



# Investors' perspective on determinants of foreign direct investment in wind and solar energy in developing economies – Review and expert opinions

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## ABSTRACT

Foreign direct investment (FDI) in renewable energy projects in 2015 has reached more than 10% of the total green-field FDI worldwide, and developing economies were increasingly at the forefront of these investments. However, there are few studies that focus on the FDI in this emerging sector. Understanding determinants behind the location decisions of the FDI would lead to creating a better investment climate and further facilitate worldwide deployment of renewable energy technologies. Thus, this paper identifies the determinants of FDI in wind and solar energy in developing economies based on a literature review and semi-structured interviews. Factors that are identified through the literature review are categorized into the following categories: institutional environment, macroeconomic environment, natural conditions, and renewable energy policies. Semi-structured interviews were conducted with experts from multinational corporations that are active in FDI in wind and solar energy. Based on these interviews, 18 factors that could be considered as important determinants are selected and presented along with expert opinions. The experts' opinions suggest strong importance of renewable energy policies when compared to traditionally argued determinants of FDI including macroeconomic environment, institutional environment and natural conditions. Among traditionally argued determinants, exchange rate stability is suggested to be one of the most important factors considering the positioning of investments in solar and wind energy in most of the companies' investment portfolios.

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## 1. Introduction

By approaching renewable energy as part of their industrialization process, developing economies are transitioning from enduring carbon-based economies, dependent on non-renewable sources of electricity such as coal, natural gas and oil to clean-energy economies. In the process they are generating employment, enhancing energy security, and avoiding burdens on the balance of payments. In 2015, the aggregated investment in renewable energy in developing economies reached USD 156 billion, exceeding that in developed economies for the first time in history (REN21, 2016). However, since the energy demand growth in developing economies is so rapid, fossil fuels still play a

significant role in meeting this rising demand, and the forecast shows annual emissions will continue increasing for some time in the developing economies (IEA, 2016). The term “developing economies” indicates countries listed as developing economies on the International Monetary Fund's World Economic Outlook Report (2016).

In order to accelerate the transformation from carbon-based economies, technologies need to be transferred properly, and financial resources need to be allocated in a suitable manner. In this regard, for numerous developing economies, foreign direct investment (FDI) serves as an indispensable source of capital and an important channel for introducing more productive technology and techniques. The importance of private finance, especially FDI for developing countries, was also well recognized at the 21st Conference of the Parties of the United Nations Framework Convention on Climate Change (McInerney and Johannsdottir, 2016). In fact, many developing economies are seeking to attract more FDI in

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renewable energy, which has been increasing steadily worldwide reaching capital investment of USD 76 billion, accounting for more than 10% of all FDI in 2015 as shown in Fig. 1 (FDIintelligence, 2016). However, through analyzing the composition of investment in each developing economy using plant-based data based on GlobalData (2016), authors find that the amount of FDI attracted differs greatly among developing economies (Table 1).

One of the keys to mobilizing FDI in wind and solar energy in developing economies is creating attractive risk/reward profiles, which means higher financial return and lower risk of investments. There are various ways that can increase the financial return and minimize the risk of investment both directly and indirectly. These include i) having renewable support policies such as feed-in tariff, renewable energy certificates and renewable portfolio standards, providing guaranteed access to grid, avoiding setting local content requirements, and ii) lowering country-risk and improving the business environment. Through these changes, countries can create attractive investment environment for conducting wind and solar energy projects. Since there are various factors that could function as determinants that create attractive investment environment for foreign investors, identifying and classifying the factors, and understanding what factors are really significant from investors' perspective provides valuable information for policy makers for creating enabling environment that facilitates FDI in wind and solar energy. This also further contributes to clarifying the effect of various renewable support policies.

Therefore, this paper identifies determinants of FDI in renewable energy, particularly focusing on the wind energy and solar energy sectors, in developing economies through a literature review and semi-structured interviews with practitioners active in the field of wind and solar energy investment in developing economies. However, clarifying the relative importance of the identified determinants is beyond the scope of this paper.

The rest of the paper is structured as follows. Section 2 provides the theoretical background of determinants of FDI and identifies gaps in the research, and then presents the results of the literature review of preceding studies on determinants of FDI in wind and solar energy and categorizes them. Section 3 explains the method used in this study. Section 4 presents the results of the semi-structured interviews, with detailed description of the

determinants that are narrowed down to the ones that are especially relevant to FDI in wind and solar energy in developing economies. The importance of each critical determinant is explained together with opinions on the determinants obtained through the semi-structured interviews with experts in the field. Finally, conclusions and future extensions of this work are presented in Section 5.

**2. Theories and empirical studies on the determinants of FDI**

This section first provides the theoretical background of determinants of FDI and identifies gaps in the research. Then the results of the review of the empirical studies on the determinants of FDI are presented, which aims to identify the potential determinants of FDI in wind and solar energy and categorize them into broad categories.

*2.1. Theoretical background of the determinants of FDI*

Since the 1970s, as global movement of capital started to intensify, it became popular to search for general theories of FDI. By the late 1980s, the limitations of particular theoretical approaches as a catchall explanation have become clear among the researchers (Cantwell, 2000). Among all the endeavors to develop a theoretical framework that explains FDI, eclectic theory developed by Dunning (1980) is known as the most comprehensive and effective explanation of FDI and the activities of multinational firms. The eclectic theory is a combination of different theories of FDI (O-L-I): "O" from Ownership advantages, "L" from Location advantages, and "I" from Internalization advantages. Although the eclectic theory is a strong framework of analysis that deliberately draws on a variety of theoretical approaches, on the other side of the coin, the eclectic theory is weak when ascertaining which factors are the most decisive in attracting FDI. Some scholars assert that "the eclectic theory is not a theory but a paradigm" (Cantwell, 2000) or "taxonomy of various determinants of FDI" (Itaki, 1991).

Later on Dunning and Lundan (2008) further work on the research of the determinants of FDI in terms of locational components of O-L-I, reflecting the growing impact of location choice of FDI to the host economies. According to their research, three types

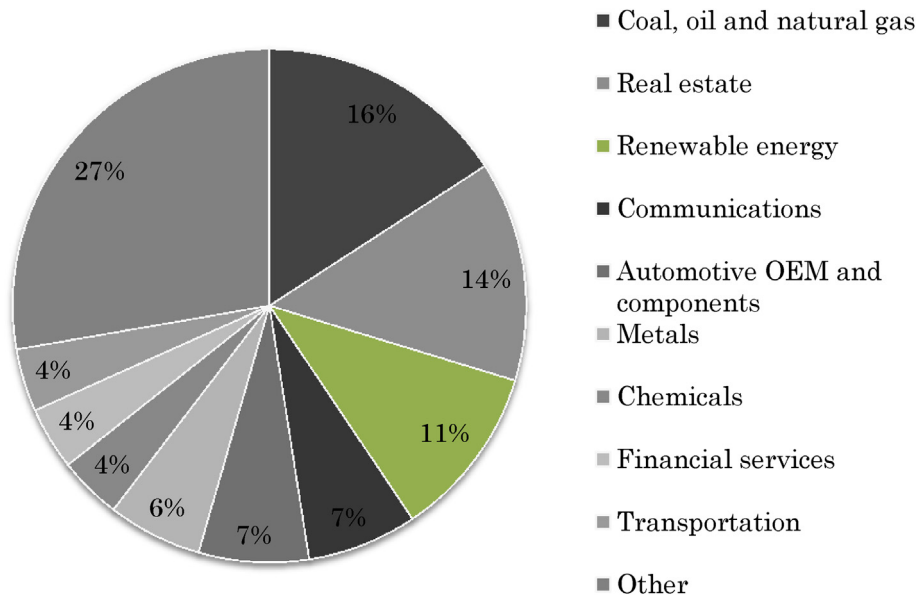


Fig. 1. FDI (capital investment) by sector in 2015. Created based on FDIintelligence, 2016.

