# Going green: Chinese OFDIs in the European Renewable Energy sector

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## Economics focus: policy framework

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As a result of specific **industrial policy** measures, the green industry in China has been growing on size and competitiveness, also expanding abroad through **FDI**.

**European countries** are among the preferential target destinations for Chinese investors in the green related industries.

The **economic diplomacy** efforts and **cooperation dialogue** developed so far with China on the environment issues has contributed to **strengthen** partnering opportunities.

PARTNERING OPPORTUNITIES BETWEEN EUROPE AND CHINA IN
THE RENEWABLE ENERGIES AN ENVIRONMENTAL INDUSTRIES

China is now leading many green-tech areas of the global market (China Greentech initiative, 2012, p. 11). It has become the largest manufacturer of wind turbines and solar panels, and has more wind generation capacity installed than any other country

**China green policy**

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12ᵗʰ Five-year plan:  measures to face environmental issues in key policy areas ("economic restructuring", "social equality", "energy and environment")

3ʳᵈ Plenary Session of the 18th Communist Party of China:  confirmed and strengthened measures to support China commitment for environmental issues (put at the top priority of reforms).

12ᵗʰ  Five-Year Plan for National Economic and Social Development: clean energy will take the leading role in energy development

12ᵗʰ  Five-Year plan on Inward and Outward: active internationalization projects in natural resources field are promoted "in order to secure sustainable, stable, economic, and safe supply of energy and natural resources".

PARTNERING OPPORTUNITIES BETWEEN EUROPE AND CHINA  IN THE RENEWABLE ENERGIES AN ENVIRONMENTAL INDUSTRIES

Energy saving, environmental cleanup, promotion of renewable energies are affecting demand and supply trends.

Industrial measures are supporting the growth of a competitive national sectors related environment products/technologies and clean energy

*Go Global* strategy developed by China to expand overseas. International investments, cooperation initiatives and strategic alliances have been booming, since 2011, in the oil and renewable energy sector (wind, solar, bio-energy), in basic infrastructure (water and power grid utilities), and green building (China Greentech initiative, 2012, p. 35). Active internationalization projects in natural resources field are prioritized by 12ᵗʰ Five-Year plan on Inward and Outward FDI (NDRC, 2012) "in order to secure sustainable, stable, economic, and safe supply of energy and natural resources" (Sauvant, Chen, 2014, p. 144).

From **climate change**, **energy security** to **environmental security,** linking development, economic growth, international security issues.

| Channels of cooperation | Specific Programs |
|---|---|
| • The Environment Policy Dialogue, at ministerial level. Since 2003 meetings have been taking place regularly, alternating between Brussels and China.<br>• Bilateral cooperation mechanism on forests (BCM), beetwen the Chinese State Forestry Administration and director level at the EC (since 2009);<br>• The Climate Change Partnership, developed by Directoral General of the EC on climate action. | ● **EGP**, The EU-China Environmental Governance Program(2011-2015)<br>In partnership with the Chinese Ministry of Environmental Protection, EGP aims to contribute to the strengthening of environmental governance in China through enhanced administration, public access to information, public participation, access to justice and corporate responsibility in the environmental field (http://www.ecegp.com/index_en.asp)<br><br>● **ESP**, The EU-China Environmental Sustainability Program<br>Launched in September 2012, the project aims to support China's efforts to meet the environmental and climate change targets defined in the 12th Five Year Development Plan. The specific objectives focus on the achievement of environmental sustainability through improved water quality and the prevention and control of heavy metal pollution and implementation of sustainable solid waste management. |

Several aspects are commonly considered drivers of the European interest in strengthening environment partnership with China (De Matteis, 2010, p. 464). Europe has a comparative advantage in the field and has the opportunity to use it to gain diplomatic power. China is a profitable market both for European environmental goods to be exported and for European firms to develop penetration strategies. Moreover, helping China to diversify its energy demand and to improve its energy efficiency could help Europe in the run for energy supply (Freeman, Holslag, 2009). On the other hand, as already anticipated, China has several reasons to engage with the EU, which include its experience in these areas and its necessity to implement "more sustainable growth strategies" (Gill et al. 2008).

