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Environmental impact of FDI – the case of US subsidiaries

Environmental
impact of FDI

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Abstract

Purpose – This paper aims to examine how foreign direct investment (FDI) and firm-specific advantages (FSAs) of US multinational enterprises (MNEs) majority-owned subsidiaries affect environmental pollution in host countries. The research results contribute to helping managers and policymakers understand the environmental impact of MNEs activities, and encourage these firms to develop environmentally responsible management (ERM) as an element of their corporate social responsibility practice.

Design/methodology/approach – Panel data consisting of developing and developed countries spanning the years 2004 through 2014 are used. The dynamic panel generalised method of moments technique is implemented. This method avoids common estimation bias, such as endogeneity, heteroscedasticity and autocorrelation.

Findings – This paper finds that the direct environmental impacts of FDI vary significantly between the two groups of countries. The environmental benefits of FDI to the recipient country are achieved through capital and technology transfer. The study also reveals that R&D intensity moderates the relationship between FDI and environmental pollution in both developing and developed countries in such a way that environmental pollution decreases.

Research limitations/implications – Future research could explore the environmental impact of MNEs on host countries by considering both equity and non-equity entry modes. The findings offer some support to host government policies offering generous incentive packages to attract R&D investment to improve environmental pollution. This research raises questions as to the reasons corporations operating in developing and developed countries should pursue their ERM practices.

Originality/value – This research examines both the direct effect of FDI and the moderating effects of FSAs on the relationship between FDI and the environment. Although previous studies have already looked at the relationship between FDI and the environment, the moderating effect of FSAs is very under-developed in this relationship.

Keywords FDI, Environmental impact, GMM, Firm-specific advantages, CSR and environmental responsibility, Majority-owned subsidiaries

Paper type Research paper

Introduction

There is a long-standing debate in the field of international business (IB) concerning the effects of environmental regulation on the location of foreign direct investment (FDI). It has been argued that multinational enterprises (MNEs) locate their most polluting activities in countries with less environmental standards. On a different perspective, some authors claim that MNEs follow environmentally responsible management (ERM)

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practices (Cetindamar and Husoy, 2007; Cave, 2014). MNEs are increasingly perceived not only as profit maximisers but also at prioritising corporate social responsibility (CSR) in the global economy, independently of countries' environmental regulations' level of commitment (Christmann and Taylor, 2006). Scholars show that the strategies adopted by MNEs to cope with international environmental policy depend on firm-specific advantages (FSAs) (Rugman and Verbeke, 1998). FSAs refer to advantages specific to a firm irrespective of location (Rugman and Verbeke, 1992). Environmental issues such as climate change can not only give MNEs the opportunity to develop "green" FSAs but also help reconfigure key FSAs that are viewed as the main sources of firms' profitability, growth and survival (Kolk and Pinkse, 2008).

Studies addressing how MNEs deal with environmental management and sustainability have been receiving increasing attention in IB scholarship as they seek to understand the environmental implications of FDI in host economies (Buckley *et al.* 2017). Although, research has generated very useful insights, usually at the macro level, regarding the nature of environmental innovation and regulation, the characteristics and drivers peculiar to MNEs, particularly the attempt to link sustainability to FSAs, have remained underexplored in the policy-related literature on clean technology transfer and development (Pinkse and Kolk, 2012; Kolk, 2015; Kolk and Fortanier, 2013). Yet, to what extent MNEs activities are deploying ERM practices to tackle sustainability issues is within the debatable ground. Although MNEs have an important role in fostering advanced technology and knowledge diffusion across host countries (Cantwell *et al.* 2004), which might lead to the development of sustainable products and services, one question remains: how to understand and evaluate ERM practiced by MNEs in foreign markets (Kolk and Van Tulder, 2010).

Given the lack of work examining the environmental behaviour of MNEs, this paper examines how FDI can generate benefits and costs on the host country's environment. It empirically analyses how FSAs of US MNEs' majority-owned subsidiaries affect the environment in host countries. More specifically, this paper has three main aims:

- (1) to examine the environmental impact of US MNEs' majority-owned subsidiaries – particularly linking sustainability issues to FSAs to understand the disagreements over the relationship between FDI and the environment in the IB literature;
- (2) to shed some light on the way in which MNEs' activities affect environment pollution and contribute to the understanding and assessment of ERM practiced by US MNEs in both developing and developed countries; and
- (3) to support managers and policymakers to understand what factors lead to ERM practices and to encourage ERM practices as an element of CSR-related practices in MNEs subsidiaries.

The IB literature has laid a solid foundation for isolating and better understanding the "country-specific" and "firm-specific advantages" in ERM practices from the perspective of Rugman's CSA-FSA matrix (Rugman *et al.* 2012) by determining location choice and MNEs responses to environmental regulations. However, it has not shed much light on the role of other factors, such as firm-specific competitive advantages, in understanding environmental outcomes and ERM practices of MNEs. By reconciling the contrasting evidence, we answer the question posed by IB scholars in determining the factors leading to ERM practices regardless of location decisions and environmental regulatory stringency of host countries. The rationale of this study is that as the relationship between business and society is shifting, MNEs cannot continue to ignore environmental issues. Environmental practices and MNEs actions – which can both cause problems and provide benefits – are a growing

concern worldwide. This paper aims to contribute to the research interest in CSR activities and sustainable development implications of IB. Contrary to previous research, this empirical investigation examines both the direct effect of FDI and the moderating effects of FSAs on the relationship between FDI and the environment. To achieve our objectives, the generalised method of moments (GMM) technique is applied to a sample of developing and developed countries over the period 2004-2014. This method avoids common estimation bias, such as endogeneity, heteroscedasticity and autocorrelation.

This paper proceeds with the review of the literature on the relationship between FDI and the environment covering theoretical and empirical aspects of this relationship. We present a set of hypothesis for empirical testing and a discussion of the data and methodology used to study the topic. The final sections refer to presentation and discussion of research results and recommendations for further research.

Theory and hypothesis development

The development of CSR concepts and practices has been changing over time (Buckley and Ghauri, 2004). In this paper, we argue that ERM practices are an element of CSR, and that there may be both moral and strategic imperatives for corporations to reinforce the communities in which they operate. MNEs are not exclusively regarded as profitable businesses any longer, as they have become ethically and socially responsible and place great emphasis on respecting the environment and communities within which they are located (Cave, 2014). The market values firms that satisfy minimum requirements in what pertains to environmental protection (Bird *et al.* 2007). Given the change taking place in society regarding the environmental behaviour of MNEs and the role they play in addressing social and environmental issues, the focus placed on ERM practices is rising. Yet, incorporating socially and environmentally responsible behaviour arises as a result of stakeholders engagement to achieve sustainability-related goals and regulations that add new requirements and change how the environmental impact is addressed by business firms through the concept of shared value (Porter and Kramer, 2006; Porter and Kramer, 2011). This is further highlighted by the “new development paradigm” and the multi-faced nature of development objectives including social and ecological development next to economic growth (Dunning and Fortanier, 2007). These two theories push ERM forward by looking at the interaction between business and society through CSR along with embracing social costs and benefits of MNEs and not simply their pure profit motivation. Given the growing role of environmental sustainability, MNEs are increasingly expressing a stronger public commitment to sustainable products and business practices and implementing ERM to reduce their negative impact on the environment. In this new line of thinking, ERM and the MNEs involvement in the improvement of host countries’ environment do not simply represent a cost to the company, as they can deliver potential benefits as well (Engle, 2007).