**Table 1**

Composition of ownership of wind energy plants in top 10 developing countries regarding the amount of the installed wind energy plants (MW).

Country	Amount owned by domestic companies	Amount owned by foreign companies	Total capacity	Percentage of FDI in total capacity
China	45,577	273	45,849	0.6%
India	16,616	662	17,278	3.8%
Brazil	5811	472	6283	7.5%
Turkey	3211	15	3225	0.5%
Poland	1747	1308	3056	42.8%
Romania	340	2138	2478	86.3%
Mexico	768	1565	2333	67.1%
Chile	340	371	711	52.2%
South Africa	498	129	627	20.6%
Morocco	403	201	604	33.3%

Source: GlobalData (2016).

of factors that influence the location choice of FDI have been identified: “endowment effects”, which refer to the existence of low-cost labor force or natural resources; “agglomeration effects”, which indicate that the ‘the attraction of one firm will generally make it more attractive for another firm to co-locate in the same region’ (Dunning and Lundan, 2008); and lastly, “policy-induced effects”, which indicate the impacts of policy intervention and institutions on location decision. This work by Dunning and Lundan shed light on the importance of the impact of support policies for specific industries on location decisions of FDI, which needs more supporting empirical evidence.

Regarding empirical studies, the absence of a widely accepted theoretical framework that explains FDI has led researchers to rely on empirical evidence for understanding the determinants of FDI. Thus, there has been a large amount of empirical studies on determinants of FDI.

## 2.2. Literature review of the empirical studies on the determinants of FDI

This sub-section presents the result of literature review of the empirical studies on the determinants of FDI to identify the potential determinants of FDI in wind and solar energy. While there are plenty of empirical studies on determinants of FDI in general, the number of studies on the determinants of FDI in the renewable energy sector is very limited. Thus, the sector specific factors are selected based on reviews of preceding studies related to determinants, barriers, and drivers of investment in the renewable energy sector. Factors that are identified through the literature review are classified in the following four categories: institutional environment, macroeconomic environment, natural conditions, and renewable energy policies.

### 2.2.1. Preceding studies on determinants of FDI in general

This sub-section reviews preceding studies on determinants of FDI that focus mainly on FDI inflows to developing economies. The determinants empirically tested in the preceding studies can predominantly be categorized in institutional environment, macroeconomic environment, and natural conditions (Table 2).

**2.2.1.1. Macroeconomic environment.** Some of the major studies on the determinants of FDI target testing the impact of macroeconomic factors. Kiyota and Urata (2004) investigate the effect of exchange rate volatility on FDI from developed economies, and find that high volatility of the exchange rate discourages FDI inflows. The study also finds low wages and trade openness as statistically significant determinants, and confirms the importance of the agglomeration effect.

Asiedu (2006) examines the determinants of FDI focusing on 22 African countries using fixed-effects panel estimation with panel

data spanning over the period 1984–2000. The study shows that market size, infrastructure, and stable and low inflation rate attract FDI. Shamsuddin (1994) shows similar findings especially regarding market size and exchange rate stability. He investigates the determinants of FDI focusing on macroeconomic factors and by employing a single-equation econometric model for 36 developing economies. The study finds that market size, labor cost, and exchange rate stability are important factors affecting the location decisions of the FDI.

Demirhan and Masca (2008) examine determinants of FDI in developing economies by using a cross-sectional econometric model and data on 38 developing economies. Growth rate of GDP, tax rate, and infrastructure are found to be important factors in attracting FDI.

Mateev (2009) analyzes the determinants of FDI flows in Southeastern and Central European countries, and shows that gravity factors (distance, population, and GDP) and other factors such as labor costs, and corruption are strong determinants of FDI.

A study focusing on the impact of economic, institutional and political factors on location decisions of FDI in Brazil, Russia, India and China shows that market size (real GDP) is a strong determinant of FDI, together with trade openness, and rule of law (Jadhav, 2012). Based on the findings, Jadhav implies that macroeconomic factors are more important than institutional factors.

Chakrabarti (2001) uses extreme bound analysis with a sample of 135 countries for the year 1994 to investigate if the determinants tested in other preceding studies are robust to subtle adjustments in the conditioning information set. The study shows that market size (per-capita GDP) is a strong and robust determinant of FDI, while the study also found that many of the determinants that have been presented in the preceding empirical studies (such as wage rate, tax rate, trade openness, and exchange rate) are very sensitive to subtle adjustments in the conditioning information set.

These studies that mainly focus on testing the impact of macroeconomic factors show that, especially market size (measured by GDP), labor cost, infrastructure, and exchange rate stability hold strong importance on location decisions of FDI.

**2.2.1.2. Institutional environment.** While macroeconomic determinants are considered as strong determinants of FDI in general, there are scholars such as Lucas (1990) who argue that only political factors limit FDI inflows. Alfaro et al. (2008) provide empirical support for this argument by conducting econometric analyses using the ordinary least squares estimates. They investigate the role of a different set of determinants, especially focusing on institutional quality.

The study shows that improving the quality of institutions, which is measured by factors such as internal and external conflict, stability of the government, corruption, effective law enforcement, and bureaucratic quality, leads to increases in FDI in developing

**Table 2**  
Summary of the literature review of empirical studies of FDI in general.

Category	Factor	Reference
Institutional environment	Political risk	Alfaro et al., 2008; Busse and Hefeker, 2007; Edwards, 1990; Merlevede and Schoors, 2005
	Rule of law (effective law enforcement)	Alfaro et al., 2008; Anyanwu, 2012; Busse and Hefeker, 2007; Campos and Kinoshita, 2002; Jadhav, 2012; Merlevede and Schoors, 2005
	Efficient and transparent administrative procedure	Alfaro et al., 2008; Busse and Hefeker, 2007; Campos and Kinoshita, 2002; Dumludag, 2009; Morisset and Lumenga-Neso, 2002; Pirlagea, 2011
Macroeconomic environment	Corruption	Alfaro et al., 2008; Busse and Hefeker, 2007; Mateev, 2009; Painuly, 2001; Pirlagea, 2011
	Access to local finance	Alfaro et al., 2008; Merlevede and Schoors, 2005; Painuly, 2001; Zeng et al., 2017
	Exchange rate stability	Asiedu, 2006; Globerman and Shapiro, 2003; Kiyota and Urata, 2004; Shamsuddin, 1994
	Labor cost	Chakrabarti, 2001; Kiyota and Urata, 2004; Mateev, 2009; Shamsuddin, 1994
	Geographical proximity	Campos and Kinoshita, 2002; Mateev, 2009
Natural conditions	Market size	Anuchitworawong and Thampanishvong, 2015; Anyanwu, 2012; Asiedu, 2006; Chakrabarti, 2001; Edwards, 1990; Jadhav, 2012; Mateev, 2009; Shamsuddin, 1994
	Tax rate (corporate)	Demirhan and Masca, 2008; Kemsley, 1998; Tang et al., 2014
	Infrastructure	Asiedu, 2006; Chan et al., 2014; Demirhan and Masca, 2008; Painuly, 2001
	Natural resources (wind potential, insolation/sunshine duration)	Anyanwu, 2012; Asiedu, 2006; Poelhekke and van der Ploeg, 2010
	Risk of disaster	Anuchitworawong and Thampanishvong, 2015; Escaleras and Register, 2011
	Access to land	Aryeetey et al., 2008; Te Velde, 2001

economies. The study conducted by Merlevede and Schoors (2005) investigates the determinants of FDI in European developing economies, and they also find institutional quality to be a robust determinant of FDI.