At the moment, the agenda of Europe and China cooperation is carried out through three main channels and specific programs(see Table 1).

**Purpose and Methodology**　　　　　　　　　绿 |oreen

**Purpose -** We investigate Chinese OFDI in the EU, in the **renewable energy** (RE) sector to understand:
(a) how the institutional, market, technological, and human capital factors of host country affect the location choice in the RE sector;
(b) what are the differences of the determinants of location decision in the RE sector among overseas subsidiaries with different functions.

**Methodology** - Mofcom database of greenfield and non-greenfield Chinese investments abroad is used. A six fixed-effects logit analysis is performed.

PARTNERING OPPORTUNITIES BETWEEN EUROPE AND CHINA IN
THE RENEWABLE ENERGIES AN ENVIRONMENTAL INDUSTRIES

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The increasing number of Chinese firms investing in Europe is a new step forward the economic integration of China and Europe, that already share the primacy of one of

the most importance trade partnership in the word.

Energy and environment, as well as climate change have been playing an important

role in the agenda of cooperation initiatives where the European Union has pledged to

assist China in its efforts to address global concerns (De Matteis, 2010). Europe and

China share a common goal of environmental protection.

Research target: Chinese firms in the RE sector with foreign subsidiaries in EU by the end of 2013 (Greenfield and M&A)
Dataset: 202 location choices by 132 Chinese firms in renewable energy sector in the EU countries from 2004 to 2013

| Country | N. of Chinese OFDI | Country | N. of Chinese OFDI |
|---|---|---|---|
| Austria | 1 | Luxembourg | 19 |
| Bulgaria | 21 | Romania | 4 |
| Belgium | 2 | Sweden | 3 |
| Poland | 1 | Slovakia | 1 |
| Denmark | 4 | Spain | 9 |
| Germany | 88 | Hungary | 3 |
| France | 5 | Italy | 15 |
| Netherlands | 11 | United Kingdom | 10 |
| Czech | 5 | Total | 202 |

Our research target is all Chinese firms in renewable energy sector with foreign subsidiaries in EU by the end of 2013, which come from MOFCOM, covering both greenfield and non-greenfield (e.g. M&A, joint venture) investments. The dataset includes 202 location choices by 132 Chinese firms in renewable energy sector in the EU countries from 2004 to 2013 (See Table 1). 17 EU countries were involved that has target destinations within this period by Chinese firms. More than 40% of the sample firms invest in Germany. Firms engaged in manufacturing, R&D, sales and services in EU host countries constitute 29%, 35% and 84%, respectively, of the total sample of firms. This indicates that sales and services are the main function of Chinese green OFDI in renewable energy sector in EU. The Chinese firms are from 19 provinces, with nearly 30% from Jiangsu Province, one of the most active areas of renewable energy sector in China. For each investment decision, we have the data of the year of investment, the destination country of the investment, the entry mode of the investment, overseas activities of the investment, and the ownership structure of the firm, which come from MOFCOM. We also collect the parent firm's information, such as the year of foundation, the number of employees, and if it is a listed company, from sample firms' homepages or their annual reports

# Measures

## Dependent and Independent variables

| Variables | Measurement | Data sources |
|---|---|---|
| *Dependent variable* | | |
| Country chosen | 1 = the choice of the country, 0 = otherwise | Mofcom |
| *Independent variables* | | |
| Political stability | perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism. Scoring from -2.5 (weak) to 2.5 (strong). | Worldwide Governance Indicators |
| Rule of law | perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Scoring from -2.5 (weak) to 2.5 (strong) | Worldwide Governance Indicators |
| Control of corruption | perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. Scoring from -2.5 (weak) to 2.5 (strong). | Worldwide Governance Indicators |
| Prevalence of trade barriers | tariff and non-tariff barriers significantly reduce the ability of imported goods to compete in the domestic market. Scoring from 1 (strongly disagree) to 7 (strongly agree) | Global Competitiveness Report |
| Prevalence of foreign ownership | foreign ownership of companies in your country is limited or encouraged. Scoring from 1 (rare and limited) to 7 (prevalent and encouraged) | GC Report |
| Market size | log of GDP | World Bank |
| Market affluence | log of GDP per capita | World Bank |
| Technological readiness | agility with which an economy adopts existing technologies to enhance the productivity of its industries. | GC Report |
| Human capital | gross secondary education enrollment rate | World Bank |