In addressing previous research on environmental responsibility, major trends emerge in the CSR domain. The first trend pays attention to the benefits of corporate investment along with the possibly negative environmental impact of inward FDI in the countries with the weakest environmental regulations (Madsen, 2009). The second trend considers the location decision of MNEs when broader societal and sustainability implications of their actions are taken into account (Kolk, 2010). Two main streams of IB literature with respect to ERM emerge: on one hand, some literature focuses on the negative aspect of ERM composed of the “pollution haven hypothesis” (PHH) and “race-to-the bottom” (RTB) and, on the other hand, the so-called “Porter hypothesis” (PH) or the mutually beneficial strategy of ERM.

The relationship between foreign direct investment and the environment

The PHH claims that FDI will seek host countries to locate its production, primarily in manufacturing and natural resource extraction industries, with less stringent environmental regulations or poor environmental enforcement laws/procedures. These locations constitute a source of comparative advantage to the pollution-intensive foreign capital (Cole and Elliott, 2005). The main assumption of the PHH is that environmental regulations in the host country impose costs on firms and affect the location decisions of MNEs. In terms of the environmental regulatory requirements, MNEs will prefer locations which are cheaper and more efficient to maximise profits. The PHH posits that, as environmental regulations increase, production within polluting industries will relocate and move to countries with low environmental standards. In addition, FDI in the beneficiary country is a major catalyst for development (Haskel *et al.* 2007). Yet, FDI flows do not accrue automatically and evenly across countries. Therefore, countries with lax environmental regulations hope to benefit from FDI because they offer lower costs of production and a comparative advantage in pollution intensive industries (OECD, 2017). There is quite an extensive volume of literature on the PHH (Jaffe *et al.* 1995; Frankel and Rose, 2005), but little solid evidence exists to support the view that MNEs seek developing countries as pollution havens (Eskeland and Harrison, 2003).

In parallel, host countries may attempt to exempt or lower their environmental standards to attract FDI. As a result, the competition for FDI may lead to a subset of the pollution haven phenomenon known as the RTB of environmental standards. The core of the RTB hypothesis is that FDI inflows increase the elasticity of demand for labour in labour-abundant host countries and push wages downward towards minimum levels in the global labour market (Mehmet and Tavakoli, 2003). The RTB concept posits that once FDI has been attracted, governments will continuously pursue the deregulation of environmental protection to attract new FDI.

Differences in environmental regulation are particularly pronounced between developed and developing countries, and have given rise to much controversy and debate on the impact of environmental regulation on international competitiveness and the location of polluting industries. Strong regulations are hypothesised to lead to “industrial flight”, whereas a less strict, or non-existent, regulatory regime is feared to turn the country into a “pollution haven” (Copeland and Taylor, 1994; Motta and Thisse, 1994). Empirical evidence in support of the RTB hypothesis is lacking (Keller and Levinson, 2002). The PHH has been challenged by what is often marketed as a mutually beneficial form of ERM.

The PH is an alternative theory to PHH and RTB – known as the mutually beneficial approach to ERM (Porter, 1991). The PH asserts that the tightening of environmental regulations can encourage technological innovations and improve industrial competitiveness, triggering the introduction of cleaner technologies and environmental improvements (Ambec *et al.* 2013). The PH is based on the premise that environmental regulations are market-based regulations – for example in the form of carbon taxes or emissions trading – and conducive to innovative practice. Well-designed environmental regulations are seen as a potential economic benefit that can over-compensate for the costs of complying with these new regulations and innovation costs (Porter and Van der Linde, 1995). By reducing agency costs, an environmental regulation may enhance pollution-reducing innovation while at the same time increasing firms’ private benefit (Ambec and Barla, 2002). Compliance with environmental requirements confers firms a first mover advantage, as they will be able to exploit innovation by moving up the learning curve to be able to increase productivity or product value, which leads to private benefits. Environmental standards can provide those companies a competitive edge compared to those in countries having lesser environmentally

regulatory scope. Developments introduced by foreign companies can affect local businesses and change the environmental behaviour of domestic firms. As a consequence, environmental regulation would benefit both society and regulated firms by triggering dynamic efficiency (Van Leeuwen and Mohnen, 2017).

Yet, the theory is not without its critics (Palmer *et al.* 1995). Ambec and Barla (2006) raised the question whether environmental regulation is necessary for companies to adopt innovation that will help them to thrive and drive increased profits. Constantatos and Herrmann (2011) showed that consumers recognise that a product is “green” only within a certain period of time and that a “greener” strategy is not more profitable.

Environmental problems are usually caused by negative externalities of economic activity. Environmental policy has become a key issue in developed countries forcing firms to reduce the external costs of pollution that are passed on to society. Moreover, there are positive environmental externalities from activities of MNEs (Antweiler *et al.* 2001; Dardati and Saygili, 2012). Yet, public opinion in developed countries tends to be more sensitive to the potentially adverse environmental effects of economic activity. Besides this, although developing countries are going through general economic growth and industrialisation, their capability to exploit the financial resources and embodied technology remains somehow limited. When facing the choice between economic development and environmental protection, developing countries would tend to favour “pollution-intensive” FDI, which jeopardises the environment. This leads to the formulation of the following hypothesis:

- H1. Foreign capital is negatively (positively) related to environmental pollution in host developed (developing) countries.

Direct effects of foreign direct investment and moderating effects of firm-specific advantages on the environment

Table I provides an overview of economic theories of FDI and the implications for the environment. The market imperfections theory and FDI state that MNEs have market power that enables them to operate subsidiaries abroad more profitably than local companies can. In addition, MNEs are minimisers of transaction costs and efficient-driven organisations that are able to transfer technological capabilities, organisational know-how and marketing skills (Buckley, 2016). MNEs possess competitive advantages (also referred to as FSAs) enabling them to outcompete rivals internationally (Dunning, 1998). Such advantages are usually not available to local firms and are specific to the investing firm. As key drivers of globalisation, MNEs have unique ownership advantages, which can induce technology, knowledge and competences for business (Rugman and Verbeke, 2004). According to Dunning (1980), MNEs must have ownership advantages *vis-à-vis* other firms to compete in foreign locations, which represent a range of competitive strengths that are vital to their business success regardless of the disadvantage of foreignness. Lundan (2010) contended that companies can sustain their competitive advantage if the assets they possess, in the form of tacit knowledge, product innovation and innovatory capacity and tangible property and equipment, are valuable, rare and difficult to imitate. These advantages constitute any kind of income-generating asset that allows firms to engage in foreign production (Dunning, 1991).