Anyanwu (2012) conducts cross-country regressions analysis focusing on African countries for the period 1996–2008, and finds positive relationships between rule of law and FDI inflows. Rule of law refers to, as defined by Kaufmann et al. (2011), “the extent to which agents have confidence in and abide by the rules of society”.

Edwards (1990) presents the results of an econometric analysis of the determinants of the cross-country distribution of the FDI into developing economies. The analysis provides evidence in terms of both economic and political variables, including GDP and political risk. Political risk refers to, as Edwards (1990) defines, “the probability of a change of government”, and “the frequency of political assassinations, violent riots and politically motivated strikes”. The variables political instability and political violence are statistically significant determinants of location decisions of FDI into developing economies.

Busse and Hefeker (2007) analyze the effect of political risk and institutions on FDI inflows to 83 developing economies during the period from 1984 to 2003. Using a combination of econometric tools, the Arellano–Bond Generalized Method of Moments (GMM) estimator and a country fixed-effects model, they find that stability and accountability of government, corruption, ethnic tensions, and the quality of law enforcement and bureaucracy are strong determinants of FDI.

Using the standard GMM with panel data of 25 developing economies between 1990 and 1998, Campos and Kinoshita (2002) find that agglomeration effects are strong for FDI in the examined countries, and the quality of law enforcement and bureaucracy are statistically significant determinants.

Dumludag (2009) conducts surveys regarding barriers to FDI in Turkey to multinational corporations operating in Turkey, and shows that administrative barriers such as complex and slow process for starting a company are significant barriers to FDI.

Morisset and Lumenga-Neso (2002) present a new database on the administrative costs faced by foreign private investors in 32 developing countries, and show that the cost of administrative procedures differ greatly among countries, and they can be strong barriers to FDI.

Cole et al. (2017), by introducing various studies related to the relationship of FDI and environment, point out that environmental regulations can also affect location choices of FDI. However,

considering that the negative environment effects of renewable energy plants are significantly lower compared to other investment projects, the impact of environmental regulations on location decisions would be very limited.

These empirical studies show that institutional factors should also be considered as important determinants of FDI in developing economies. The major institutional factors discussed in these studies include: political risk; rule of law, or effective law enforcement; and corruption.

**2.2.1.3. Natural conditions.** These are also studies that focus on the impact of natural conditions on location decisions of foreign investors. The study conducted by Escaleras and Register (2011) is one of the few studies that look into the relationship between natural disasters and FDI. Using panel data of the number of disasters and FDI allocation for 94 countries between 1984 and 2004, they find that natural disasters negatively and statistically significantly affect FDI. Similarly, by focusing on Thailand, Anuchitworawong and Thampanishvong (2015) use a simultaneous equation approach and find that natural disaster does affect FDI negatively with some time lag.

Studies including the one conducted by Aryeetey et al. (2008), and Te Velde (2001) suggest that gaining access to land can be major challenges for foreign investors especially in developing economies.

Regarding natural conditions, as suggested by studies including the one by Asiedu (2006), natural resource endowments are considered as an important determinant of FDI in developing economies. Anyanwu (2012) also identifies natural resource endowments as strong determinants of FDI. The analysis further shows that there are negative relationships between higher financial development and FDI inflows, which suggests that FDI is a substitute for financial market development in African countries. Poelhekke and van der Ploeg (2010) also provide supportive argument that natural resource endowment acts as a strong determinant of FDI. They further show that subsoil assets boost resource FDI, but crowd out non-resource FDI.

As the literature review shows, the preceding empirical studies have examined various sets of determinants of FDI with mixed results, which call for analyses with better resolution focusing on sector-level.

Table 2 provides summary of the literature review of empirical studies of FDI in general.

### 2.2.2. Preceding studies on barriers and determinants of investment in renewable energy

This sub-section reviews preceding studies on barriers and determinants of investment in renewable energy in order to narrow down the determinants of FDI in wind and solar energy in developing economies. [International Energy Agency \(IEA\)/International Renewable Energy Agency \(IRENA\) Joint Policies and Measures Database](#) covers renewable energy policy measures deployed at country-level, covering both IEA member countries and non-IEA countries ([IEA/IRENA Joint Policies and Measures Database, 2016](#)). The database classifies renewable energy policies into economic instruments, policy support, regulatory instruments, information and education, research, development and deployment, and voluntary approaches. Based on the classification of the database, renewable energy determinants used in this paper will be grouped into the following three categories: economic support policies, regulatory support policies, and political support policies.

**2.2.2.1. Studies using quantitative approaches.** The following studies are the studies that look in to the determinants of investment in renewable energy using quantitative approaches.

[Eyraud et al. \(2013\)](#) investigate determinants of green investment (including both domestic and foreign inward investment), which they define as investment in renewable energy, selected energy-efficient technologies, and research and development in green technologies, over the last 10 years for 35 advanced and emerging economies. The study concludes that low interest rates, economic growth, high fuel prices, and policy interventions including economic support policies such as feed-in-tariffs have positive impact on green investment. Feed-in tariff is a policy tool adopted in various countries and facilitated rapid spread of wind energy and solar energy in a lot of countries, which offers a guaranteed price for electricity generated by renewable energy with a purchase obligation by the utilities for a fixed long-time period contracts ranging from 10 to 20 years ([Jacobsson and Lauber, 2006](#)).

[Ang \(2016\)](#) provides empirical evidences on the impacts of various renewable energy policies drawing on an econometric analysis, and conclude that feed-in tariff system contributes to attracting FDI, but local content requirements in wind and solar energy decrease the effectiveness of feed-in tariff system and negatively affect FDI.

[Menanteau et al. \(2003\)](#) investigate the relative efficiency of the different economic support policies. They classify the support policies into quantity-focus ones, which set national targets and set up a competitive bidding or setting quota system with renewable energy certificate trading policies, and price-focus policies such as feed-in tariffs. They compare these policies both from a theoretical approach by comparing price-based approaches with quantity-based approaches, and a practical approach by investigating the actual impact of the policies in selected European countries. The study indicates that a feed-in tariffs system is more efficient than a competitive bidding system, and asserts that the real efficiency of renewable energy certificate system is unclear in situations where information is incomplete.

[Murovec et al. \(2012\)](#) examine the determinants of environmental investments (including investments into renewable energy) using structural equation modeling, and find that financial incentives, tax measures, and regulations act as strong determinants. [Keeley and Ikeda \(2017\)](#) also use structural equation modeling to investigate the determinant of FDI in wind energy in developing economies. They find renewable energy policies work as strong determinants, and clarify that especially regulatory support policies (including guaranteed access to grid and technical standard) have strong impact on investment decisions of foreign investors.

[Romano et al. \(2017\)](#) investigate the effectiveness of renewable

energy policies, using a panel of 56 countries with different social, political and economic characteristics. The policies are categorized into regulatory policies, fiscal incentives, and public investments. Their effects on renewable energy investment are investigated using econometric analysis with panel-corrected standard error estimates, which shows that not all policies facilitate investments in renewable energy, and the effectiveness of the policies depends on the stage of development of the countries. Although the study doesn't directly focus on FDI, their results provide empirical support for focusing specifically on developing economies in this research.

These studies empirically show that renewable support policies, especially economic support policies such as feed-in tariff, and regulatory support policies such as guaranteed access to grid hold strong importance on location decision of FDI in renewable energy.

