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Environmental regulation and international expansion of MNEs: The moderating role of pollution reduction resources and firm multinationality on location choice

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ABSTRACT

We examine how stronger environmental regulations influence MNE international expansion decisions by attending to two sources of firm heterogeneity that moderate this effect: possession of pollution reduction capabilities and firm multinationality. Empirical tests on 523 cases of international manufacturing expansion into 49 potential host countries by 124 Japanese chemical industry firms between 2001 and 2010 reveal that the market entry deterring effect of stronger environmental regulations is weaker for firms possessing unique capabilities for pollution reduction and for more multinational firms. Moreover, because more multinational firms have greater incentives and skills for modifying capabilities to create value in host-country environments, the positive moderating effect of PR-capabilities are strengthened yet further for high multinationality firms.

INTRODUCTION

Concern among politicians and business leaders that stronger environment regulations damage competitiveness and discourage firms from maintaining or establishing domestic operations continues to ensure that government efforts to improve environmental quality through regulation remain contentious. Deeper understanding of how environmental regulations influence the global location patterns of multinational enterprises (MNEs) is therefore an issue of clear practical importance. Curiously, however, and despite long-standing attention from management scholars to issues of international location choice, the role of environmental regulations in influencing those decisions has been neglected in management research (Christmann & Taylor, 2012; Madsen, 2009).

Addressing this gap is important in light of the fact that the bulk of academic studies on the impact of environmental regulations have been conducted at the national level, focusing on outcomes such as effects on overall productivity or economic growth (Jaffe, Peterson, Portney, & Stavins, 1995). However, a country-level focus is likely to overlook two critical factors for understanding firm responses to environmental regulation. The first is that heterogeneity among firms can engender substantially divergent responses to the same set of environmental regulations (Berrone, Fosfuri, Gelabert, & Gomez-Mejia, 2013; Delmas & Toffel, 2008). The second is that while environmental regulation is almost exclusively the purview of national (or sub-national) governments, the entities being regulated are multinational. MNEs inherently operate across a range of regulatory environments of varying stringency in terms of environmental performance requirements. Such institutional complexity substantially complicates the potential impact of regulations adopted by any one country (Kostova, Roth, & Dacin, 2008), creating opportunities for firms to benefit from both weak (Surroca, Tribo, & Waddock, 2010) and strong (Sharfman, Shaft, & Tihanyi, 2004) environmental performance.

In this study, we combine an institutional perspective with Teece's (2014) dynamic capabilities-based theory of the multinational enterprise to build on recent studies that have begun to highlight the importance of considering firm heterogeneity when assessing the impact of environmental regulations on firm behavior (Albrizio, Botta, Koźluk, & Zipperer, 2014; Berrone et al., 2013; Madsen, 2009). Specifically, we take up the question of how more stringent national environmental regulations influence the international expansion decisions of MNEs. We argue that while stronger environmental regulations may increase the costs and challenges associated with entering a given host country, these disadvantages are mitigated by the possession of valuable firm capabilities that reduce harmful environmental pollution and by the experience and arbitrage advantages accumulated by firms with a more substantial global footprint. Importantly, firm multinationality also shapes how firms develop and deploy resources globally.

More multinational firms will not only have more occasion to find pollution reduction capabilities valuable in multiple locations, the need to modify those capabilities across an increasing number of national regulatory environments engenders experience that will ease any potential transition into a new host with stronger environmental regulations, further weakening any negative influence of stronger regulations on potential host country attractiveness.

Empirical tests using a sample of 523 instances of foreign expansion for new manufacturing facilities by 124 Japanese firms in the chemical industry between 2001 and 2010 provide support for our arguments. These results prove robust to reasonable variation in model specification, sampling and estimation strategies.

This study makes several contributions to management research. First, we answer the call from international management (IM) scholars to capitalize upon the relative advantages of the IM perspective for understanding how firm heterogeneity weighs on the relationship between environmental regulations and location choice (Christmann & Taylor, 2012). Attending to firm differences allows for more granular understanding of the phenomenon than has been provided by research focusing on national level outcomes. Moreover, such an approach allows for better understanding of when stronger regulations might have positive outcomes. Perspectives on the effects of stronger regulation can be broadly classified into two viewpoints. One, the "race to the bottom" perspective argues that challenges associated with complying with stronger environmental regulations will increase the costs of conducting business, leading firms to seek locations with less stringent and burdensome environmental requirements. Conversely, what has come to be known as the Porter hypothesis, argues that stronger environmental regulations will induce firms to innovate, in turn leading to the development of capabilities providing competitive advantage over rivals from weaker environmental domains. However, by failing to attend to the differential impact of environmental regulation across firms, neither perspective considers the potential for such regulations to be a net positive, at least for some firms, based on their extant (rather than potential future) environmental capabilities. The IM perspective adopted in the present study allows us to overcome these limitations and provide new insights on the phenomenon.

This study also contributes to management research on firm location choice where studies considering how national regulation influences location choice have focused predominantly on the effects of characteristics of the regulatory environment that create contractual hazards (e.g. Coeurderoy & Murray, 2008; Delios & Henisz, 2003; Holburn & Zelner, 2010). While attention to contractual hazards follows logically from the importance of internalization theory to international management (IM) research

(Buckley & Casson, 1976; Hennart, 1982), contractual hazards comprise only part of the story (Teece, 2014). As Teece (2014) articulates, the relevance of firm capabilities in a particular potential host constitute a relatively overlooked dimension of location choice. This oversight is particularly salient in light of the fact that the value of resources is, to a substantial degree, externally determined (Barney, 1991; Priem & Butler, 2001). To the extent that the policy choices influence the value of specific firm resources, such as the pollution reduction technologies examined in this study, greater attention to the combinatorial effects of regulatory content and firm resources on location choice is called for.