FSAs are some of the major factors used to explain the strategic decisions of MNEs like entry modes selection (Agarwal and Ramaswami, 1992). The results suggest that MNEs with higher FSA prefer the wholly-owned mode rather than the cooperative mode such as international joint venture (Siripaisalpipat and Hoshino, 2000). Within the concept of industrial organisation, some factors internal to the firm are essential for its competitive position in international markets. FSAs are superior abilities that stem from proprietary

MBR	Theory		
	Theory	Theoretical emphasis	Environmental implications
	Market imperfections theory	MNEs possess monopolistic and oligopolistic advantages	MNEs seek to minimise environmental costs Double environmental standards in exports of products, waste and production facilities
	Internalisation theory	MNEs gain competitive advantage in creating their own internal market to facilitate the transfer of intangible assets Ownership of specific advantages allow MNEs to overcome market imperfections	MNEs allocate resources efficiently and globally Diffusion of cleaner production methods and technologies, environmental standards and management know-how
	Institutional theory	MNEs are organisers of integrated production networks and have corporate environmental responsibilities MNEs create value and gain competitive advantage through corporate environmental management and strategies	MNEs conform to regulatory requirements and normative pressures Diffusion of environmental management standards
	Eclectic paradigm	The cross border environmental conduct of MNEs depends on the combination of ownership, location, and internalisation advantages Firms benefit from economies of scale by organising the production of environmental quality across borders	Greening of industries across borders Agglomeration effects facilitating learning and uptake of new low-carbon technologies and products including green brand strategies

Table I.
Micro perspectives on the environmental impact of FDI

Note: Own elaboration adapted from [Hansen \(1998\)](#)

products, manufacturing processes, technological innovation, know-how about production, specialised market knowledge, organisational talents management and marketing. These assets are transferable from a parent firm to a subsidiary through the process of internalisation and the possession of these strategic assets is a necessary condition for sustained competitive advantage abroad ([Buckley and Strange, 2011](#)).

The literature indicates that foreign affiliates' ownership might have positive environmental effects because global ties increase self-regulation pressures on companies in low-regulation countries ([Christmann and Taylor, 2001](#)). [Talukdar and Meisner \(2001\)](#) also demonstrated that the higher the degree of private sector involvement in a developing economy, the lower its environmental degradation is. In addition, [Nehrt \(1996\)](#) showed that timing of pollution-reducing investments in manufacturing technologies has a significant positive impact on profitability and early pollution reduction provides companies with cost advantages over their competitors. Firms concentrate on lowering costs by reducing pollution to gain first-mover advantages to first introduce a product or service to the market. The results further indicate that the effect of environmental regulation is nonsignificant, which is opposed to the view that firms in highly regulated countries operate at a competitive disadvantage. In addition, as firms create value and enhance revenues in investing in environmental actions and initiatives, they can create demand for new environmentally friendly products ([Porter and Van der Linde, 1995](#)). A key assumption in the literature is that firms can benefit from environmental action, which in turn not only boost sales and revenues but also avoid potential future costs related to environmental

compliance. [Dowell et al. \(2000\)](#) found that firms with higher environmental standards have higher market values than firms with less rigorous standards. In the same vein, adopting “best practices” of environmental management that focus on firms’ production processes can help mitigate the negative impact of firms’ activities on the environment and can give the company competitive advantage in a market ([Christmann, 2000](#)). These process-focused “best practices” are intended to reduce the cost of production by increasing technical efficiency of the firm. Such practices include redesigning production processes to be less polluting. This approach involves substituting a more polluting input for its less polluting counterpart, recycling by-products and innovating in cleaner processes technologies. A study by [Noailly and Ryfisch \(2015\)](#) on the internationalisation of green R&D by MNEs, as measured by patent data, concluded that MNEs tend to locate their foreign green R&D activities in OECD markets and in China. The empirical analysis reveals that the probability of conducting green R&D abroad also augments with the host country’s stringency of environmental regulation.

MNEs also forge FSAs based on technological innovation. The accumulation of technology and innovation provides them with a cumulative competitive advantage leading to agglomeration economies of scale ([Cantwell, 1989](#)). In addition, corporate strategies can lead to innovations and the biggest opportunities arise with respect to environmental improvement and eco-friendly practices that may confer companies a competitive advantage ([Jorgenson, 2007](#)). Firms may seek to minimise damage to the environment through investment in “greener” process technology to redesign processes/products in environmentally oriented ways ([Gunningham, 2009](#)). FSAs are key resources which the firm has accumulated over time in its foreign operations and which are necessary to compete efficiently.

FDI spurs managerial and technological innovation and clean state-of-art production techniques ([Dunning, 1970](#); [OECD, 2002](#)). FDI is important for the transfer of technology and enhances economic growth as it complements domestic investment ([Borensztein et al. 1998](#)). MNEs may transfer and diffuse clean technology, through equity and non-equity market entry modes, and undertake technology dissemination through internalised channels within the networks of MNEs ([Markusen and Trofimenko, 2008](#)). [Buckley et al. \(2007\)](#) found evidence of greater positive spillovers from FDI in technology-intensive industries than in labour-intensive industries. In addition, foreign-owned firms are more likely to implement environment-related management practices and encourage good environmental practices ([Albornoz et al. 2009](#)). Foreign affiliates can diffuse technology and skills to local firms, particularly through backward linkages in the value chain ([Brambilla et al. 2009](#); [Smarzynska Javorcik, 2004](#)). This leads to the formulation of the following hypothesis:

- H2.* Subsidiary profitability is positively (negatively) associated with environmental pollution in developing (developed) host countries.
- H3.* Value added per employee is positively (negatively) associated with environmental pollution in developing (developed) host countries.
- H4.* Research and development (R&D) intensity is positively (negatively) associated with environmental pollution in developing (developed) host countries.
- H5.* Subsidiary profitability will moderate the relationship between foreign direct investment and environmental pollution in such a way that there will be a positive (negative) interaction effect between foreign direct investment and environmental pollution in developing (developed) host countries.

- H6. Value added per employee will moderate the relationship between foreign direct investment and environmental pollution in such a way that there will be a positive (negative) interaction effect between foreign direct investment and environmental pollution in developing (developed) host countries.
- H7. Research and development intensity will moderate the relationship between foreign direct investment and environmental pollution in such a way that there will be a positive (negative) interaction effect between foreign direct investment and environmental pollution in developing (developed) host countries.

Data and methodology

Data selection and sample

This study uses FDI data provided by the US Bureau of Economic Analysis (BEA) which is affiliated with the US Department of Commerce. The BEA conducts annual surveys, which are mandatory, and periodic benchmark surveys to analyse FDI trends for US MNEs'. The "majority-owned foreign affiliates" section in the several survey categories provides the most detailed information about the financial structure and operations results of US MNEs' subsidiaries. By using a majority-owned subsidiary sample, we implicitly control for the entry mode of US MNE's FDI. We use anthropogenic carbon dioxide emissions data from the World Bank's World Development Indicators. Our data set is a balanced panel of annual data for 67 developing countries and 34 developed countries covering the study period 2004-2014 ([Appendix](#)).

Model specification

This study attempts to assess how foreign capital and subsidiary FSAs of US MNEs' majority-owned subsidiaries affect the environment of host countries. Environmental pollution is explained by the following model:

$$\text{Environmental pollution} = f(\text{Foreign capital, Subsidiary firm – specific advantages}) \quad (1)$$

where subsidiary FSAs include subsidiary profitability, value added per employee and R&D intensity.

The model can be expressed in first-differences as:

$$\Delta Y_{it} = \Delta \beta Y_{it-1} + \Delta \delta X_{it} + \Delta \varepsilon_{it} \quad (2)$$

where Y_{it} is the dependent variable, Y_{it-1} is the lagged dependent variable and X_{it} denotes the usual vector of independent variables that vary across country i at time t . ε_{it} is the disturbance term and Δ is the difference operator.

Dependent variable

Environmental pollution. Our dependent variable is a measure of environmental performance. We use carbon dioxide emissions in metric tons per capita in country i at year t . This variable has been used in previous studies ([Frankel and Rose, 2005](#); [Holtz-Eakin and Selden, 1995](#)).