**2.2.2.2. Studies using qualitative approaches.** Compared to the studies using quantitative approaches, there are a large number of studies that are dealing with barriers and drivers of investment in renewable energy using qualitative approaches.

[Painuly \(2001\)](#) develops an analysis framework for identifying barriers to renewable energy penetration, and suggests measures to overcome them. Painuly categorizes broad ranges of barriers to diffusion of renewable energy into market failure/imperfection, market distortions, economic and financial, institutional, technical, social, cultural and behavioral categories. Some of the barriers that are highly relevant to determinants of FDI include: lack of access to capital, lack of a legal/regulatory framework, unstable macro-economic environment, lack of standard and codes and certification, lack of social acceptance, lack of infrastructure, uncertain governmental policies.

[Jones \(2015\)](#) investigates how investors perceive barriers to clean energy infrastructure investment by conducting semi-structured interviews and workshops, and identifies policy certainty, overall governance in countries, and limitations in support infrastructure including transport and grid infrastructure as strong barriers.

[Pirlogea \(2011\)](#) reviews investment barriers to renewable energy primarily focusing on Romania, and classifies the barriers into: administrative barriers, technological and technical barriers, market barriers, and economic barriers. Some of the major barriers identified through the review include obtaining authorization and permits, corruption and lack of transparency, access to grid infrastructure, and high initial investment.

[Abdmouleh et al. \(2015\)](#) examine different types of renewable support policies through case studies of both successful and failed experiences of various countries. They conclude that feed-in tariff, auction, priority access to grid, renewable energy target, and renewable energy development plan have shown successful impact on diffusion of renewable energy. Auction is a call for running competitive bidding for predetermined quantity of renewable energy under long-term power purchase agreements. Renewable energy development plan refers to a mid-to long-term strategic framework for promoting installation of renewable energy. Regarding economic support policies, the study provides supportive argument for feed-in tariff systems, but also points out that tariffs are not always easy to determine at the beginning, especially in developing economies, and recommends initially having competitive bidding system to discover the adequate price before applying feed-in tariff system. They also shed light on the importance of strong political support at national, regional or local levels, through smooth bureaucratic application procedures, target setting, and development planning.

[Zeng et al. \(2017\)](#) review the problems and solutions of renewable energy development in BRICS countries, especially

focusing on financial aspects. The study asserts that the lack of financing channels and investment shortages in small and medium-sized enterprises are impeding development of renewable energy in these countries. The authors claim the need for the development of a financial market for renewable energy. They argue that the renewable energy sector is still perceived as a risky and uncertain sector in the BRICS countries compared to other developed countries and commercial banks are not confident enough to allocate their limited funds in the sector with low-interest rates.

These studies that employ qualitative approaches including literature review, case studies, and semi-structured interviews strengthen the argument that regulatory support policies such as priority access to grid are important in facilitating renewable energy investment. Furthermore, these studies also shed light on the importance of economic support policies other than feed-in tariff such as competitive bidding, and also stress the importance of political support policies including having renewable energy target and well-structured development plan.

Table 3 provides summary of the literature review of studies on barriers and determinants of investment in renewable energy.

### 2.3. Discussion based on the review of theories and empirical studies of the determinants of FDI

The preceding sub-sections reviewed theoretical background and empirical studies on the determinants of FDI to identify the potential determinants of FDI in solar and wind energy. The literature review revealed that, regardless of the underlying hypothesis, existing empirical studies have investigated different combinations of various variables, producing inconsistent results regarding the statistical significance of those variables, and the direction of the effect. Part of the reason why the empirical results are producing inconsistent results is because most of the empirical studies employ aggregated FDI. The use of aggregated FDI does not provide clear resolution to study the determinants of FDI. It is clear from sector-level analyses, such as the ones by Moshirian (2001), Terpstra and Yu (1988) and Wheeler and Mody (1992) that determinants of FDI could greatly differ among different industries. Furthermore, since most of the studies focus on aggregated FDI, supporting empirical studies on the impact of support policies on location decision of FDI on sector-basis are lacking. Additionally, as shown in the literature review, there are few studies that look into

the determinants of FDI in renewable energy sector despite of the large amount of capital flowing into the sector and the future importance of securing capital in the sector.

The theoretical background of FDI and the status of empirical studies bring us to the following two points: 1) the focus needs to shift from aggregated FDI to FDI by sector; and 2) there needs to be more supporting empirical studies on the impact of support policies on location decision of FDI on a sector-basis. As shown in Fig. 1, more than 50% of FDI is conducted within the top 5 industries, which include the renewable energy sector. Considering that each sector could have its own specific determinants of FDI, empirical studies and theoretical development of determinants of FDI need to shift toward a sector-basis. Furthermore, most of the empirical studies on determinants of FDI consider mainly institutional, macroeconomic, and natural condition aspects such as corruption, political risk, labor cost, natural resources and GDP. When focusing on a specific sector, the impact of policy intervention and institutions cannot be neglected, and the impact of these factors needs to be examined in comparison with widely tested institutional, macroeconomic, and natural condition determinants. Thus, this paper addresses this research gap, and looks into the specific determinants of FDI in renewable energy sector especially focusing on wind and solar.

### 3. Methods

This study aims to identify the determinants of FDI in renewable energy in developing economies, with a particular focus on the wind energy and solar energy sectors. Painuly (2001) stresses that interaction with practitioners in the field through structured interviews and/or questionnaires is “very crucial to identification of the barriers as the perception of stakeholders on barriers may reveal the lacunae in existing policies and help in identification of measures to overcome the barriers”. In order to reflect the opinions of practitioners and verify the importance of the factors identified through the literature review, semi-structured interviews were conducted with experts in wind and solar energy investment (hereafter referred to as “experts”). Following the studies that use expert opinions including the one by Kuhnert et al. (2010), the term experts is defined as someone having specialist knowledge acquired through practice, or experience. In this study, practitioners who are in the decision-making positions in large multinational companies that are active in the field of wind and solar energy are

**Table 3**  
Summary of the literature review of studies on renewable energy investments.

Category	Factor	Reference	
Renewable energy policies	Economic support policies	Feed-in tariff	Abdmouleh et al., 2015; Ang, 2016; Eyraud et al., 2013; Jacobsson and Lauber, 2006; Keeley and Ikeda, 2017
		Renewable portfolio standards and renewable energy certificates	Menanteau et al., 2003; Romano et al., 2017;
		Auction/competitive bidding	Abdmouleh et al., 2015; Lewis and Wiser, 2007; Mourelatou and Birmingham ECOTEC Research and Consulting Limited, 2001; Romano et al., 2017
	Regulatory support policies	Tax incentives	Mourelatou and Birmingham ECOTEC Research and Consulting Limited, 2001; Romano et al., 2017; Murovec et al., 2012
		Priority/guaranteed access to grid	Abdmouleh et al., 2015; Jones, 2015; Keeley and Ikeda, 2017; Mourelatou and Birmingham ECOTEC Research and Consulting Limited, 2001; Pirlogea, 2011;
		Technical standards (aligned with national standards)	Keeley and Ikeda, 2017; Painuly, 2001; Pirlogea, 2011; Stepp and Atkinson, 2012;
	Political support policies	Absence of local content requirement	Ang, 2016
		National renewable energy target	Abdmouleh et al., 2015; Reiche and Bechberger, 2004
		Well-structured renewable energy development plan	Abdmouleh et al., 2015; Foxon and Pearson, 2008
	Social acceptance	Eleftheriadis and Anagnostopoulou, 2015; Painuly, 2001; Pirlogea, 2011; Reiche and Bechberger, 2004	

interviewed as experts. Although the number of semi-structure interviews ( $n=7$ ) is not large, when the interviewees of a study are all considered to be well-defined experts in the field, even 5 interviewees are considered to be sufficient as suggested by Krueger et al. (2012). The interviewees are carefully selected to be less biased considering the headquarters of the companies and the targeted sectors (wind and solar energy), and the investment experiences of the companies. A detailed description of the experts is provided in Table 4. The names of the interviewees are kept anonymous in this paper in consideration of the sensitivity of the subject.