Empirically, our use of patents to measure firm-specific capabilities for pollution reduction constitutes an advance on prior research. Patents provide a clearer, more objective indication of firm capabilities than studies that rely on less precise and potentially biased survey measures (e.g. Christmann, 2004). They also better capture firm capabilities that are simultaneously rare, valuable and inimitable (Barney, 1991) than the use of ISO 14001 adoption (e.g. Delmas & Toffel, 2008; Madsen, 2009), which is often adopted ceremonially, having minimal impact on actual firm operations (Boiral, 2007). The use of patents also represents an advance over studies that infer firm-level characteristics deriving from features of the home-country institutional environment, such as home-country regulatory stringency (e.g. Madsen, 2009)—an important consideration in light of the failure of prior studies to find a relationship between home-country conditions and pollution by foreign subsidiaries (King & Shaver, 2001).

Practically, our results allow us to weigh in on discussion between and among firm managers and policy makers regarding the effects that strengthening environmental regulatory regimes may have on firm and national competitiveness.

THEORY AND HYPOTHESES

International expansion and firm capabilities

Firm capabilities influence how firms expand and diversify (e.g. Chatterjee & Wernerfelt, 1991; Helfat & Lieberman, 2002). Firms are more likely to enter new lines of business in which extant capabilities can be profitably deployed (Silverman, 1999). A similar logic applies to decisions regarding geographic expansion. Because firm success in foreign markets derives largely from the ability to deploy valuable resources in ways that competitors cannot imitate, firm capabilities constitute an important constraint on (and enabler of) market entry (Teece, 2014). At a minimum, the value of firm capabilities in a foreign market needs to compensate for inherent liabilities of operating in different and unfamiliar environments (Hymer, 1976;

Zaheer, 1995) in order to justify international expansion (Buckley & Casson, 1976; Dunning, 1988; Hennart, 1982).

While some firm capabilities create value regardless of where they are deployed, others—including valuable technologies and fundamental know-how underlying the ability to provide a particular product or service—tend to be more specialized, creating heterogeneity in terms of the ability of resources to create value across geographic locations (Helfat & Lieberman, 2002; Teece, 1986). Accordingly, the relevance of firm capabilities in a specific foreign market is an important influence on which countries firms elect to enter (Teece, 2014). Further, to the extent that the value of firm capabilities is externally determined (Barney, 1991; Priem & Butler, 2001), differences in characteristics of national environments can be expected to induce variation in the value of firm capabilities across potential host countries.

Below, we detail how national environmental regulations constitute one such source of variation in the value of firm capabilities across potential host countries. Because environmental regulations cover pollution that occurs within a country, our analysis concerns firm expansion decisions where the established subsidiaries are likely to generate pollution. Most pollution for which firms are directly responsible is emitted during the manufacturing process. Consequently, environmental regulations are more salient to decisions regarding the siting of manufacturing operations than, say, the siting of subsidiaries engaged in marketing or distribution of imported goods produced elsewhere. We therefore focus our analysis on international expansion of manufacturing activities.

Environmental regulation and host-country attractiveness

Environmental regulations set the minimal acceptable environmental performance for firms operating within a jurisdiction. Failure to comply with national environmental regulations can lead to the imposition of fines or other legal sanctions on a subsidiary's activities, weakening its competitive position. Beyond issues of legality, compliance also helps firms address challenges with establishing and maintaining their legitimacy in host nations (Kostova & Zaheer, 1999). Foreign firms can be targets of increased scrutiny from the local public as well as regulators (Hymer, 1976). Such increased scrutiny is especially likely in the context of environmental issues, where the effects of pollution can have direct and drastic impacts on the health of the local population in addition to the natural environment. Failure to comply with environmental regulations can therefore precipitate social as well as legal sanctions (Deephouse, 1996).

Stronger environmental regulations set lower limits for various types of pollution that may be discharged into the environment. Hart (1995) describes two general approaches for meeting such

requirements. Firms can attempt to *control* their emissions directly through the use of pollution-control equipment capable of trapping, storing, treating and disposing the pollutant. Alternatively, firms can attempt to *prevent* emissions through such means as the modification of existing or development of new processes, routines and technologies.

Pollution control approaches require the firm to purchase, install and operate new equipment. Such an approach imposes costs—sometimes substantial—while failing to provide a means to improve productivity and performance (Hart, 1995). Indeed, rather than improve productivity, adopting pollution control measures can reduce incentives to scrutinize extant routines and processes for inefficiencies that reduce waste and enhance productivity, weakening financial performance (King & Lenox, 2002). Further, applying pollution control measures to extant firm processes and routines can interfere with their operation, thereby weakening the performance (and value) of current capabilities. For example, Klassen and Whybark (1999) found that more extensive use of pollution control reduced firm manufacturing performance.

The desire to avoid the drawbacks of adoption pollution control measures are particularly salient in the context of international expansion where, in addition to limiting the level of pollution emissions, stricter regulations often cover *how* firms comply with those limits as well. For example, national governments may require the use specific technologies or the adoption of particular processes for reducing various forms of pollution. Mandating specific approaches to compliance can create obstacles to market entry by foreign firms, a desirable outcome when, as often happens, environmental regulations are used to shelter domestic industry (Vogel, 1997; Vogel & Rugman, 1997). The costs associated with pollution control decrease the potential value of firm resources in a given country, working to reduce its attractiveness as a potential host.