Independent and moderating variables

Foreign capital. This variable is a proxy of capital investment spending in host countries originated by US multinationals and their majority-owned subsidiary operating activities of which 50 per cent or more is owned by the parent company. More precisely, it captures the long-term relationship that is established between a foreign direct investor and a direct investment enterprise in the host country, where the former has a lasting interest and a significant degree of influence in the latter (Wacker, 2016). Given the direction of capital flows, it constitutes outward FDI or US direct investment abroad. This variable is operationalised by the ratio of total capital expenditures of US MNEs' majority-owned subsidiaries measured in millions of US dollars, in country i , at year t , divided by the total number of US MNEs' majority-owned subsidiaries in country i at year t .

Subsidiary profitability. MNEs possess vital assets and oligopolistic advantages that make them usually more profitable than their domestic counterparts (Dunning and Pearce, 1981). MNEs possess market power that has been attributed to their intensive investments in advanced technology, product differentiation and wide-ranging advertising. Subsidiary profitability measures the asset power of US MNEs' majority-owned subsidiaries. The measure of subsidiary profitability in this study is return on total assets and it is computed by dividing net income of US MNEs' majority-owned subsidiaries in country i , at year t , by total assets of US MNEs' majority-owned subsidiaries in country i at year t . The subsidiary return on total assets has been used in previous studies (Buckley, 2012).

Value added per employee. This variable is a proxy of the level of technical efficiency in the production process of a subsidiary and measures the effectiveness with which the inputs used by a firm are used to produce its output. According to Braunerhjelm (1996), this does not directly imply that subsidiaries specialise in more advanced production, but higher value added per employee may indicate higher employment of superior technology in production. Yet, according to previous IB studies, multinationals usually exhibit higher productivity and innovation output relative to firms that serve the domestic market only (Siedschlag and Zhang, 2015). Value added per employee is measured as the ratio of value added (millions of dollars) of US MNEs' majority-owned subsidiaries in country i , at year t , divided by the number of employees of US MNEs' majority-owned subsidiaries in country i at year t .

R&D intensity. This variable is used as a proxy to measure specialised knowledge and technology of US MNEs' majority-owned subsidiaries. R&D intensity is defined as the proportion of R&D expenditures to total sales in country i at year t . This variable has been used by IB scholars (Dunning and Narula, 1995). There is a general consensus that MNEs tend to be in industries with high levels of R&D relative to sales (Markusen, 1995). For instance, MNEs receive higher returns from innovation activities than single plant companies do (Pfaffermayr, 1999). Fernández *et al.* (2018) show that spending on R&D contributes positively to the reduction of pollutant emissions.

To test the hypotheses regarding joint effects of FSAs and FDI, this study further analyses their interaction effects on environmental pollution. Three interaction terms of FSAs and foreign capital are formed and each interaction term is added into the previous model. In so doing, we analyse how subsidiary profitability, value added per employee and R&D intensity moderate the relationship between FDI and environmental pollution in developing and developed countries.

Method of estimation

This study uses the dynamic panel method GMM proposed by Arellano and Bond (1991) rather than conventional statistical techniques such as ordinary least squares (OLS) to address endogeneity issues and to account for dynamics in the econometric

model. GMM includes a lagged-dependent variable in the regression and the individual effects are assumed to be stochastic. If so, these effects will be correlated with the lagged-dependent variable. In such circumstances, the OLS estimator is inconsistent and the estimators are biased because the lagged variable is positively correlated with the error term. Therefore, GMM transforms the data into first differences and removes individual effects, but at the cost of introducing a correlation between the error term and the lagged dependent variable. The disadvantage of the first difference transformation is that it performs poorly if the coefficient of the lagged-dependent variable is close to 1 as a random walk, because the instruments do not provide much information about future changes (Bundell and Bond, 1998).

This research uses the two-step version of the difference GMM estimator, that provides more asymptotic efficient estimates, and corrects for biases associated with endogenous regressors and unobserved heterogeneity. Though, this regression approach only provides unbiased and consistent coefficient estimates if several conditions are satisfied. First, the random error term should be serially uncorrelated. To ensure that this condition holds, the first differenced residuals should have a negative and significant first-order serial correlation, and non-significant negative second-order serial correlation. Second, consistency of the GMM estimator depends on the validity of the instruments. The Sargan test of over identifying restrictions is used to ascertain the overall validity of the instruments. The null hypothesis of the Sargan test is that there is no correlation between the over-identified instruments and the error term. To address these problems, we used the procedures provided by the STATA 13.0 program.

Results of the empirical analysis

Table II reports the correlations among variables. Environmental pollution, our dependent variable, has a positive correlation with foreign capital, subsidiary profitability and value added per employee in both developing and developed countries. Despite the statistical significance, the magnitude of the correlation between those variables seems to be relatively low. The results show both negative and positive correlations between environmental pollution and the interaction terms. The correlations of the interaction terms are small and statistically significant. The signs of the interaction terms with subsidiary profitability and value added per employee are not as expected in both samples. The interaction term with R&D intensity is positively correlated to environmental pollution in developing countries and has a small and negative correlation with the dependent variable in developed countries.

Tables III and IV present the regression results for the direct effect of FDI and the moderating effects of the three FSAs on environmental pollution. The negative and significant first-order serial correlation and a non-significant second-order serial correlation indicate that the assumption of no serial correlation in the differenced residuals is satisfied in all models. The results of the Sargan test of over-identifying restrictions show that the instruments used are uncorrelated with the error term in all models. In addition, the coefficients of the lagged environmental pollution variable confirm the significance of including this variable in all specifications, and the effect is quite similar and persistent, which is in line with what was expected.

In the GMM regression analysis reported in Table III, all the FSAs, as well as the foreign capital variable, are statistically significant at the 5 per cent level. The coefficient on foreign capital, which reflects outward FDI, has significant positive effects on environmental pollution in developing countries and significant negative effects on environmental pollution in developed countries, which follows the hypothesised directions. The GMM results

Sample Variable	Developing countries							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Environmental pollution	1							
Foreign capital	0.119*	1						
Subsidiary profitability	0.122*	0.323*	1					
Value added per employee	0.355*	0.449*	0.355*	1				
R&D intensity	0.229*	0.130*	-0.179*	-0.346*	1			
Subsidiary profitability x Foreign capital	-0.110*	-0.904*	-0.034	-0.279*	-0.291*	1		
Value added per employee x Foreign capital	0.185*	0.930*	0.357*	0.671*	-0.013	-0.768*	1	
R&D intensity x Foreign capital	0.278*	-0.534*	-0.360*	-0.454*	0.713*	-0.334*	-0.636*	1
Mean	1.033	1.583	-2.778	4.786	-1.832	-4.143	8.093	-2.916
Standard deviation	1.224	1.323	0.757	1.426	1.507	3.280	8.788	3.663
<i>Sample Variable</i>	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Environmental pollution	1							
Foreign capital	0.178*	1						
Subsidiary profitability	0.179*	0.004	1					
Value added per employee	0.206*	0.231*	0.251*	1				
R&D intensity	0.055	-0.115*	-0.134*	0.130	1			
Subsidiary profitability x Foreign capital	-0.119*	-0.918*	0.324*	-0.080	0.014	1		
Value added per employee x Foreign capital	0.167*	0.969*	0.074	0.397*	-0.087	-0.846*	1	
R&D intensity x Foreign capital	-0.097*	-0.496*	-0.225*	-0.126*	0.784*	0.316*	-0.510*	1
Mean	2.036	1.157	-3.147	4.806	-0.488	-3.693	5.866	-0.724
Standard deviation	0.418	0.921	0.767	0.712	0.784	2.941	5.102	1.363