In the semi-structured interviews, each factor that was identified through the literature review was explained in detail to the interviewees using the interview material (see Appendix A) in order to create a common understanding. Then the interviewees were asked to provide opinions on the importance of each factor based on their experiences. In order to narrow down the important factors, the interviewees were also asked to point out factors that were not considered to be significant enough to be included. The interviews were conducted via phone or video call using Skype, interview length being around 1–2 h. All interviews took place between November 2016 and June 2017. The factors that have been narrowed down based on the semi-structured interviews are presented and explained with the expert opinions obtained through the interviews in Section 4.

#### 4. Results: determinants of FDI in wind and solar energy in developing economies

This section presents the determinants of FDI in wind and solar energy in developing economies that have been narrowed down from the factors identified through the literature review (Tables 2 and 3) based on the semi-structured interviews. Some of the factors that were perceived as less important factors by the experts are not included in this section as determinants of FDI in wind and solar energy in developing economies. Each determinant is explained in light of preceding studies, and expert opinions obtained through the semi-structured interviews. All of the opinions obtained through the semi-structured interviews are cited as “(Company X)”, which corresponds to Table 4, in order to distinguish them from citations of academic articles.

In the semi-structured interviews, the interviewees were also asked to point out factors that were not considered to be significant enough to be included. Then the factors that were raised by more than four experts were removed from the determinants of FDI in wind and solar energy. Experts were also asked to provide any other factor that could be an important location determinant, but no additional critical factors were suggested to be included by the experts. In fact, it was suggested that critical factors could be narrowed down to a smaller number, which we followed in our practice. Table 5 provides the summary of the removed factors and the number of experts who raised the factors as less important determinants.

**Table 4**  
Description of the interviewees.

Company	Headquarter	Sector	Investment experiences (developing economies)	Interview date
Company A	Japan	PV and wind	Chile, Peru, Philippines, Mexico, and South Africa	November 16th, 2016
Company B	Korea	PV and Wind	Hungary, Malaysia, Poland, and Turkey	March 10th, 2017
Company C	Japan	PV and Wind	Chile, Malaysia, Philippines, Thailand, and United Arab Emirates	March 13th, 2017
Company D	Japan	PV	Kenya, South Africa, and Tanzania	March 30th, 2017
Company E	United States	PV and Wind	Chile, Romania, South Africa, and United Arab Emirates	June 8th, 2017
Company F	Japan	PV and Wind	Mongolia, Morocco, South Africa, UAE, and Poland	June 15th, 2017
Company G	United Kingdom	PV and Wind	Algeria, Chile, Peru, South Africa, and Uruguay	June 16th, 2017

**Table 5**

List of removed factors and the number of experts who considered them not significant enough to be included.

Category	Removed Factor	Number of experts who raised the factor as less important factors
Institutional environment	Corruption	4
Macroeconomic environment	Geographical proximity	7
	Market size	6
	Tax rate (corporate)	5
	Infrastructure	6
Natural conditions	Risk of disaster	5

#### 4.1. Institutional environment

##### 4.1.1. Political risk

Diamonte et al. (1996) show, using analyst estimates of political risk, “that average returns in emerging markets experiencing decreased political risk exceed those of emerging markets experiencing increased political risk by approximately 11 percent a quarter” and further clarifies that there are statistically significant differences regarding the effect of political risk between developed and developing economies. Countries with high political risk are perceived as a great risk to implementing wind and solar energy projects since they can cause sudden changes to renewable energy policies (Company F). Developing economies need to decrease political risk in order to provide sense of security to conduct wind and solar energy projects in the countries.

##### 4.1.2. Rule of law

Hoff and Stiglitz (2005) argue that the presence of rule of law is an important factor that protects future returns, and affects the long-term value of assets. Foreign companies become confident if the law is functioning well, which makes it possible to sue the government or any other related stakeholders if there are any legal issues (Company A). From the investor side, when investing in developing economies, it is considered safer to obtain funding from domestic government development/export bank for safety backup (Company C). Establishing a well-functioning rule of law is important to create the necessary climate of stability and predictability for foreign investors.

##### 4.1.3. Efficient and transparent administrative procedure

A lot of studies assert that inefficient administrative procedures can be time-consuming and absorb personnel, and lead to increase in up-front expenses (Loy and Coviello, 2005). Companies have experienced several cases in developing economies where they had to wait for more than 3 years after winning the competitive bidding due to very slow administrative procedure (Company E). Another point raised by some of the experts was the importance of the quality of administrative procedure of local governments. Local

governments often have great influence over companies, issuing local operating permits, and having communities that directly affect business operations of the companies in the region (Evans and Hamner, 2003), which has been the case in FDI in wind and solar energy, too (Company F). Especially for the developing economies with less experience in implementing renewable energy projects, it would be beneficial to establish a one-stop agency that could guide investors through the stages of administrative process, including planning, application for approval, approval procedure and project implementation. The one-stop agency could also provide support for the utilization of Clean Development Mechanism when applicable.

## 4.2. Macroeconomic environment

### 4.2.1. Access to local finance

Developed financial markets may make financing short- and long-term transactions easier for foreign firms, which helps foreign firms to reduce the exposure to the exchange rate risk. However, wind and solar energy projects require a large up-front capital cost but small variable cost, thus the relative importance of easy access to local finance is low (Company B). In a lot of the cases with competitive bidding, the guaranteed revenue will be paid in US dollars, which makes getting funding from host country not that important. However, in some cases, the tariff is paid in domestic currency even for competitive bidding projects, which makes access to local finance important (Company D). Adding to this, obtaining funding from a local bank could enhance the credibility of the company in the country, and help the smooth implementation of the project (Company G). Providing the guaranteed revenue in US dollars will boost the confidence of foreign investors especially for countries with less developed financial markets.

### 4.2.2. Exchange rate stability

Continuous fluctuations of exchange rate indicate currency instability of a country. For risk-averse investors, exchange rate volatility can be regarded as additional cost, which could discourage FDI. The stability of exchange rate is recognized as one of the most important factors besides renewable energy policies especially because of the following reasons: the long-term payback period of wind and solar energy projects makes currency volatility a factor that negatively affects investors' decisions (Company B); wind and solar energy projects are perceived to serve as low-volatility investment in a lot of companies' investment portfolio, thus a stable exchange rate is preferred (Company C). Therefore, host countries need to avoid over-valuation of the exchange rate for maintaining a stable economic environment (Kiyota and Urata, 2004).

### 4.2.3. Labor cost

The installation segment, which is labor-intensive, is the largest segment in the solar value chain regarding employment in the sector. Similar to solar energy projects, around 70% of total jobs of wind energy sector in the US were created in downstream activities including installation and sales (55,200 out of 80,700; AWEA, 2011). However, since the relative cost of labor to hardware (turbines and PV modules etc.) is low, labor cost is a less important factor when choosing investment location (Company E).