In contrast to pollution control approaches, pollution reduction can precipitate financial performance improvements (Hart, 1995; King & Lenox, 2002). Indeed, one of the preeminent arguments for the case that stronger regulations benefit, rather than hurt firms, is that such regulations induce the development of new and valuable capabilities (Porter & van der Linde, 1995). However, managerial biases and concerns about the time frames for payback to investments improving environmental performance lead firms to systematically underinvest in development of PR-capabilities (Berchicci & King, 2007; Marcus, Geffen, & Sexton, 2002; McWilliams & Siegel, 2001). Managers desiring strategic flexibility and biased against investments to improve environmental performance are unlikely to choose a market based on the potential benefits of being forced by local regulations to develop new environmental capabilities.

Rather, in the context of international expansion decisions, firms prefer countries where their *existing* capabilities and resources already meet the resource requirements for successful market entry (Helfat & Lieberman, 2002).

Even in firms that possess PR-capabilities, it is the general competitive capabilities unrelated to pollution reduction (non-PR-capabilities) that are central to competitive advantage (Kolk & Pinkse, 2008). The stronger the environmental regulations of a potential host, the greater the likelihood that entry will necessitate the implementation of pollution control or prevention measures that will diminish the net benefits to the firm from deploying its present FSAs in the potential host. All things being equal, given the choice between entering a country that requires supplementation to or modification of non-PR capabilities or limits their value and one that does not, firms will prefer the latter.

Hypothesis 1: Stronger national environmental regulations discourage MNEs from entering a potential host country.

Environmental regulation and pollution-reduction capabilities

Competitive performance is dictated by the possession of core capabilities which are only rarely explicitly connected to environmental performance (Kolk & Pinkse, 2008). Nonetheless, for various reasons and to varying degrees firms do develop capabilities designed to lessen the negative environmental impacts on their activities. Such capabilities provide several important benefits when it comes to complying with host-country environmental regulations. To the extent that PR-capabilities enable compliance with the relevant regulations, compliance and liability costs are mitigated. PR-capabilities may obviate the need to install costly pollution control equipment and can precipitate direct costs savings through lowering the costs of raw material inputs that would become waste pollution as well as the costs associated with disposal of pollutants (Hart & Ahuja, 1996). Finally, PR-capabilities also spur improved efficiency of both material input and firm asset use (Hart & Ahuja, 1996; Porter & van der Linde, 1995; Schmidheiny, 1992; Smart, 1992) that can better position the firm competitively with respect to local competitors.

Firms with more extensive PR-capabilities are more likely to possess the requisite capabilities for compliance with increasingly stringent levels of environmental regulation. Further, the ability to tout the use of state-of-the art pollution reduction technology can also help to enhance local legitimacy. Even where national environmental regulations contain provisions mandating the form of compliance approach, firms with more extensive PR-capabilities will be better positioned in terms of possessing the underlying

skills and knowledge necessary to meet those demands. Although the value of non-PR-capabilities in a host may be weakened by stronger environmental regulation, those costs will be counter-balanced to at least some extent by the possession of PR-capabilities that increase the ease and reduce the costs of compliance with national environmental regulatory regimes. Madsen (2009) has shown that generic, non-firm specific environmental capabilities can mitigate the effects of stronger environmental regulation. Such effects can be expected to be stronger in the case of firm-specific PR-capabilities, which better position firms to benefit competitively relative to rivals.

More extensive development of PR-capabilities also engenders a shift in managerial thinking about environmental regulation. When firms develop experience in a particular area of technology, they become better positioned to develop further innovations in the same domain (Fleming & Sorenson, 2001; Teece, Pisano, & Shuen, 1997). Development of pollution reduction capabilities leads to the accumulation and dissemination of knowledge relevant to pollution reduction throughout the firm (Lapre, Mukherjee, & Van Wassenhove, 2000). Moreover, because the knowledge related to pollution reduction is tacit (and often causally ambiguous), the accumulation of such knowledge among a firm's employees leads to the development of yet more capabilities increasingly likely to be valuable, rare and difficult to imitate (Barney, 1991; Hart, 1995). As this process proceeds, competing based on environmental performance becomes an increasingly viable strategic approach for improving overall firm performance.

As awareness among firm management regarding how pollution reduction efforts can improve competitive performance accumulates, firms become increasingly active in seeking out opportunities to profitably use PR-capabilities (Berchicci & King, 2007). From this perspective, stronger environmental regulations can function as a type of strategic asset that complements existing PR-capabilities (Dunning, 1998) allowing firms to extract more value from these assets, by increasing their potential cost and efficiency advantages vis-a-vis local competitors and decreasing legitimacy challenges associated with operating in a foreign environment.

In sum, the development of more extensive PR-capabilities, not only helps to mitigate the negative effects of environmental regulation on non-PR capabilities, but leads firms shift from perceiving environmental regulation as a constraint to be avoided to being an opportunity to be sought out.

Hypothesis 2: Firm capabilities for reducing pollution will positively moderate the effect of national environmental regulations such that the entry-deterring effect of stricter protections is weaker for firms with more extensive PR-capabilities.

Environmental regulation and firm multinationality

In addition to PR-capabilities, firm multinationality represents another source of firm heterogeneity that will condition how firms perceive environmental regulations when considering international expansion. The negative influence of stronger environmental regulations on host country attractiveness is likely to be less significant in firms with a more extensive global presence for several reasons. First, international expansion engenders experiential learning that enables firms to reduce costs associated with newness and foreignness when they make subsequent new market entries (Hymer, 1976). As firms gain experience establishing subsidiaries in new locations, they become better attuned to salient features of new institutional environments likely to bear on their operations (Lu & Beamish, 2004). More multinational firms are therefore not only more likely to recognize local conditions likely to influence firm performance, but have the experience in modifying and localizing capabilities to address those conditions. Accordingly, the negative influence on the value of non-PR capabilities will be offset to some extent by experience with new country entry.