Note: *Significant at 5 per cent; data are in logarithm

Environmental
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Table II.
Summary statistics
and correlations

Table III.
Direct effects of FDI
on environmental
pollution

Panel Model	Developing countries			Developed countries				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Independent variable								
Lagged environmental pollution	0.313* (0.012)	0.221* (0.016)	0.249* (0.015)	0.338* (0.011)	0.912* (0.009)	0.788* (0.020)	0.732* (0.017)	0.690* (0.018)
Foreign capital	0.019* (0.002)	0.021* (0.002)	0.014* (0.001)	0.051* (0.002)	-0.045* (0.003)	-0.052* (0.003)	-0.049* (0.004)	-0.048* (0.006)
Subsidiary profitability		0.008* (0.002)	0.008* (0.002)	0.001 (0.001)		0.026* (0.004)	0.023* (0.004)	0.022* (0.004)
Value added per employee			0.027* (0.004)	0.059* (0.002)			-0.052* (0.007)	-0.037* (0.010)
R&D intensity				0.012* (0.002)				-0.022* (0.005)
Observations	454	389	379	219	275	256	250	225
Sargan test ^a	47.791 (0.321)	49.312 (0.269)	49.670 (0.290)	31.288 (0.923)	32.922 (0.889)	32.466 (0.900)	32.377 (0.902)	27.953 (0.971)
AR(1) test ^b	-4.027*	-3.219*	-3.121*	-1.784*	-3.548*	-3.155*	-3.140*	-2.947*
AR(2) test ^c	-0.340	-0.592	-0.679	-0.987	-1.079	-1.050	-0.915	-0.843

Notes: Values in parenthesis under the coefficients are standard errors; ^aSargan test of over-identifying restrictions and valid specification, p -value is in parenthesis; ^{b, c} First- and second-order serial correlation tests; ^{*}Significant at 5 per cent

Panel Model Independent variable	Developing countries			Developed countries		
	(9)	(10)	(11)	(12)	(13)	(14)
Lagged environmental pollution	0.345* (0.010)	0.334* (0.003)	0.343* (0.013)	0.692* (0.022)	0.729* (0.027)	0.697* (0.022)
Foreign capital	0.082* (0.003)	-0.133* (0.015)	0.038* (0.005)	0.019* (0.010)	-0.155* (0.047)	-0.056* (0.004)
Subsidiary profitability	-0.010* (0.001)	0.003* (0.001)	0.001 (0.001)	-0.002 (0.003)	0.023* (0.005)	0.022* (0.002)
Value added per employee	0.049* (0.004)	-0.028* (0.011)	0.053* (0.005)	-0.042* (0.009)	-0.056* (0.020)	-0.037* (0.007)
R&D intensity	0.016* (0.001)	0.015* (0.002)	0.028* (0.003)	-0.017* (0.002)	-0.008 (0.006)	-0.010 (0.006)
Subsidiary profitability × Foreign capital	0.010* (0.001)			0.021* (0.002)		
Value added per employee × Foreign capital		0.041* (0.003)			0.021* (0.009)	
R&D intensity × Foreign capital			-0.008* (0.001)			-0.006* (0.002)
Observations	219	219	219	225	225	225
Sargan test ^a	30.110 (0.945)	30.845 (0.933)	31.684 (0.917)	23.847 (0.994)	26.029 (0.985)	26.787 (0.981)
AR(1) test ^b	-1.807*	-1.776*	-1.825*	-3.133*	-2.977*	-2.868*
AR(2) test ^c	-0.991	-0.979	-1.003	-1.015	-0.897	-0.818

Notes: Values in parenthesis under the coefficients are standard errors; ^aSargan test of over-identifying restrictions and valid specification, p -value is in parenthesis; ^{b, c} First- and second-order serial correlation tests; *Significant at 5 per cent

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Table IV.
Moderating effects of
FDI on
environmental
pollution

indicate that the environmental impact of FDI is generally larger in more developed countries than in less developed countries.

Consistent with the hypothesis that subsidiary profitability has a positive effect on environmental pollution, this explanatory variable is positively and significantly associated with environmental pollution in both groups of countries. In the two samples, value added per employee and R&D intensity are also positively and significantly associated with environmental pollution in developing countries, but negatively and significantly associated with the dependent variable in developed countries. Evidence is gathered to support the hypotheses that value added per employee and R&D intensity have positive (negative) effects on environmental pollution in developing (developed) host countries.

As presented in [Table IV](#), the main effect variables show generally similar results to those in the original model and those findings support our hypotheses. Foreign capital and value added per employee appear to have positive (negative) association with environmental pollution in developing (developed) host countries, whereas subsidiary profitability usually presents positive results in both samples. Finally, R&D intensity shows a positive and significant association with our dependent variable in developing countries, and a negative – but not always significant – association in developed countries. Although two of the coefficients of R&D intensity in the sample of developed countries yield no statistical significance, the directions of the findings support our hypotheses.

As shown in [Table IV](#), all the interaction coefficients are statistically significant. Two interaction terms have a positive sign, implying that (a) the positive effect of subsidiary profitability on environmental pollution appears to be higher in developed countries than in developing ones and (b) the positive effect of *value added per employee* \times *foreign capital* on environmental pollution is larger in developing countries than in developed ones. The latter has the largest effect and the former has the second largest effect on environmental pollution. The coefficient of the interaction term *R&D intensity* \times *foreign capital* seems to be negatively associated with environmental pollution in both samples, but is smaller in developed countries. Two results do not follow the hypothesised directions: the sign of the interaction term *R&D intensity* \times *foreign capital* is negative for developing countries and the sign of the interaction term *value added per employee* \times *foreign capital* is positive for developed countries. However, the positive and negative signs of the interaction effects give some supportive directions for our underlying hypotheses regarding the effect of the fit between FSAs and FDI on environmental pollution. The strength in the statistical significance makes this claim reliable.

Discussion of results

This paper examined the influence of US MNEs' overseas subsidiaries FSAs on environmental pollution. The results support *H1*. The results show that the coefficient of FDI is positive in developing countries, which brings evidence to support the PHH. This result is consistent with the finding of [Eskeland and Harrison \(2003\)](#). However, the coefficient of FDI is significantly negative in developed countries, indicating that FDI will reduce environmental pollution of the host country, which supports the PH in developed countries. This finding further highlights the importance of FDI flows from the US into developed countries ([Clegg, 1996](#)). This outcome might be explained as developed countries choose stronger environmental protection and specialise in relatively clean goods ([Copeland and Taylor, 1994](#)). Another explanation for this is that FDI originates from a developed economy, where the levels of technical efficiency and regulatory requirements are compatible, and these transnational linkages accelerate the international spread of environmentally beneficially innovations and hence improvements in environment-

efficiency (Perkins and Neumayer, 2008). As American firms possess advanced technology and can deploy their competitive advantage in host countries by engaging in arm's length environmental technology transfer directly through investments in subsidiaries, majority-owned foreign subsidiaries of US MNEs are more likely to receive the transfer of specialised high-tech content and knowledge in an efficient and complete manner due to the high level control of parent operations of US-based multinationals.

