sinopec	$540	Shell	Cameroon
2011	June	CNPC	$170	Maysan Oil	Iraq
2011	July	CNOOC	$2040	Opti Canada	Canada
2011	September	CNPC	$500	Tanzania Petroleum Development	Tanzania
2011	October	Sinopec	$2100	Daylight Energy	Canada
2011	October	CNPC	$400	Watan	Afghanistan
2011	November	Sinopec	$4800	Galp Energia	Brazil
2011	December	Sinopec	$990	Australia Pacific Liquefied Natural Gas	Australia
2011	December	CNPC	$150	Varun Industries	Madagascar
2011	December	Sinopec	$850	Marubeni	Kazakhstan
2011	December	Sinopec	$700	Ghana National Gas	Ghana
2012	January	CNPC	$270	Bow Energy	Australia
2012	January	Sinopec	$2440	Devon Energy	USA
2012	January	CNPC	$670	Athabasca Oil Sands	Canada
2012	February	CNPC	$1030	Shell	Canada
2012	February	Sinochem	$260	Siat	Belgium
2012	February	Sinochem	$980	Total	Colombia
2012	February	Sinopec	$850	Ghana National Gas	Ghana
2012	June	Sinochem	$700	Sumber Segara Primadaya	Indonesia

2012	July	Sinopec	$1500	Talisman Energy	Britain
2012	September	Sinopec	$1020	Summit Power	USA
2012	October	CNPC	$1510	TransCanada	Canada
2012	October	Sinopec	$850	-	Indonesia
2012	October	Sinopec	$170	Mercuria	Switzerland
2012	October	CNOOC	$1930	BG	Australia
2012	November	Sinopec	$2500	Total	Nigeria
2012	November	Sinochem	$400	Saudi Basic Industries	Saudi Arabia
2012	November	Sinopec	$1980	DKRW	USA
2012	December	CNPC	$1630	BHP	Australia
2012	December	CNPC	$2180	Encana	Canada
2012	December	CNOOC	$15100	Nexen	Canada

Source: China Global Investment Tracker

Appendix B

Variables	Indicators	Data Sources
Dependent:		
Amount of Chinese OFDI (Y_{i1})	Expressed as the amount of FDI received from Chinese MNEs by each of the 92 countries in our sample	Heritage Foundation China Global Investment Tracker
Number of investment projects (Y_{i2})	The number of projects in each of the 92 countries in the sample	Heritage Foundation China Global Investment Tracker
Independent:		
Energy production (X_{i1})	Energy production - Thousand kt of oil or equivalent in 2004	World Bank Data
Controls:		
Cereal yield	Kg per hectare - Average 2005 -2011	World Bank Data
Land under production	Land under cereal production - Thousand hectares - Average 2005 - 2011	World Bank Data
Forest area	Thousand sq. km in 2005	World Bank Data
Iron and steel production	Thousands of tons in 2007	World Bank Data
Chinese imports from country	Chinese imports from country i - average 2005 - 2012	World Bank Data
Electricity and telephony infrastructure	Score between 0 and 7	World Economic Forum
Trustworthiness and confidence	Score between 0 and 7	World Economic Forum
Macroeconomic environment	Score between 0 and 7	World Economic Forum
Paved roads	% of total roads, latest available value	World Bank Data
Ease of doing business rank	1=most business-friendly regulations - Data for 2012	World Economic Forum
Domestic market size	Score between 0 and 7	World Economic Forum
GDP per capita	current US$, average 2005 - 2012	World Bank Data
Inflation	annual %, average 2005 - 2012	World Bank Data
Health infrastructure	Score between 0 and 7	World Economic Forum
Public institutions strength	Score between 0 and 7	World Economic Forum
Total tax rate	% of commercial profits, average 2005 - 2012	World Bank Data
Time to prepare and pay taxes	Hours, average 2005 - 2012	World Bank Data
Distance	Kms between Beijing and the country’s capital	World Distance Calculator

Source: Elaborated by the authors.

Appendix C

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1.Cereal yield	1																			
2.Land under cereal production	-0.0095	1																		
3.Forest area	-0.0208	0.4761	1																	
4.Energy production	0.1490	0.6679	0.6896	1																
5.Iron and steel production	0.2220	0.5340	0.4696	0.6047	1															
6.Chinese imports from country $_i$	0.2384	0.2503	0.2614	0.4254	0.7888	1														
7. Electricity and telephony infrastructure	0.5862	-0.0274	0.1124	0.2100	0.3254	0.3731	1													
8.Trustworthiness and confidence	0.2933	0.1000	-0.0151	0.0828	0.1253	0.2350	0.4593	1												
9.Macroeconomic environment	0.1443	-0.0537	0.0774	0.1219	0.0019	0.1299	0.4539	0.3007	1											
10.Roads, paved (%)	0.3570	0.0008	-0.0817	0.0691	0.2307	0.1849	0.6535	0.2412	0.1426	1										
11.Ease of doing business rank	-0.5089	0.0469	0.0115	-0.1543	-0.2271	-0.3770	-0.7972	-0.6505	-0.4175	-0.5161	1									
12.Domestic market size	0.4657	0.5017	0.3620	0.5248	0.6014	0.5471	0.5433	0.2845	0.1483	0.3621	-0.4550	1								
13.GDP per capita	0.4966	-0.0269	0.0472	0.2134	0.2631	0.2880	0.7575	0.4709	0.4340	0.5032	-0.6561	0.4019	1							
14.Inflation, consumer prices	-0.1474	-0.0295	-0.0176	-0.0422	-0.0481	-0.0462	-0.1552	-0.0406	-0.1060	-0.1030	0.1797	-0.1987	-0.0817	1						
15.Health	0.4666	-0.0054	0.0675	0.1359	0.2914	0.3444	0.7944	0.4520	0.3386	0.5605	-0.6330	0.4101	0.6546	-0.0036	1					
16.Public institutions	0.4085	-0.0875	-0.0690	0.0674	0.1172	0.2536	0.6734	0.6866	0.4474	0.4178	-0.7083	0.2129	0.7466	-0.0868	0.6565	1				
17.Total tax rate	-0.0568	0.1137	0.0904	-0.0102	0.0954	-0.0319	-0.1621	-0.2834	-0.3995	-0.1621	0.2883	0.0217	-0.1590	-0.0156	-0.2327	-0.3253	1			
18.Time to prepare and pay taxes	-0.1026	0.1253	0.3511	0.0219	0.1094	-0.0057	-0.2000	-0.2237	-0.1417	-0.1791	0.3868	0.1230	-0.3144	-0.0287	-0.2856	-0.4128	0.2397	1		
19.Time required to enforce a contract	-0.0277	0.1347	-0.0985	-0.1348	-0.1499	-0.2490	-0.2752	-0.1398	-0.1489	-0.1724	0.2966	-0.1007	-0.2583	-0.0707	-0.2814	-0.2494	0.0780	0.0524	1	
20.Distance in Km between capitals	-0.0397	-0.1224	0.1275	-0.0356	-0.2011	-0.2563	-0.1810	-0.0833	-0.1325	-0.4519	0.2421	-0.1798	-0.1615	0.0578	-0.2947	-0.2248	0.2875	0.2922	0.1085	1

Source: Elaborated by the authors.

Appendix D

Test	Statistic	Degrees of Freedom	p-value
Spatial error:			
Moran's I	-0.38	1	1.296
Lagrange multiplier	0.534	1	0.465
Robust Lagrange multiplier	0.463	1	0.496
Spatial lag:			
Lagrange multiplier	0.886	1	0.346
Robust Lagrange multiplier	0.815	1	0.367

Source: Elaborated by the authors