More multinational firms also operate in more diverse national institutional environments. This increases the likelihood firms will have experience operating in an institutional environment at least similar to that of a potential host country, working to lower the institutional distance and the associated challenges such distance creates for market entry (Ghemawat, 2007; Madsen, 2009). As Henisz (2003) describes, even when the institutional environments of subsidiary host countries are not identical, more extensive international experience enables firms to develop general routines for managing regulatory challenges. Such experience will mitigate the entry-deterring effect of stronger environmental regulations on market entry.

Finally, operating across a more extensive diversity of environments opens up possibilities for firms to engage in institutional arbitrage (Ghemawat, 2007; Hennart, 2011). Operating in a greater number of countries exposes an MNE to weaker as well as stronger environmental regulatory regimes. To the extent an MNE conducts operations in a host with a more permissive regulatory environment, it may be able to concentrate, in that host, activities that would conflict with environmental regulations elsewhere. For example, Surroca and colleagues (2010) found that stakeholder pressure in one country induced MNEs to transfer socially irresponsible practices from that country to its foreign subsidiaries. To the extent an MNE's global footprint allows it to enter a potential host nation without conducting activities

that conflict with local environmental regulations, such regulations will bear less strongly on international location decisions.

Hypothesis 3: Firm multinationality will positively moderate the effect of national environmental regulations such that the entry-deterring effect of stricter protections is weaker for more multinational firms.

Pollution-reduction capabilities and firm multinationality

Firm multinationality will also influence the nature of PR-capability development and deployment. The attractiveness of a potential host country is shaped not only by the relevance of its capabilities in that market but by the challenges associated with transferring a firm's capabilities to the host as well as (Teece, 2014). In this regard, two characteristics of more multinational firms will facilitate the ability of firms to create value from PR-capabilities in foreign markets, further weakening the entry-deterring effect of stronger environmental regulation.

First, more multinational firms are more likely to develop what Rugman and Verbeke (2001) term "nonlocation-bound" PR-capabilities—that is, capabilities that "can be exploited globally" (Rugman & Verbeke, 2001: 241). Firms with a larger international footprint find it more beneficial to develop nonlocation bound PR-capabilities as a means to reduce the inherent complexity and uncertainty of operating in multiple institutional environments (Aragon-Correa & Sharma, 2003; Sharfman et al., 2004). More multinational firms are increasingly at risk to confront pressure from both home- and host-country stakeholders to comply with environmental performance expectations (Sharfman et al., 2004). Standardizing PR-capabilities at a high level can help firms to manage those demands while simultaneously confronting the inherent challenges of maintaining legitimacy across divergent institutional contexts (Kostova & Zaheer, 1999). Accordingly, researchers have documented how more multinational firms are more likely to have uniform environmental practices across their global operations (Christmann, 2004; Dowell, Hart, & Yeung, 2000). The tendency toward development of nonlocation-bound PR-capabilities means that such capabilities align with the requirements of any particular host, rendering stronger environmental regulations in any specific host less relevant to location choice.

PR-capabilities are frequently incentivized through government regulations (Jaffe, Newell, & Stavins, 2005; Marcus, 1980). Accordingly, many PR-capabilities are initially location-bound. Difficulties of adapting pollution reduction technologies to the unique demands of foreign environments (King &

Shaver, 2001), can lead PR-capabilities remain location-bound (Kolk & Pinkse, 2008). However, even PR-capabilities originally developed for a specific country only remain location-bound over time under relatively unique circumstances. In particular, it must remain true that restricting the use of a PR-capability to a single (or limited number of) location(s) does not have a negative impact on firm performance (Rugman & Verbeke, 2001)—that is, there are no opportunities to beneficially deploy the capability in other locations. As firms expand their operations into more countries, such conditions become less likely to hold. Firms with a larger international footprint operate in an increasingly diverse range of environmental regulatory environments and are therefore more likely to find PR-capabilities to be of use beyond a single location when it comes to compliance with local environmental regulations (Sharfman et al., 2004).

A second mechanism by which firm multinationality enhances the benefits of PR-capabilities is that more multinational firms possess more experience in modifying these capabilities to unique requirements across countries. Given that using a PR-capability in a new country is likely to require at least some degree of modification (King & Shaver, 2001), firms develop experience in adapting their PR-capabilities to unique country circumstances, with such experience accumulating more extensively as firms extent operations abroad. Characteristics of the knowledge underlying the capabilities (Jensen & Szulanski, 2004; Kogut & Zander, 1993), institutional barriers to capability transfer (Cuervo-Cazurra, Maloney, & Manrakhan, 2007) and differences in the level of infrastructure development (Tsai & Child, 1997) can all increase the difficulty of capability transfer and necessitate modification or adaptation. The challenges associated with capability transfer are particularly acute in the context of transferring PR-capabilities (Kolk & Pinkse, 2008). More multinational firms will therefore possess skills that facilitate deployment of PR-capabilities in new contexts. By contrast, PR-capabilities developed in one country are less likely to be relevant elsewhere when MNEs operate in a limited number of foreign environments. In any event, such firms will have less experience in modifying PR-capabilities for foreign environments. These considerations suggest our final hypothesis.