## 4.3. Natural conditions

### 4.3.1. Natural resources

Natural resource endowment has been long time perceived as strong determinants of FDI (Anyanwu, 2012). In fact, most of the interviewed experts emphasized availability of natural resources as

one of the prerequisites for choosing a country to conduct solar and/or wind energy projects. Although solar energy is widely available around the world, annual solar radiation ranges between 750 kWh/m<sup>2</sup> and 2500 kWh/m<sup>2</sup> in various parts of the world (Shoubi and Shoubi, 2013). Similarly, wind speed varies greatly between different locations, and what times of day and what times of year the wind is most likely to blow could greatly vary, too. These differences could directly impact the revenue of wind and solar energy projects by changing the amount of electricity that could be generated, and also indirectly impact the projects through influencing the ease/difficulty of grid integration. Therefore, when choosing a country to implement a wind and solar energy project, companies attach great importance to the availability of natural resources as much as the expected electricity sales price set through feed-in tariff, renewable energy certificates, or competitive biddings (Company F). This also means that accumulation of detailed data regarding wind speed and solar radiation in a country will create an attractive environment for foreign investors.

### 4.3.2. Access to land

Some countries place land-purchase restrictions for foreign companies, which sometimes make projects infeasible to implement, or force changes in business structure such as shifting to joint venture with local companies. Because of the site-specific nature of wind and solar energy resources, securing stable and reliable access to land is one of the most important factors that affect project feasibility (Company E). Slow administrative procedures for securing land can be often observed in a lot of developing economies, and it can drive up the cost of the projects greatly (Company D).

## 4.4. Renewable energy policies

### 4.4.1. Economic support policies

4.4.1.1. *Feed-in tariff.* Although Feed-in tariff system is raised as a very attractive system by most of the experts, the attractiveness of the system depends on the guaranteed price and trustworthiness of the system. For the system to be trustworthy, the cost structure can be important factor: it is safer when the cost of the system is covered through electricity tariff paid by the consumer of the host country. Spain is a good case showing the risk of having the cost of the system covered by the government: sudden boom in investment put pressure on the government budget, which eventually led to sudden change in the feed-in tariff system (Couture and Gagnon, 2010; Company B).

4.4.1.2. *Renewable energy certificates and renewable portfolio standards.* Renewable energy certificates (REC) are often used in combination with renewable portfolio standards (RPS), which oblige electricity producers and/or distributors to either buy or produce fixed amount of electricity generated with renewable energy (Menanteau et al., 2003). REC allows competition between renewable producers since the price of certificate depends on supply and demand of certificates (Abdmouleh et al., 2015). From the perspectives of foreign investors, this volatility in the price of certificate increases the volatility of the revenue of projects, and this will make the country less attractive for conducting a project especially when combined with high volatility in exchange rate (Company D).

4.4.1.3. *Auction/competitive bidding.* Competitive bidding has become popular in recent years, and a large number of countries prefer competitive bidding to feed-in tariff policies due to its controllability by the government. More than 64 countries had held competitive bidding by the end of 2015, and record bids in terms of



both price and volume occurred in developing economies (REN21, 2017). While competitive bidding facilitates development of specific technologies since it allows competition within technologies, aggressive competitions among developers of the projects and often time-consuming tendering process make the system hard to provide long-term market stability or profitability (Mourelatou and Birmingham ECOTEC Research and Consulting Limited, 2001).

The experts consider auction as a system that has both advantages and disadvantages compared to other popular systems including feed-in tariff. In case of Auction, although the competition could be quite severe, it is mostly the case that government provides close support for the company that wins the bidding for smooth development of the project, which makes it easier for foreign companies since foreign companies sometimes encounter difficulties in dealing with permits and other regulatory issues in the host country (Company B). However, considering that the competition is getting too severe, especially for solar energy projects, lowering the return on the investment rate, it is questionable if competitive bidding is a long-term support policy that a country can hold successfully (Company C). This point has also been raised by Lewis and Wiser (2007), stating that competitive bidding “has historically not provided long-term market stability or profitability, due in part to the often uncertain or long lead times between tenders and the fierce competition among project developers to win the competitive process”.

**4.4.1.4. Tax incentives.** Tax exemptions or reductions can encourage private individuals and companies to consider investing in wind and solar energy projects. These incentives can come in the form of capital- or production-based income tax deductions or credits, accelerated depreciation, property tax incentives, sales or excise tax reductions, and value-added tax reductions. As with financial incentives, tax-based incentives are generally found to play a supplemental role to other policies, and countries that have relied heavily on tax-based strategies (e.g., US and India) have often been left with unstable markets for wind power (Lewis and Wiser, 2007). However, especially in developing economies, since wind and solar energy FDI projects are mostly conducted under special purpose company, tax exemptions provide little benefit (Company C).

#### 4.4.2. Regulatory support policies

**4.4.2.1. Priority/guaranteed access to grid.** Most of the experts raise guaranteed access to grid as a critical factor for implementing solar and wind projects. For small-scale energy projects, the logistics and cost of grid connection can significantly drive up the cost of the projects, thus it is critical to provide priority access to electricity grid for independent power producers to distribute their electricity (Mourelatou and Birmingham ECOTEC Research and Consulting Limited, 2001). Especially for investors coming from outside the host country, transparent and straightforward access to the grid would be essential for smooth and secured project development. Since in most of the cases, FDI wind and solar energy projects are implemented with project finance, which require guaranteed flow of revenue, if there are any risks in grid connection that affects the future revenue of the project, the company would not be able to obtain finances for the project (Company A). With competitive bidding, it is often the case that access to grid infrastructure is guaranteed, but in other cases access to grid could be challenging in some countries (Company E).

**4.4.2.2. Technical standards.** Setting technical standards that are aligned with international standards is important for proper function of technical systems as long as the standard does not mandate specific standards that only benefit domestic firms. However, countries are increasingly using technical standards as

an industrial policy tool to limit foreign companies' participation in their wind energy and solar energy markets (Stepp and Atkinson, 2012). There were cases where companies gave up investment in wind energy projects since there were technical standards that require wind turbines to be larger than specific size or to contain domestic parts for the turbines (Company C). Technical standards that are not aligned with international standards could drive up costs and act as a de facto market-access barrier. Therefore, foreign companies would prefer investing in a country having technical standards that are aligned with international standards.

**4.4.2.3. Absence of local content requirement.** Most of the experts expressed that the existence of local content requirement (LCR) is a critical factor that strongly and negatively affects wind and solar energy FDI projects. When there is LCR, it forces foreign companies to choose the supplier of turbines/panels from the companies in the host country, which often drives up the cost (Company E). Also, for choosing a reliable supplier that provides continuous support for more than 20 years, LCR greatly reduces the freedom of selection (Company D).

#### 4.4.3. Political support policies

**4.4.3.1. National renewable energy target.** Renewable energy targets could be laid out both for long term as well as for short term based on the needs and feasibility in each country, which could be an indicator for investors regarding the degree of commitment of government. Reiche and Bechberger (2004) show that for some countries the strong political support with feasible and ambitious national renewable energy target is an important basis that ensures security of energy supply and to reduce their imports of fossil fuels and the use of coal. However, targets serve as a good indicator for the market provision of the host country only if it seems feasible and supported by a well-structured development plan (Company E). Targets are especially trustworthy when there is a system that penalizes if the host country fails to attain the target (Company F).

**4.4.3.2. Well-structured renewable energy development plan.** A stable and consistent strategic framework encourages investment in renewable energy for the long term (Foxon and Pearson, 2008). Development plans provide great confidence for foreign investors especially when it includes establishment of a renewable energy institution that can act as a one-stop agency when conducting a wind and solar energy projects, and addresses land-usage issues and grid the infrastructure development plans (Company C).