Overall, *H2* and *H5* are supported by the results for developing countries but the hypotheses are not validated for developed countries. Contrary to our expectation, subsidiary profitability moderates the relationship between foreign capital and environmental pollution, as both samples show a positive interaction effect between FDI and environmental pollution. One possible explanation for this finding is that overseas subsidiaries of US MNEs managed to exploit their FSA in both types of countries by taking into account CSR-based policies on a world-wide basis. As such, ERM practices are quite similar across the corporation, which leads to similar firm-base behaviour in developing and developed countries. This is in tune with previous findings (Cave, 2014).

H3 and *H6* concerning the technical efficiency of subsidiaries are validated, although *H6* is only partly validated. The results indicate that US subsidiaries are technologically more environmental-efficient in developed countries than in developing countries. However, the results obtained for the interaction term indicate that if value added per employee rises in both groups of countries environmental pollution augments more in developing countries than in developed countries. Although statistically significant, the magnitudes of the moderating effects of value added per employee are twice larger in the sample of developing countries in comparison to that of developed countries. As technology is easily transferred within the corporation, so are FSAs as well as ERM practices. As such, as "clean" technologies and production processes are made available by US MNEs' overseas subsidiaries, it is the relative prices of labour between the two groups of countries that make the difference. As a result, low labour cost destinations, such as less-developed countries, have production processes which are more labour intensive and more production efficient.

The hypothesised substantive influence of R&D spending on environmental pollution which is most likely to be using FDI with new technologies and innovations validates *H4* and partly *H7*. R&D-specific advantages deriving from proprietor know-how and technology of MNEs appear to be the primary factor for reducing environmental pollution in developed countries, which supports the finding of Fernández *et al.* (2018). It seems plausible to admit that developing countries tend to adopt environmental friendly technology in compliance to those that exist in "cleaner" economies, as a result this has important implications for companies working across borders. Yet, our results indicate that R&D intensity has a negative impact on environmental pollution in developing countries, which confirms that more stringent environmental regulation in developed countries *vis-à-vis* developing countries play an important role in reducing environmental pollution. This result may also indicate that the transfer of technology to developing countries that lack indigenous technology know-how and infrastructure to reduce environmental pollution is a necessary condition but not a significant one.

However, an interesting result is that R&D intensity moderates the relationship between FDI and environmental pollution in both developing and developed countries in such a way that environmental pollution decreases. This finding means that developing countries can obtain technology spillovers from FDI, and further verifies the existence of the PH. As such, one can claim that is the joint effort of MNEs that deploy their ERM practices, based on more stringent environmental policies, and the technology transfer within the MNE that really makes the difference. Moreover, it is consistent with the findings of Talukdar and

Meisner (2001) who show that the nature of enterprise ownership affect the environment. The result also supports some of the findings of Noailly and Ryfisch (2015) and complements their empirical evidence on the internationalisation of green R&D by MNEs. Overall, the findings support the view that multinationals become a vehicle for deploying cleaner technologies and promote more resource-efficient business activities. They demonstrate some empirical support for arguments made in the literature for public policy makers to promote strategies to attract R&D-intensive FDI through a policy mix of innovation policy and inward investment promotion.

Conclusions

This paper has empirically investigated how subsidiaries of multinationals from advanced economies investing in both developing and developed economies affect the host country's environment. We have focused on the direct effect of FDI and three moderating effects on environmental pollution. In so doing, we contribute to the ERM field and to the understanding of MNEs sustainable development strategies. This paper proposes some public policy recommendations.

The results support the idea that a dichotomous perspective between PHH and PH is very simplistic. On one hand, companies world-wide are deploying corporate-wide ERM practices, which favours the transfer of environmental technology and knowledge throughout the corporation and, on the other hand, stringent environmental regulations not only are facilitating the widespread of ERM practices within corporations but also are becoming more widespread across nations. As such, it is expected that progressively a more environment-friendly perspective will be deployed by MNEs as developing nations are also incorporating more stringent environmental policies.

Investment promotion agencies are being asked by their governments to actively look for ways to contribute to sustainable development. Therefore, this study offers some support to host government policies offering generous incentive packages to attract R&D-intensive FDI.

From a managerial perspective, the findings shed light on subsidiary' strategic decisions related to technology transfer and CSR. This is not to suggest that only technology is capable to affect the environment, but rather to indicate that firms need to understand that they can gain and sustain their competitive advantage while integrating environmental concerns into their corporate strategies by implementing cleaner production practices across their operations world-wide.

Nevertheless, this study also has limitations in that the empirical study was conducted using the samples of US subsidiaries only. This restricted the study to the behaviour of corporations from the US in several host countries, which hinders generalisations. The proposed empirical model may be more extensively tested with the samples including multiple-nationality parents in one or several host countries. We have only considered asset-based advantages in the US subsidiaries, and thus the environmental impact of FDI is treated only in terms of efficiency and market power effects. Other firm-specific characteristics, such as advantages of common governance capturing organisational effectiveness, and institutional advantages within the firm that govern the value-added processes in the multi-plant firm, might potentially reveal some missing transmission channels, or enable future research to model the underlying dynamics in a more elaborated way. Moreover, the study does not distinguish between equity and non-equity modes of entry in foreign markets. The environmental impact of FDI might be potentially bigger through non-equity entry modes, contractual agreements and outsourcing, as there is no direct presence in the host country and hence no environmental liability.