Hypothesis 4: The positive moderating effect of pollution-reduction capabilities on the entry-deterring effect of stricter national environmental regulations is stronger in more multinational firms.

DATA AND METHODS

Sample and Data

To assess how environmental regulations influence international expansion decisions, we employ data from the *Kaigai Shinshutu Kigyou Souran* database (Overseas Japanese companies) provided by Toyo Keizai (OJC). The OJC database provides information on each foreign subsidiary, including its parent firm, location, business scope, industry, and foundation year. We limit our sample to firms from the chemical industry (Japan SIC between 1600 and 1699). Important differences exist across industries in terms of both the relative propensity to (and importance of) patent(ing) new technologies. The extent to which firm operations create pollution and to which environmental regulations are likely to bear on those activities can also vary substantially across industries. Focusing on the chemical industry limits the sample to firms for which patenting is prominent and for which environmental regulations are salient. Moreover, international investment tends to be prominent in the chemical industry, accounting for roughly 12% of all greenfield FDI projects in manufacturing over the decade through 2012 (UNCTAD, 2015).

Because our research question concerns *where* firms choose to locate as opposed to *whether* they elect to make a foreign investment, we limit the sample to years in which firms establish a new foreign manufacturing subsidiary. The final sample comprises 357 firm-expansion-years in which a Japanese chemical firm established at least one new foreign manufacturing subsidiary. In some cases, firms established new manufacturing facilities in more than one host country in a given year. In total, the sample comprises 534 instances where one of 124 Japanese chemical industry firms in the OJC established a new foreign manufacturing subsidiary. For each firm-expansion-year, the base choice set of potential locations for establishment of a new manufacturing subsidiary comprises all countries hosting at least one manufacturing subsidiary of at least one Japanese chemical firm in our sample over the ten-year (2001-2010) sample period. There were 49 such countries in our sample for which data were available.[1]

Measures

Dependent variable. Country Entry is a binary indicator set to one when a firm establishes a new manufacturing subsidiary in a host country (zero, otherwise). We identified manufacturing subsidiaries by referring to the description of the business scope of each subsidiary provided in the OJC. We then

[1] The 49 countries: Australia, Austria, Bangladesh, Belgium, Brazil, Brunei, Canada, China, Colombia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, India, Indonesia, Ireland, Israel, Jordan, Luxembourg, Malaysia, Mexico, Netherlands, New Zealand, Pakistan, Philippines, Poland, Portugal, Russia, Saudi Arabia, Singapore, Slovak Republic, South Africa, South Korea, Spain, Sri Lanka, Sweden, Switzerland, Tanzania, Thailand, Turkey, United Arab Emirates, United Kingdom, United States, Venezuela, Vietnam

employed structured content analysis (Jauch, Osborn, & Martin, 1980; Yu & Cannella, 2007). First, 1,000 foreign subsidiaries were randomly selected for the identification of foreign subsidiary activities. Second, the authors read all the descriptions of the business scope of these foreign subsidiaries and generated a list of keywords that are likely to indicate manufacturing-related activities. These keywords were generated based on interviews conducted with Japanese practitioners with experience working abroad. The set of keywords was then applied to the complete list of business scope descriptions in the OJC through a combination of computer aided and human coding to identify which subsidiaries were engaged in manufacturing activities.

Independent variable. Direct measurement of environmental regulations over time and across countries is challenging (Albrizio et al., 2014). Within countries, myriad laws cover environmental protection. Relevant laws can vary across industries and types of pollution. Typically, both the content of laws and extent of enforcement evolve and change over time. Across countries, the set of relevant environmental laws differs substantially in both form and substance. Further complicating measures of environmental regulatory stringency is the fact that even when protective laws exist "on the books," weak enforcement can limit their effectiveness in practice. Esty and Porter (2005) provide evidence that the stringency of a country's environmental regulatory regime is closely related to cross-national differences in environmental performance. We therefore turned to measures of national environmental performance to serve as an indicator of environmental regulatory stringency. Looking at environmental performance outcomes provides the additional advantage of accounting for the extent to which environmental regulations are actually enforced, better capturing their influence on firm behavior.

One of the most comprehensive efforts to measure national environmental performance across a large number of countries is the Environmental Performance Index (EPI) developed by the Yale Center for Environmental Law and Policy and Columbia University Center for International Earth Science Information Network, Columbia University in collaboration with the World Economic Forum and Joint Research Centre of the European Commission (Emerson et al., 2012). The 2012 EPI tracks 22 environmental performance indicators across a range of policy categories measuring the effects pollution on human and ecosystem health for 132 countries. The 2012 EPI also provides historical annual indicators of environmental performance going back to 2000. We use a country's overall EPI score as our measure national environmental regulatory stringency—*EPI*.

Moderating variables. We measure PR-capabilities by referencing firm patents. To measure firm pollution reducing patents we first obtain the set of patents granted by the Japan Patent Office (JPO) to

the sample firms using the Institute of Intellectual Property (IIP) Patent Database (Goto & Motohashi, 2007). To identify which of the granted patents in the IIP database are related to pollution reduction we use the CleanTech PatentEdge (CTPE) database provided by IP Checkups—a private research firm. The CTPE database provides a comprehensive description of patents filed at major global patent offices (including JPO) covering technologies that mitigate negative environmental externalities and has been used by other scholars investigating similar issues, such as the development of renewable energy technologies (e.g. Nanda, Younge, & Fleming, 2013). We define pollution reduction patents as those identified by IP Checkups to reduce air or water pollution, improve waste treatment or improve manufacturing and industrial processes. *Pollution Reduction Patents* is a count of the number of pollution reduction patents granted to the sample firm over the previous four years—based on prior research to account for the greater relevance of more recent patents.[2]

We define firm multinationality based the number of counties in which a firm operates (Lu & Beamish, 2004; Tallman & Li, 1996). *Country Scope* is count of the number of countries in which a sample firm has manufacturing subsidiaries in a given year.