**4.4.3.3. Social acceptance.** As expressed in “Not In My Back Yard (NIMBY)” problem occasionally encountered in wind and solar energy projects, social acceptance toward wind and solar energy is important for smooth implementation of wind and solar energy projects. Reiche and Bechberger (2004) state that policy can influence social acceptance by introducing the case in Austria, public awareness is raised through requiring information about the electricity mix in electricity bills. By doing so, some customers might change to other electricity companies if they see that they receive electricity from coal or nuclear power. For foreign investors, social acceptance is something that is hard to see clearly, unless there are projects that have been aborted due to resistance from the local community of the host country (Company B).

## 5. Conclusions and future research

This paper identified determinants of FDI in wind and solar energy in developing economies based on a literature review and

semi-structured interviews. FDI has a great role to play in accelerating the transformation to cleaner energy system being a great source of capital and an important channel for introducing more productive technology and techniques for many developing economies. Therefore, understanding what factors affect investment decisions of FDI is critical for creating an enabling environment that facilitates FDI in wind and solar energy.

In this paper, 24 factors were identified as potential determinants of FDI in the wind and solar energy sector in developing economies, and they have been validated and narrowed down to 18 factors in the eyes of experts active in the field. The factors were classified into four categories: institutional environment; macro-economic environment; natural conditions; and renewable energy policies, and the importance of each factor is explained in the light of preceding studies and the expert opinions obtained through the semi-structured interviews. The experts' opinions suggest that renewable energy policies, especially economic support policies including feed-in tariff system and competitive bidding, and regulatory support policies such as priority access to grid and absence of local content requirements, are quite important even in comparison with the traditionally argued determinants of FDI. Among the traditionally argued determinants of FDI that are classified within categories of macroeconomic environment, institutional environment, and natural condition, exchange rate stability and availability of natural resources are suggested as some of the key factors.

The factors identified in this study provide basis for conducting further research on the determinants of FDI in wind and solar energy sector, and also provide great insight for policy makers to enhance the enabling environment for attracting FDI in the sector.

Being one of the first studies that look into the determinants of FDI in wind and solar energy sector, this study is subject to some limitations that provide starting points for further research. The first limitation of the study is the sample size. Although the number of the interviews can be deemed sufficient considering that interviewees of the study are solely focused on the well-defined experts in the field, future research should validate whether similar findings can be found when more companies are surveyed. The study by Bu and Wagner (2016) shows that heterogeneity in capabilities and size of companies affect FDI location decisions of the companies. Thus, it would be particularly interesting to conduct further investor segmentation (e.g., size of companies, environmental capabilities, and the role of renewable energy investment in companies' business strategies) and see how the findings differ by types of companies. The second limitation of the study is that to what extent each factor impacts the decision-makings of the investors remains unsolved. Thus, one of the next steps of the research is to identify relative importance among the determinants that are identified through this study, which could offer criteria for prioritizing policies and actions to policy makers. This could be implemented through further interactions with practitioners active in the field by conducting questionnaires, or through econometric approach using quantitative data.

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## Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.jclepro.2017.12.154>.

## References

- Abdmouleh, Z., Alammari, R.A., Gastli, A., 2015. Review of policies encouraging renewable energy integration & best practices. *Renew. Sustain. Energy Rev.* 45, 249–262.
- Alfaro, L., Kalemli-Ozcan, S., Volosovych, V., 2008. Why doesn't capital flow from rich to poor countries? An empirical investigation. *Rev. Econ. Stat.* 90, 347–368.
- American Wind Energy Association (AWEA), 2011. Wind Industry Annual Market Report Year Ending 2010. AWEA, Washington D.C.
- Ang, G., 2016. Overcoming Barriers to International Investment in Clean Energy. OECD Insights, pp. 83–86.
- Anuchitworawong, C., Thampanishvong, K., 2015. Determinants of foreign direct investment in Thailand: does natural disaster matter? *Int. J. Disaster Risk Reduct.* 14, 312–321.
- Anyanwu, J.C., 2012. Why does foreign direct investment go where it goes?: new evidence from African countries. *Ann. Econ. Finance* 13, 425–462.
- Aryeetey, C., Barthel, F., Busse, M., Loehr, C., Osei, R., 2008. Empirical study on the determinants and pro-development impacts of foreign direct investment in Ghana. In: Study on behalf of the German Ministry for Economic Cooperation and Development and the German Technical Cooperation (GTZ). <http://www.hwwi.org/fileadmin/hwwi/Leistungen/Gutachten/Report-FDI-Ghana-final.pdf>. (Accessed 19 March 2017).
- Asiedu, E., 2006. Foreign direct investment in Africa: the role of natural resources, market size, government policy, institutions and political instability. *World Econ.* 29, 63–77.
- Bu, M., Wagner, M., 2016. Racing to the bottom and racing to the top: the crucial role of firm characteristics in foreign direct investment choices. *J. Int. Bus. Stud.* 9, 1032–1057.
- Busse, M., Hefeker, C., 2007. Political risk, institutions and foreign direct investment. *Eur. J. Polit. Econ.* 23, 397–415.
- Campos, N., Kinoshita, Y., 2002. The Location Determinants of Foreign Direct Investment in Transition Economies. Working Paper Group3–9 Kinoshita. William Davidson Institute, Michigan.
- Cantwell, J., 2000. A survey of theories of international production. In: Pitelis, N., Sugden, R. (Eds.), *The Nature of the Transnational Firm*. Routledge, London, pp. 16–63.
- Chakrabarti, A., 2001. The determinants of foreign direct investments: sensitivity analyses of cross-country regressions. *Kyklos* 54, 89–114.
- Chan, M.L., Hou, K., Li, X., Mountain, D.C., 2014. Foreign direct investment and its determinants: a regional panel causality analysis. *Q. Rev. Econ. Finance* 54, 579–589.
- Cole, M.A., Elliott, R.J.R., Zhang, L., 2017. Foreign direct investment and the environment: a review of the literature. *Annu. Rev. Environ. Resour.* 42, 465–487.
- Couture, T., Gagnon, Y., 2010. An analysis of feed-in tariff remuneration models: implications for renewable energy investment. *Energy Pol.* 38, 955–965.
- Demirhan, E., Masca, M., 2008. Determinants of foreign direct investment flows to developing countries: a cross-sectional analysis. *Prague Econ. Pap.* 4, 356–369.
- Diamonte, R.L., Liew, J.M., Stevens, R.L., 1996. Political risk in emerging and developed markets. *Financ. Anal. J.* 52, 71–76.
- Dumludag, D., 2009. An analysis of the determinants of foreign direct investment in Turkey: the role of the institutional context. *J. Bus. Econ. Manag.* 10, 15–30.
- Dunning, J.H., 1980. Toward an eclectic theory of international production: some empirical tests. *J. Int. Bus. Stud.* 11, 9–31.
- Dunning, J.H., Lundan, S.M., 2008. The MNE as a creator, Fashioner and respondent to institutional change. In: Collinson, S., Morgan, G. (Eds.), *The Multinational Firm*. Blackwell Publishers, Oxford, pp. 93–115.
- Edwards, S., 1990. Capital Flows, Foreign Direct Investment, and Debt-equity Swaps in Developing Countries. NBER, Cambridge. Working Paper, 3497.
- Eleftheriadis, I.M., Anagnostopoulou, E.G., 2015. Identifying barriers in the diffusion of renewable energy sources. *Energy Pol.* 80, 153–164.
- Escaleras, M., Register, C.A., 2011. Natural disasters and foreign direct investment. *Land Econ.* 87, 346–363.
- Evans, J.W., Hamner, B., 2003. Cleaner production at the Asian development bank. *J. Clean. Prod.* 11 (6), 639–649.
- Eyraud, L., Clements, B., Wane, A., 2013. Green investment: trends and determinants. *Energy Pol.* 60, 852–865.
- FDIntelligence, 2016. The FDIreport 2016 Global Greenfield Investment Trends. Financial Times, London, UK.
- Foxon, T., Pearson, P., 2008. Overcoming barriers to innovation and diffusion of cleaner technologies: some features of a sustainable innovation policy regime. *J. Clean. Prod.* 16, 148–161.
- GlobalData Energy, plant database, Accessed 20 April 2016. (2016)<https://energy.globaldata.com/>.
- Globerman, S., Shapiro, D., 2003. Governance infrastructure and US foreign direct investment. *J. Int. Bus. Stud.* 34, 19–39.
- Hoff, K., Stiglitz, J.E., 2005. The Creation of the Rule of Law and the Legitimacy of Property Rights: the Political and Economic Consequences of a Corrupt Privatization. NBER, Cambridge working paper 11772.
- International Energy Agency (IEA), 2016. World Energy Outlook 2016. International Energy Agency, Paris.
- International Energy Agency/International Renewable Energy Agency (IEA/IRENA) Joint Policies and Measures Database. <https://www.iea.org/policiesandmeasures/renewableenergy/> (Accessed 24 December 2016).
- International Monetary Fund, 2016. World Economic Outlook: Subdued Demand