References

- Agarwal, S. and Ramaswami, S. (1992), "Choice of foreign market entry mode: Impact of ownership, location and internalization factors", *Journal of International Business Studies*, Vol. 23 No. 1, pp. 1-27.
- Albornoz, F., Cole, M.A., Elliott, R.J. and Ercolani, M.G. (2009), "In search of environmental spillovers", *World Economy*, Vol. 32 No. 1, pp. 136-163.
- Ambec, S. and Barla, P. (2002), "A theoretical foundation of the porter hypothesis", *Economics Letters*, Vol. 75 No. 3, pp. 355-360.
- Ambec, S. and Barla, P. (2006), "Can environmental regulations be good for business? An assessment of the porter hypothesis", *Energy Studies Review*, Vol. 14 No. 2, pp. 42-62.
- Ambec, S., Cohen, M.A., Elgie, S. and Lanoie, P. (2013), "The porter hypothesis at 20: Can environmental regulation enhance innovation and competitiveness?", *Review of Environmental Economics and Policy*, Vol. 7 No. 1, pp. 2-22.
- Antweiler, W., Copeland, B. and Taylor, M. (2001), "Is free trade good for the environment?", *American Economic Review*, Vol. 91 No. 4, pp. 877-908.
- Arellano, M. and Bond, S. (1991), "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations", *The Review of Economic Studies*, Vol. 58 No. 2, pp. 277-297.
- Bird, R., Hall, A., Momentè, F. and Reggiani, F. (2007), "What corporate social responsibility activities are valued by the market?", *Journal of Business Ethics*, Vol. 76 No. 2, pp. 189-206.
- Borensztein, E., Gregorio, J. and Lee, J. (1998), "How does foreign direct investment affect economic growth?", *Journal of International Economics*, Vol. 45 No. 1, pp. 115-135.
- Brambilla, I., Galina, H. and Cheryl, L. (2009), "Foreign direct investment and the incentive to innovate and imitate", *Scandinavian Journal of Economics*, Vol. 111 No. 4, pp. 835-861.
- Braunerhjelm, P. (1996), "The relation between firm-specific intangibles and exports", *Economics Letters*, Vol. 53 No. 2, pp. 213-219.
- Buckley, P. (2012), *Innovations in International Business*, Palgrave Macmillan, London.
- Buckley, P. (2016), "The contribution of internalisation theory to international business: New realities and unanswered questions", *Journal of World Business*, Vol. 51 No. 1, pp. 74-82.
- Buckley, P., Doh, J. and Benischke, M. (2017), "Towards a renaissance in international business research? big questions, grand challenges, and the future of IB scholarship", *Journal of International Business Studies*, Vol. 48 No. 9, pp. 1045-1064.
- Buckley, P. and Ghauri, P. (2004), "Globalisation, economic geography and the strategy of multinational enterprises", *Journal of International Business Studies*, Vol. 35 No. 2, pp. 81-98.
- Buckley, P. and Strange, R. (2011), "The governance of the multinational enterprise: insights from internalization theory", *Journal of Management Studies*, Vol. 48 No. 2, pp. 460-470.
- Buckley, P., Wang, C. and Clegg, J. (2007), "The impact of foreign ownership, local ownership and industry characteristics on spillover benefits from foreign direct investment in China", *International Business Review*, Vol. 16 No. 2, pp. 142-158.
- Bundell, R. and Bond, S. (1998), "Initial conditions and moment restrictions in dynamic panel data models", *Journal of Econometrics*, Vol. 87 No. 1, pp. 115-143.
- Cantwell, J. (1989), *Technological Innovation and Multinational Corporations*, Basil Blackwell, Oxford, United Kingdom.
- Cantwell, J., Dunning, J. and Janne, O. (2004), "Towards a technology-seeking explanation of US direct investment in the United Kingdom", *Journal of International Management*, Vol. 10 No. 1, pp. 5-20.
- Cave, A. (2014), "Environmentally responsible management in international business: a literature review", *Multinational Business Review*, Vol. 22 No. 1, pp. 78-102.

- Cetindamar, D. and Husoy, K. (2007), "Corporate social responsibility practices and environmentally responsible behavior: the case of the united nations global compact", *Journal of Business Ethics*, Vol. 76 No. 2, pp. 163-176.
- Christmann, P. (2000), "Effects of "best practices" of environmental management on cost advantage: the role of complementary assets", *The Academy of Management Journal*, Vol. 43 No. 4, pp. 663-680.
- Christmann, P. and Taylor, G. (2001), "Globalization and the environment: Determinants of firm self-regulation in China", *Journal of International Business Studies*, Vol. 32 No. 3, pp. 439-458.
- Christmann, P. and Taylor, G. (2006), "Firm self-regulation through international certifiable standards: determinants of symbolic versus substantive implementation", *Journal of International Business Studies*, Vol. 37 No. 6, pp. 863-878.
- Clegg, J. (1996), "United States foreign direct investment in the European community: the effects of market integration in perspective", in Burton, F., Yamin, M. and Young, S. (Eds.) *The Changing European Environment*, Macmillan, Macmillan, pp. 189-206.
- Cole, M. and Elliott, R. (2005), "FDI and the Capital intensity of "dirty" sectors: a missing piece of the pollution haven puzzle", *Review of Development Economics*, Vol. 9 No. 4, pp. 530-548.
- Constantatos, C. and Herrmann, M. (2011), "Market inertia and the introduction of green products: can strategic effects justify the porter hypothesis?", *Environmental and Resource Economics*, Vol. 50 No. 2, p. 267.
- Copeland, B. and Taylor, M. (1994), "North-South trade and the environment", *Quarterly Journal of Economics*, Vol. 109 No. 3, pp. 755-787.
- Dardati, E. and Saygili, M. (2012), "Multinationals and environmental regulation: Are foreign firms harmful?", *Environment and Development Economics*, Vol. 17 No. 02, pp. 163-186.
- Dowell, G., Hart, S. and Yeung, B. (2000), "Do corporate global environmental standards create or destroy market value", *Management Science*, Vol. 46 No. 8, pp. 1059-1074.
- Dunning, J. (1970), "The effects of United States direct investment on British technology", in Dunning, J.H. (Ed.) *Studies in International Investment*, George Allen and Unwin, London, pp. 345-400.
- Dunning, J. (1980), "Toward an eclectic theory of international production: Some empirical tests", *The International Executive*, Vol. 22 No. 3, pp. 9-31.
- Dunning, J. (1991), "The eclectic paradigm of international production: a personal perspective", in Pitelis, C.N. and Sugden, R. (Eds.) *The Nature of Transnational Firm*, Routledge, United Kingdom.
- Dunning, J. (1998), "The eclectic paradigm of international production: a restatement and some possible extensions", *Journal of International Business Studies*, Vol. 19 No. 1, pp. 1-31.
- Dunning, J. and Fortanier, F. (2007), "Multinational enterprises and the new development paradigm: consequences for host country development", *Multinational Business Review*, Vol. 15 No. 1, pp. 25-46.
- Dunning, J. and Narula, R. (1995), "The R&D activities of foreign firms in the United States", *International Studies of Management and Organization*, Vol. 25 Nos 1/2, pp. 39-74.
- Dunning, J. and Pearce, B. (1981), *Profitability and Performance of the World's Largest Industrial Companies*, Economists Advisory Group, London.
- Engle, R. (2007), "Corporate social responsibility in host countries: a perspective from American managers", *Corporate Social Responsibility and Environmental Management*, Vol. 14 No. 1, pp. 16-27.
- Eskeland, G. and Harrison, A. (2003), "Moving to greener pastures? multinationals and the pollution haven hypothesis", *Journal of Development Economics*, Vol. 70 No. 1, pp. 1-23.
- Fernández, Y.F., López, M.F. and Blanco, B.O. (2018), "Innovation for sustainability: the impact of R&D spending on CO2 emissions", *Journal of Cleaner Production*, Vol. 172, pp. 3459-3467.