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## Measures

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| Control variables | | |
|---|---|---|
| Firm size | log of number of employees | Firm's homepage or annual report |
| Firm age | number of years since the founding of the firm | Firm's homepage or annual report |
| Listed company | 1 = listed company, 0 = otherwise | Firm's homepage |
| Ownership | 1 = SOE, 0 = non-SOEs | Mofcom |

## Empirical results

| | Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Political Stability | 1.000 | | | | | | | | |
| 2 | Rule of Law | .527*** | 1.000 | | | | | | | |
| 3 | Control of Corruption | .467*** | .947*** | 1.000 | | | | | | |
| 4 | Prevalence of trade barriers | .715*** | .649*** | .546*** | 1.000 | | | | | |
| 5 | Prevalence of foreign ownership | .554*** | .628*** | .579*** | .849*** | 1.000 | | | | |
| 6 | GDP | -.189*** | .450*** | .393*** | -.065*** | -.087*** | 1.000 | | | |
| 7 | GDP per capita | .454*** | .895*** | .864*** | .591*** | .476*** | .525*** | 1.000 | | |
| 8 | Technological readiness | .450*** | .941*** | .933*** | .590*** | .568*** | .405*** | .874*** | 1.000 | |
| 9 | Human capital | -.043*** | .425*** | .520*** | -.027*** | .018 | .360 | .405*** | .458*** | 1.000 |

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Table 5 presents correlations of the variables used in this study, from which we can see that the correlations among independent variables are not very high. Because the variance inflation factors are well below the recommended threshold of 10, multicollinearity is not a serious issue in our models.

Two primary attributes of the data determine our choice of estimation technique: (1) the dichotomous dependent variable, and (2) the dependence among the records comprising each firm investment year. A fixed-effects logit model is appropriate for data with these attributes (Holburn & Zelner, 2010). The fixed-effects logit model accounts for unobserved heterogeneity among firms as well as investment year.

# Empirical results

We examine the impact of host country factors on Chinese green OFDI in six fixed-effects logit models

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| Firm size | -.0228*** | .0057** | -.0044* | -.0140*** | -.0021 | .0016 |
|  | (.0014) | (.0029) | (.0028) | (.0027) | (.0031) | (.0023) |
| Firm age | .0001 | -.0000 | .0000 | .0001* | .0000 | -.0000 |
|  | (.0005) | (.0005) | (.0004) | (.0005) | (.0005) | (.0003) |
| Listed company | .0253** | -.0050 | .0043 | .0146 | 0.0019 | -.0031 |
|  | (.0109) | (.0085) | (.0090) | (.0108) | (.0099) | (.0064) |
| Ownership | -.0227*** | 0.0057 | -.0045 | -.0111*** | -.0021 | -.0004 |
|  | (.0083) | (.0076) | (.0075) | (.0032) | (.0085) | (.0058) |
| Political Stability |  | .0105*** |  |  |  | .0370*** |
|  |  | (.0015) |  |  |  | (.0114) |
| Rule of Law |  | -.0142*** |  |  |  | -.1041*** |
|  |  | (.0094) |  |  |  | (.0217) |
| Control of Corruption |  | .0277*** |  |  |  | .0563*** |
|  |  | (.0135) |  |  |  | (.0140) |
| Prevalence of trade barriers |  | -.0167*** |  |  |  | -.1004*** |
|  |  | (.0054) |  |  |  | (.0194) |
| Prevalence of foreign ownership |  | .0261*** |  |  |  | .0193* |
|  |  | (.0096) |  |  |  | (.0115) |
| GDP |  |  | .0265*** |  |  | .0116*** |
|  |  |  | (.0028) |  |  | (.0030) |
| GDP per capita |  |  | .0263*** |  |  | .0294*** |
|  |  |  | (.0027) |  |  | (.0086) |
| Technological readiness |  |  |  | .0111*** |  | .0347*** |
|  |  |  |  | (.0033) |  | (.0121) |
| Human capital |  |  |  |  | -.0013*** | -.0019*** |
|  |  |  |  |  | (.0002) | (.0003) |
| Fixed effect of year | Done | Done | Done | Done | Done | Done |
| Fixed effect of firm | Done | Done | Done | Done | Done | Done |
| Pseudo $R^2$ | .804 | .823 | .819 | .806 | .813 | .838 |
| LR chi$^2$ | 3173.7*** | 3297.0*** | 3270.9*** | 3186.0*** | 3224.6*** | 3397.1*** |