Control Variables. In addition to the stringency of national environmental regulations, the degree of economic and institutional development also weigh on a country's environmental performance (Esty & Porter, 2005). Because these factors simultaneously play a role in shaping the relative attractiveness of host countries, it is necessary to control for their influence. We therefore include a measure of *GDP per capita* (constant US dollars) to capture the overall level of economic development. To control for the level of institutional development we include a measure of *Government Effectiveness* developed by Kaufman and colleagues (2009; 2000) from the World Bank's Governance Matters database. This measure captures "perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies" (Kaufmann et al., 2009: 6).

We control for three measures of host-country attractiveness. Host country *GDP* (constant billion US dollars) is included as a measure of overall market size. The annual percentage change in *GDP Growth* accounts for recent trends in economic conditions. Total net inflows of foreign direct investment (*FDI*) (constant billion US dollars) control for general market attractiveness and openness to foreign investment. These three variables and *GDP per capita* come from the World Development Indicators Database provided by the World Bank. As a final country-level control, we include the *Geographic Distance*

[2] Results are robust to varying this measure from three and five years

(kilometers) from Japan to account for dimensions of market attractiveness stemming from proximity to the home market. This measure is taken from the GeoDist database provided by the Centre d'Etudes Prospectives et d'Informations Internationales.

At the firm-level, we control for two characteristics that may influence both location decisions and pollution reduction technology development. *Size* is a measure of annual sales (10 billion Japanese Yen). *R&D Intensity*—measured as annual firm R&D expenditure divided by annual sales—captures the extent to which firms emphasize technological competition and prioritize development of new technological resources. Data for both measures come from Nikkei Financial Quest. To account for the potential influence that current operations in a potential host country may have on the relative attractiveness of the host, we include an annual count of the total number of firm subsidiaries in each potential host country (*Number Country Subsidiaries*). Data for this measure come form the OJC database. Finally, to account for general time effects we include a set of year dummy variables. All right-hand-side variables are lagged by one year.

Estimation Strategy

As described above, our data are structured to examine where firms choose to expand internationally, conditional on the decision to establish a foreign manufacturing subsidiary. Because we employ a discrete dependent variable to indicate which host countries firms select for foreign manufacturing expansion, a logit model is appropriate for testing our hypotheses. In order to account for the fact that observations within firms are not independent, we cluster standard errors at the firm-level.

This study is centrally concerned with the moderating effects of PR-capabilities and firm multinationality on the influence of environmental regulations. Because coefficient estimates do not represent marginal effects in non-linear models, care must be taken when interpreting estimation results (Hoetker, 2007; Shaver, 2007). Accordingly, we assess the moderating relationships in two ways. First, we follow Zelner and Holburn (2010) who employ a simulation-based approach developed by King and colleagues (2000) to plot, and test for the significance of, the difference in predicted probabilities of country entry across levels of environmental regulatory stringency in firms with high and low levels of, respectively, PR-capabilities and multinationality. Second, we follow Hoetker (2007) and split the sample at meaningful levels of the moderating variables and compare the average marginal effect (AME) of environmental regulatory stringency across the subsamples. We defer additional description of these approaches to the results section.

RESULTS

Core results

Table 1 reports descriptive statistics and pair-wise correlations. The bivariate correlation of 0.83 between *GDP per capita* and *Government Effectiveness* stands out. Conceptually, this correlation is intuitive as economic and institutional development tend to go hand-in-hand (North, 1981). Multicollinearity diagnostic tests reveal that the largest individual variance inflation factor (VIF) is 3.79, and the average VIF is 1.82, both sufficiently below threshold levels where multicollinearity becomes a concern (Belsley, Kuh, & Welsch, 1980).[3]

———*Insert Table 1 around here*———

Results of logistic regression estimations are reported in Table 2. Column 1 reports results for control variables only. Results align with intuition. Firms are more likely to locate manufacturing subsidiaries in countries with larger markets, stronger economic growth and better regulation that are more geographically proximate. At the firm level, firms are more likely to establish new manufacturing facilities in countries where they already have an established presence. Column 2 adds *EPI* and the two moderating variables—*Pollution Reduction Patents* and *Country Scope*. Here, we do not find support for Hypothesis 1, which argued that stronger environmental regulation discouraged market entry. Not only is the coefficient estimate not significant, it is positive, opposite the prediction. This results comports with extant research examining the influence of environmental regulation on FDI (Madsen, 2009) and suggests the importance of investigating contingencies through which EPI may be relevant to international location decisions.

———*Insert Table 2 around here*———

[3] Nonetheless, because economic and institutional development are so tightly linked, we reestimate our main specifications: 1. without *GDP per capita* 2. without *Government Effectiveness* 3. with neither measure 4. with a single factor variable combining the two created using the principal-component factor method. In all cases, coefficient estimates for the interaction terms between *EPI* and *Pollution Reduction Patents* and *EPI* and *Country Scope* remain fully consistent with reported results.