- Symptoms and Remedies. IMF, Washington, USA.
- Itaki, M., 1991. A critical assessment of the eclectic theory of the multinational enterprise. *J. Int. Bus. Stud.* 22, 445–460.
- Jacobsson, S., Lauber, V., 2006. The politics and policy of energy system transformation—explaining the German diffusion of renewable energy technology. *Energy Pol.* 34, 256–276.
- Jadhav, P., 2012. Determinants of foreign direct investment in BRICS economies: analysis of economic, institutional and political factor. *Procedia. Soc. Behav. Sci.* 37, 5–14.
- Jones, A.W., 2015. Perceived barriers and policy solutions in clean energy infrastructure investment. *J. Clean. Prod.* 104, 297–304.
- Kaufmann, D., Kraay, A., Mastruzzi, M., 2011. The worldwide governance indicators: methodology and analytical issues. *Hague J. Rule Law* 3, 220–246.
- Keeley, A.R., Ikeda, Y., 2017. Determinants of foreign direct investment in wind energy in developing countries. *J. Clean. Prod.* 161, 1451–1458.
- Kemsley, D., 1998. The effect of taxes on production location. *J. Account. Res.* 36, 321–341.
- Kiyota, K., Urata, S., 2004. Exchange rate, exchange rate volatility and foreign direct investment. *World Econ.* 27, 1501–1536.
- Krueger, T., Page, T., Hubacek, K., Smith, L., Hiscock, K., 2012. The role of expert opinion in environmental modelling. *Environ. Model. Software* 36, 4–18.
- Kuhnert, M., Martin, G., Griffiths, P., 2010. A guide to eliciting and using expert knowledge in Bayesian ecological models. *Ecol. Lett.* 13 (7), 900–914.
- Lewis, J.L., Wiser, R.H., 2007. Fostering a renewable energy technology industry: an international comparison of wind industry policy support mechanisms. *Energy Pol.* 35, 1844–1857.
- Loy, D., Coviello, M., 2005. Renewable Energies Potential in Jamaica. United Nations Economic Commission for Latin America and the Caribbean (ECLAC). Ministry of Commerce, Science and Technology, Jamaica.
- Lucas, R.E., 1990. Why doesn't capital flow from rich to poor countries? *Am. Econ. Rev.* 80, 92–96.
- Mateev, M., 2009. Determinants of foreign direct investment in Central and Southeastern Europe: new empirical tests. *Oxf. J.* 8 (1), 133–149.
- McInerney, C., Johannsdottir, L., 2016. Lima Paris action agenda: focus on private finance—note from COP21. *J. Clean. Prod.* 126, 707–710.
- Menanteau, P., Finon, D., Lamy, M., 2003. Prices versus quantities: choosing policies for promoting the development of renewable energy. *Energy Pol.* 31, 799–812.
- Merlevede, B., Schoors, K.J., 2005. How to Catch Foreign Fish? FDI and Privatization in EU Accession Countries. Working Paper, 785. William Davidson Institute, Michigan.
- Morisset, J.P., Lumenga-Neso, O., 2002. Administrative barriers to foreign investment in developing countries. *Transnatl. Corp.* 11 (2), 99–120.
- Moshirian, F., 2001. International investment in financial services. *J. Bank. Finance* 25, 317–337.
- Mourelatou, A., Birmingham ECOTEC Research and Consulting Limited, 2001. Renewable Energies: Success Stories. Office for Official Publications of the European Communities, Luxembourg.
- Murovec, N., Erker, R.S., Prodan, I., 2012. Determinants of environmental investments: testing the structural model. *J. Clean. Prod.* 37, 265–277.
- Painuly, J.P., 2001. Barriers to renewable energy penetration; a framework for analysis. *Renew. Energy* 24, 73–89.
- Pirlogea, C., 2011. Barriers to investment in energy from renewable sources. *Economia. Spa Manag.* 4, 132–140.
- Poelhekke, S., van der Ploeg, R., 2010. Do Natural Resources Attract FDI? Evidence from Non-stationary Sector Level Data. Discussion Paper, 8079. Centre for Economic Policy Research, London.
- Reiche, D., Bechberger, M., 2004. Policy differences in the promotion of renewable energies in the EU member states. *Energy Pol.* 32, 843–849.
- REN21, 2016. Renewables 2016 Global Status Report. REN21, Paris.
- Romano, A.A., Scandurra, G., Carfora, A., Fodor, M., 2017. Renewable investments: the impact of green policies in developing and developed countries. *Renew. Sustain. Energy Rev.* 68, 738–747.
- Shamsuddin, A.F., 1994. Economic Determinants of Foreign Direct Investment in Less Developed Countries. *The Pakistan Development Review*, pp. 41–51.
- Shoubi, M.V., Shoubi, M.V., 2013. Solar wall system, the sun-centered approach toward ecosystem. *J. Genet. Breed.* 8, 39–54.
- Stepp, M., Atkinson, R.D., 2012. Green mercantilism: Threat to the Clean Energy Economy. The Innovation Technology and Innovation Foundation. <http://www.itif.org/publications/enough-enough-confronting-chinese-innovation-mercantilism>. (Accessed 3 March 2017).
- Tang, C.F., Yip, C.Y., Ozturk, I., 2014. The determinants of foreign direct investment in Malaysia: a case for electrical and electronic industry. *Econ. Modell.* 43, 287–292.
- Te Velde, D.W., 2001. Policies towards Foreign Direct Investment in Developing Countries: Emerging Best-practices and Outstanding Issues. Working Paper. Overseas Development Institute, London.
- Terpstra, V., Yu, C., 1988. Determinants of foreign investment of US advertising agencies. *J. Int. Bus. Stud.* 19, 33–46.
- Wheeler, D., Mody, A., 1992. International investment location decisions: the case of US firms. *J. Int. Econ.* 33 (1–2), 57–76.
- Zeng, S., Liu, Y., Liu, C., Nan, X., 2017. A review of renewable energy investment in the BRICS countries: history, models, problems and solutions. *Renew. Sustain. Energy Rev.* 74, 860–872.