Note: ***p<0.01, **p<0.05, *p<0.1. Standard errors in parenthesis.

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We examine the impact of host country factors on Chinese green OFDI in six fixed-effects logit models (Table 4). Model 1 depicts the baseline model including the control variables only. Model 2 ~ Model 5 includes both the control variables and the individual independent variables. Model 6 shows the full model with all variables included.

Model 1 depicts the baseline model including the control variables only. Model 2 ~ Model 5 includes both the control variables and the individual independent variables. Model 6 shows the full model with all variables included.

**1- As show in Model 2 and Model 6, the quasi-elasticities of all five institutional variables are significant but with different signs. The quasi-elasticities of political stability, control of corruption, and prevalence of foreign ownership are positive, while the quasi-elasticities of rule of law and prevalence of trade barriers are negative.**

**2- There is a positive and significant quasi-elasticities of GDP and GDP per capita respectively in Model 3and Model 6.**

**3- Considering the quasi-elasticities of technology level of the host country in Model 4 and Model 6, we find that it positively and significantly affect Chinese green OFDI to EU.**

4- **negative and significant influence that a higher level of human capital**

1 - This suggests that politically stable environment can attract Chinese green OFDI, which shows a different pattern compared to general Chinese OFDI investigated by most current literature, as the latter are usually attracted to countries that are political risky (Kang & Jiang, 2011; Kolstad & Wiig, 2012; Ramasamy, *et al*. 2012). Equally interesting is that Chinese green OFDI tend to flow to countries with good

1. Politically stable environment can attract Chinese green OFDI, which shows a different pattern compared to general Chinese OFDI investigated by most current literature, as the latter are usually attracted to countries that are political risky (Kang & Jiang, 2011; Kolstad & Wiig, 2012; Ramasamy, *et al*. 2012).

2. Equally interesting is that Chinese green OFDI tend to flow to countries with good control of corruption, the policy of encouraging foreign ownership of companies, and low trade barriers. However, we find a negative effect of rule of law on Chinese green firms' location choice. This seems to be consistent with the findings of studies on general Chinese OFDI, as the growing empirical evidences show that Chinese OFDI is relatively more attracted to countries with poor governance and weak institutions (Quer, *et al*. 2012). Poor governance and weak institution often poses a threat to the protection of property rights and contract enforcement (Dixit, 2012).

*As a whole, results indicate some different effects of host country institutional factors on Chinese green firms in terms of their location decision when comparing with general Chinese OFDI.*

There are two possible reasons: on the one hand, our research targets, green sectors, are emerging fields and have unique characteristics compared to traditional sectors; on the other hand, this study employs the latest Chinese OFDI data from 2004 to 2013, which to some extent reflects the dynamics and new trends of Chinese OFDI, especially after the financial crisis in 2008, compared to most current literature.

3. Our results strongly confirm the influence of market size and market affluence as pulling factors for Chinese green firms abroad, because of the positive and significant quasi-elasticities of GDP and GDP per capita respectively in Model 3and Model 6.

This suggests that Chinese green firms follow a conventional approach to FDI as

## Empirical results

In our database we can aggregate data into three major overseas functions:
manufacturing,
R&D,
sales and services.