- Frankel, J. and Rose, A. (2005), "Is trade good or bad for the environment? sorting out the causality", *Review of Economics and Statistics*, Vol. 87 No. 1, pp. 85-91.
- Gunningham, N. (2009), *Corporate Environmental Responsibility*, Routledge, United Kingdom.
- Hansen, M. (1998), Transnational corporations in sustainable development: an appraisal of the environmental implications of foreign direct investment in less developed countries, Copenhagen: Copenhagen Business School Ph.d.-serie 3.
- Haskel, J., Pereira, S. and Slaughter, M. (2007), "Does inward foreign direct investment boost the productivity of domestic firms?", *The Review of Economics and Statistics*, Vol. 89 No. 3, pp. 482-496.
- Holtz-Eakin, D. and Selden, T. (1995), "Stoking the fires? CO2 emissions and economic growth", *Journal of Public Economics*, Vol. 57 No. 1, pp. 85-101.
- Jaffe, A., Peterson, S., Portney, P. and Stavins, R. (1995), "Environmental regulation and the competitiveness of US manufacturing: what does the evidence tell us?", *Journal of Economic Literature*, Vol. 33 No. 1, pp. 132-163.
- Jorgenson, A. (2007), "Does foreign investment harm the air we breathe and the water we drink?", *Organization and Environment*, Vol. 20 No. 2, pp. 137-156.
- Keller, W. and Levinson, A. (2002), "Pollution abatement costs and foreign direct investment inflows to the US states", *Review of Economics and Statistics*, Vol. 84 No. 4, pp. 691-703.
- Kolk, A. (2010), "Social and sustainability dimensions of regionalization and (semi)globalization", *Multinational Business Review*, Vol. 18 No. 1, pp. 51-72.
- Kolk, A. (2015), "The role of international business in clean technology transfer and development", *Climate Policy*, Vol. 15 No. 1, pp. 170-176.
- Kolk, A. and Fortanier, F. (2013), "Internationalization and environmental disclosure: the role of home and host institutions", *Multinational Business Review*, Vol. 21 No. 1, pp. 87-114.
- Kolk, A. and Pinkse, J. (2008), "A perspective on multinational enterprises and climate change: Learning from "An inconvenient truth?"", *Journal of International Business Studies*, Vol. 39 No. 8, pp. 1359-1378.
- Kolk, A. and Van Tulder, R. (2010), "International business, corporate social responsibility and sustainable development", *International Business Review*, Vol. 19 No. 2, pp. 119-125.
- Lundan, S. (2010), "What are ownership advantages?", *Multinational Business Review*, Vol. 18 No. 2, pp. 51-70.
- Madsen, P. (2009), "Does corporate investment drive a 'race to the bottom' in environmental protection? a reexamination of the effect of environmental regulation on investment", *The Academy of Management Journal*, Vol. 52 No. 2, pp. 1297-1318.
- Markusen, J. and Trofimenko, N. (2008), "Teaching locals new tricks: Foreign experts as a channel of knowledge transfers", *Journal of Development Economics*, Vol. 88 No. 1, pp. 120-131.
- Markusen, J.R. (1995), "The boundaries of multinational enterprises and the theory of international trade", *Journal of Economic Perspectives*, Vol. 9 No. 2, pp. 169-189.
- Mehmet, O. and Tavakoli, A. (2003), "Does foreign direct investment cause a race to the bottom?", *Journal of the Asia Pacific Economy*, Vol. 8 No. 2, pp. 133-156.
- Motta, M. and Thisse, J. (1994), "Does environmental dumping lead to delocation?", *European Economic Review*, Vol. 38 Nos 3/4, pp. 563-576.
- Nehrt, C. (1996), "Timing and intensity of environmental investments", *Strategic Management Journal*, Vol. 17 No. 7, pp. 535-547.
- Noailly, J. and Ryfisch, D. (2015), "Multinational firms and the internationalization of green R&D: a review of the evidence and policy implications", *Energy Policy*, Vol. 83, pp. 218-228.
- OECD (2002), *Foreign Direct Investment for Development. Maximising Benefits, Minimising Costs*, " , Organisation for Economic Cooperation and Development, Paris.

- OECD (2017), "Foreign direct investment and the pollution haven hypothesis - Evidence from listed firms", Economics Department Working Papers No. 1379, Organisation for Economic Cooperation and Development, Paris.
- Palmer, K., Oates, W. and Portney, P. (1995), "Tightening environmental standards: the benefit-cost or the no-cost paradigm?", *Journal of Economic Perspectives*, Vol. 9 No. 4, pp. 119-132.
- Perkins, R. and Neumayer, E. (2008), "Fostering environment-efficiency through transnational linkages? trajectories of CO2 and SO2, 1980-2000", *Environment and Planning A*, Vol. 40 No. 12, pp. 2970-2989.
- Pfaffermayr, M. (1999), "Ownership advantages, foreign production and productivity: Evidence from Austrian manufacturing firms", *Review of Industrial Organization*, Vol. 15 No. 4, pp. 379-396.
- Pinkse, J. and Kolk, A. (2012), "Multinational enterprises and climate change: Exploring institutional failures and embeddedness", *Journal of International Business Studies*, Vol. 43 No. 3, pp. 332-341.
- Porter, M. (1991), "America's green strategy", *Scientific American*, Vol. 264 No. 4, p. 168.
- Porter, M. and KRAMER, M. (2006), "The link between competitive advantage and corporate social responsibility", *Harvard Business Review*, No. 12, pp. 78-93.
- Porter, M. and Kramer, M. (2011), "Creating shared value", *Harvard Business Review*, Nos 1/2, pp. 97-118.
- Porter, M. and Van der Linde, C. (1995), "Toward a new conception of the environment-competitiveness relationship", *The Journal of Economic Perspectives*, Vol. 9 No. 4, pp. 97-118.
- Rugman, A., Oh, C. and Lim, D. (2012), "The regional and global competitiveness of multinational firms", *Journal of the Academy of Marketing Science*, Vol. 40 No. 2, pp. 218-235.
- Rugman, A. and Verbeke, A. (1992), "A note on the transnational solution and the transaction cost theory of multinational strategic management", *Journal of International Business Studies*, Vol. 23 No. 4, pp. 761-771.
- Rugman, A. and Verbeke, A. (1998), "Corporate strategy and international environmental policy", *Journal of International Business Studies*, Vol. 29 No. 4, pp. 819-833.
- Rugman, A. and Verbeke, A. (2004), "A perspective on regional and global strategies of multinational enterprises", *Journal of International Business Studies*, Vol. 35 No. 1, pp. 3-18.
- Siedschlag, I. and Zhang, X. (2015), "Internationalisation of firms and their innovation and productivity", *Economics of Innovation and New Technology*, Vol. 24 No. 3, pp. 183-203.
- Siripaisalpipat, P. and Hoshino, Y. (2000), "Firm-specific advantages, entry modes, and performance of Japanese FDI in Thailand", *Japan and the World Economy*, Vol. 12 No. 1, pp. 33-48.
- Smarzynska Javorcik, B. (2004), "Does foreign direct investment increase the productivity of domestic firms? in search of spillovers through backward linkages", *The American Economic Review*, Vol. 94 No. 3, pp. 605-627.
- Talukdar, D. and Meisner, C. (2001), "Does the private sector help or hurt the environment? evidence from carbon dioxide pollution in developing countries", *World Development*, Vol. 29 No. 5, pp. 827-840.
- Van Leeuwen, G. and Mohnen, P. (2017), "Revisiting the porter hypothesis: an empirical analysis of green innovation for The Netherlands", *Economics of Innovation and New Technology*, Vol. 26 No. 1-2, pp. 63-77.
- Wacker, K. (2016), "(When) should we use foreign direct investment data to measure the activities of multinational corporations? theory and evidence", *Review of International Economics*, Vol. 24 No. 5, pp. 890-999.

Appendix. List of countries used in the empirical study
**Environmental
impact of FDI**

Developed countries	Developing countries
Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom Australia, Canada, Japan, New Zealand, Norway and Switzerland	Algeria, Angola, Cameroon, Egypt, Gabon, Ghana, Guinea, Ivory Coast, Kenya, Liberia, Libya, Morocco, Nigeria and South Africa Azerbaijan, Bahrain, Bangladesh, Cambodia, China, Hong Kong, India, Indonesia, Iraq, Israel, Jordan, Kuwait, Lebanon, Macao, Malaysia, Macedonia, Pakistan, Philippines, Qatar, Russian Federation, Saudi Arabia, Serbia, Singapore, South Korea, Thailand, Turkey, Ukraine, United Arab Emirates and Vietnam Argentina, Bahamas, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Fiji, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Trinidad and Tobago, Uruguay and Venezuela

Table AI.
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