Columns 3-5 of Table 2 add the interaction term between *EPI* and the two moderating variables. In Column 3, the coefficient for the interaction term between *EPI* and *Pollution Reduction Patents* is positive and significant (0.002, $p<0.001$), in line with the Hypothesis 2, which argued that possession of PR-capabilities would positively moderate the relationship between environmental regulation and host country attractiveness. Similarly, the coefficient for the interaction term between *EPI* and *Country Scope* is also positive and significant (0.004, $p<0.01$) in Column 4, as predicted by Hypothesis 3. Column 5 displays results of the main specification where both interaction terms are included. Results here are consistent with those in Columns 3 and 4.

To facilitate interpretation of the interaction terms, we employ the "intgph" procedure for Stata developed by Zelner (2009). Setting all right-hand-side (RHS) variables—other than the two in the interaction term—to their sample means (modes for binary variables), Figure 1 simulates how the likelihood of selecting a country to host a new manufacturing subsidiary changes as environmental regulatory stringency of that country increases for three different firms: Firm A, possessing the sample median level of pollution reduction patents (1 patent), Firm B, with one standard deviation (approximately 10 patents) above the sample median of pollution reduction patents (11 patents) and, Firm C, at the 90th percentile for pollution reduction patents (16 patents). The trend lines Figure 1, plots the likelihood of selecting a particular host nation for a new manufacturing subsidiary as a function of increasing levels of environmental regulatory stringency (*EPI*). The hollow circles indicate regions where there is a statistically significant difference in the expected likelihood of country entry between Firms A and B and Firms B and C, respectively.

———*Insert Figure 1around here*———

The trend line in Figure 1 representing Firm A, slopes downward to the right, indicating that MNEs at or below the median level of pollution reduction patents become increasingly less likely to enter a potential host country as environmental regulatory stringency increases. The trend line for Firm B, while still negative, is considerably more shallow than for that of Firm A, consistent with the argument, articulated in Hypothesis 2, that the entry deterring effect of stronger environmental regulations will be weaker in firms with more extensive PR-capabilities. Perhaps more interesting is the trend line for Firm C where, in contrast to Firms A and B, the slope moves upward to the right. MNEs with the most extensive PR-capabilities (above the 90th percentile) become *more*, not less, likely to enter a country as its environmental regulatory stringency increases.

Whereas the likelihood Firm A would enter a country at the weakest levels of sample *EPI* (33.67) is 1.85 percent, the likelihood would be only 1.33 percent for Firm B and 1.13 percent for Firm C, decreases of approximately 28 and 39 percent, respectively. The hollow circles in Figure 1 indicate that the lower likelihood entry of Firms B and C as compared to Firm A are statistically significant (at the 5 percent level) with respect to countries with *EPI* values below 44.5. Conversely, Firms B and C are more likely than Firm A to enter countries with higher *EPI* levels—these differences are statistically significant for countries whose *EPI* is greater than 67.5. For example, while the likelihood of Firm A entering a country with the most stringent environmental regulations (*EPI* of 77.99) is only 0.79 percent, the likelihood is 1.11 percent for Firm B and 1.33 percent for Firm B. That is, Firms B and C are, respectively, 40 and 68 percent more likely to enter. A test of whether the difference in the predicted likelihood of entry between Firm A and Firm B with respect to the weakest sample level of environmental regulatory stringency and the same difference with respect to the highest level of regulatory stringency rejects the null hypothesis that the two differences are the same ($p<0.01$). The trends displayed in Figure 1 are consistent with Hypothesis 2, providing evidence that the influence of an MNE's PR-capabilities on the relationship between environmental regulatory stringency and international location decision-making is both statistically significant and practically meaningful.

Figure 2 plots the predicted likelihood of country entry as a function of EPI for two firms: one at the median level of multinationality (*Country Scope* is six countries) and one at one standard deviation (approximately 5 countries) above the median level of multinationality (*Country Scope* is 11 countries). Indeed, whereas the weak downward slope of the trend line for low multinationality firms suggests become slightly less likely to enter a country as its environmental stringency increases, the effect of stronger environmental regulations is opposite for high multinationality firms, as indicated by the positively sloping trend line. Importantly, however, the difference between the two lines is only statistically significant (at the 5 percent level) with respect to the likelihood of entry into countries with low environmental regulatory stringency—*EPI* values below 45.7. The likelihood of entry into a country at the low end of the EPI range is 1.25 percent for the low multinationality firm, but only 0.92 percent for the high multinationality firm. The high multinational firm is 25% less likely to enter. Figure 2, therefore, provides support for Hypothesis 3, which argued that the influence of environmental regulatory stringency on the likelihood of country entry would be positively moderated by firm multinationality.

———*Insert Figure 2 around here*———

Hypothesis 4, argued that the positive moderating effect of PR-capabilities on the relationship between environmental regulatory stringency and international expansion will be stronger for more multinational firms. To facilitate testing and interpretation of this three-way interaction, we compare the moderating effect of PR-capabilities on the environmental regulatory stringency-international expansion relationship in firms with high to low levels of multinationality. Because separate estimation for each group is preferable to including a dummy variable in non-linear models (Hoetker, 2007), we split the sample at the sample mean level of multinationality and separately estimate the main specification for high and low multinationality MNEs. Results for the high-multinationality sub-sample are reported in Column 6, where the coefficient for the interaction term between *EPI* and *Pollution Reduction Patents* is positive and significant (0.001, $p<0.001$). By contrast, the coefficient estimate for the same interaction in low multinationality firms, reported in Column 7, is not significant (-0.0003, $p=0.890$). Taken together, the combination of the significant and non-significant estimates in Columns 6 and 7, provide support for Hypothesis 4 (Hoetker, 2007). Possession of PR-capabilities positively moderates the relationship between environmental regulatory stringency and international location choice for high-, but not low-, multinationality MNEs.