Overseas subsidiaries with different functions respond differently to host country factors.

| Variable | Manufacturing | R&D | Sales and services |
|---|---|---|---|
| Firm size | .0036 | .0009 | .0021 |
|  | (.0045) | (.0030) | (.0025) |
| Firm age | -.0051 | -.0000 | -.0000 |
|  | (.0143) | (.0005) | (.0003) |
| Listed company | -.0002 | -.0044 | -.0055 |
|  | (.0006) | (.0095) | (.0070) |
| Ownership | .0032 | .0018 | -.0004 |
|  | (.0123) | (.0099) | (.0061) |
| Political stability | .0343* | .0325* | .0402*** |
|  | (.0203) | (.0180) | (.0115) |
| Rule of law | -.1341*** | -.0501* | -.0780*** |
|  | (.0412) | (.0310) | (.0228) |
| Control of corruption | .0579** | .0525*** | .0435*** |
|  | (.0276) | (.0197) | (.0146) |
| Prevalence of trade barriers | -.1377*** | -.0482 | -.0957*** |
|  | (.0349) | (.0319) | (.0209) |
| Prevalence of foreign ownership | .0404* | .0047 | .0146 |
|  | (.0216) | (.0187) | (.0120) |
| GDP | .0021 | .0144*** | .0139*** |
|  | (.0054) | (.0046) | (.0034) |
| GDP per capita | .0290* | .0259** | .0261*** |
|  | (.0165) | (.0121) | (.0094) |
| Technological readiness | .0550** | .0005* | .0257** |
|  | (.0227) | (.0002) | (.0127) |
| Human capital | -.0013** | -.0025*** | -.0015*** |
|  | (.0005) | (.0005) | (.0003) |
| Fixed effect of year | Done | Done | Done |
| Fixed effect of firm | Done | Done | Done |
| Pseudo $R^2$ | .835 | .843 | .840 |
| LR chi$^2$ | 970.1*** | 1208.0*** | 2876.2*** |

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Note: ***$p<0.01$, **$p<0.05$, *$p<0.1$. Standard errors in parenthesis.

One of the advantages of our dataset with respect to others, such as fDi Markets and UNCTAD data, is the availability of overseas function for each investment decision, which is an important variable to investigate green FDI as emerging sectors. Thus, we can properly aggregate data into three major overseas functions: manufacturing, R&D, and sales and services. The empirical results of group analysis are presented

1. Interesting considerations arise on **the institutionally related variables**.

We find that countries with politically stable environment are most attractive to sales and services subsidiaries (an elasticity of 0.0402 with p<0.001);

countries with good control of corruption, low trade barriers and encouraging foreign ownership are most attractive to manufacturing subsidiaries (an elasticity of 0.0579 with p<0.05, an elasticity of -0.1377 with p<0.001 and an elasticity of 0.0404 with p<0.1, respectively).

Although the rule of law has a negative effect on the location decision of all types of subsidiaries, it seems that manufacturing subsidiaries are the most, while R&D subsidiaries are the least attracted to countries with poor rule of law environment.

2. As for the effects of **market size**, we find that Chinese green firms engaged in R&D abroad invest more in countries with larger market (an elasticity of 0.0144 with p<0.01), followed by firms engaged in sales and services (an elasticity of 0.0139 with p<0.01), while the quasi-elasticity for manufacturing subsidiaries is not significant (0.0021 with p>0.1). Market affluence is an attracting factor for all types of subsidiaries. Firms engaged in manufacturing abroad invest more in countries with higher income per capita compared to the other two types of subsidiaries. These results confirm the different market-oriented behavior among three types of subsidiaries.

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## Discussion 緑 *or**n*

1. Sales/services subsidiaries are attracted by Countries with politically stable environment
2. Manufacturing subsidiaries are attracted by: good control of corruption, low trade barriers; encouraged foreign ownership; richer market. They are are more technological asset-seekers.
3. R&D subsidiaries are attracted by larger market and are the most non-human capital asset-seekers

- Foreign expansion strategies of Chinese RE firms present both common and distinctive features compared to general Chinese firms.
- institutional-level, market-level, technological-level, and human capital-level factors of host countries have different attraction effect for Chinese RE firms.