To interpret these results we again plot the predicted likelihood of country entry as a function of *EPI*. Figure 3a plots the relationship for two high-multinationality MNEs (*Country Scope* above 7 countries): one possessing the median level of PR-capabilities (1 *Pollution Reduction Patent*) and one with one standard deviation above the median level of PR-capabilities (11 *Pollution Reduction Patents*). Figure 3b plots the same relationship, but for two low-multinationality MNEs. Figure 3a reveals that compared to firms with the median level of PR-capabilities, firms with high PR-capabilities are *less* likely to enter countries with EPI levels below 47.1 and *more* likely to enter countries with *EPI* above 69.5. The likelihood a firm with median PR-capabilities will enter a country at the low end of the *EPI* range is 4.17 percent, compared to 2.93 percent for the firm with high PR-capabilities. At the high end of the *EPI* range, the high PR-capabilities firm is 40 percent more likely to enter (1.91 percent vs. 1.36 percent). A test for whether the difference in probability of country between high-and low-PR-capability MNEs at the low and high ends of the EPI range rejects the null hypothesis that the differences are equal ($p<0.05$).

By contrast, the trend lines for the high- and low-PR-capability MNEs are nearly identical for the low-multinationality subsample depicted in Figure 3b. Further, at no point is the difference between the two groups statistically significant. That PR-capabilities do not moderate the relationship between

environmental regulatory stringency and international expansion for low multinationality MNEs is consistent with the arguments laid out in Hypothesis 4. PR-capabilities are more likely to be location bound in low multinationality MNEs. At the same time, a lack of experience in modifying PR-capabilities for foreign environments suggests that the challenges associated with deploying such capabilities in new institutional environments are likely more daunting, working to discourage market entry.

———*Insert Figures 3a and 3b around here*———

Robustness analyses

These core results prove robust to several reasonable variations in model specification, sampling and estimation strategies. An alternative approach to including an interaction term when testing moderating hypotheses is to split the sample at meaningful levels of the independent variables and compare the coefficient estimates for the moderated independent variable(s) across the sub-groups (Hoetker, 2007). A comparison of AMEs across the groups can further facilitate interpretation. To provide additional interpretation of our moderating hypotheses and test the robustness of our results, we therefore, follow this approach, splitting the sample into high and low levels of *Pollution Reduction Patents* and *Country Scope* at sample mean values and comparing the effect of *EPI* across the sub-groups. Columns 1 and 2 of Table 3 report the results for logit estimation of the effect of EPI on the likelihood of country entry for high and low levels, respectively, of *Pollution Reduction Patents*. Whereas the coefficient estimate for *EPI* is positive and significant for firms with high levels of *Pollution Reduction Patents* in Column 1 (0.033, $p<0.01$), it is not statistically significant in Column 2 (0.001, $p=0.924$). To interpret this effect, we can compare the AME of *EPI* across the two groups. For MNEs with high PR-capabilities, a 1-unit increase in *EPI* (a relatively modest increase in context of the overall sample range of 44.3) increases the likelihood of country entry by roughly 0.09 percentage point. Compared to the overall sample mean likelihood of entry of 3.09 percent, this would represent a 2.79 percent increase in the likelihood of entry. These results are consistent with the positive moderating effect of PR-capabilities on the relationship between *EPI* and the likelihood of country entry reported in Table 2. By contrast, the same 1-unit increase in *EPI* has essentially no effect on the likelihood of country entry for MNEs with low PR-capabilities. These results lend additional support to Hypothesis 2.

Columns 3 and 4 of Table 3 report results for firms with high and low levels of multinationality. According to Hypothesis 3, the effect of *EPI* should be more positive (less negative) in the former than in

the latter. However, coefficient estimates for *EPI* are nearly identical in both columns and, in any event, not statistically significant in either case. These results fail to provide additional support for Hypothesis 3 and suggest that the support for the positive moderating effects of firm multinationality detailed above need to be interpreted cautiously.

Columns 5-8 of Table 3 report results for four sample subgroups based on levels of both *Pollution Reduction Patents* and *Country Scope*. Column 5 reports results for firms above sample mean levels of both measures. The coefficient estimate for *EPI* is positive and significant for firms with high PR-capabilities and high multinationality (0.040 $p<0.01$). The AME of a 1-unit increase in *EPI* is a 0.11 percentage point increase in the likelihood of country entry, an increase of 3.58 percent as compared to the sample mean. Columns 6-8 report results for the high PR-capabilities/low multinationality, low PR-capabilities/high multinationality and low PR-capabilities/low multinationality, subsamples respectively. Coefficient estimates for *EPI* are in all cases smaller in magnitude than the estimate reported in Column 5 and, in any event, not statistically significant for any of the remaining subgroups. These results indicate that the positive moderating effect of PR-capabilities on the relationship between environmental regulatory stringency and the likelihood of country entry relationship is strongest for, and, indeed, only significant with respect to, high multinationality firms, providing additional support for Hypothesis 4.

A second alternative estimation strategy addresses the fact that among the 17,283 sample observations (over 357 firm-expansion years) in the sample, there are only 534 positive outcomes (instances of new foreign subsidiary establishment). To address the potential for small-sample bias in maximum likelihood logit estimation, we conduct a supplementary analysis using penalized maximum likelihood estimation. The coefficients on the terms representing the interaction between *EPI* and *Pollution Reduction Patents* and that between *EPI* and *Country Scope* are positive and statistically significant in Column 1 of Table 4 in line with Hypotheses 2 and 3, respectively. The interaction between *EPI* and *Pollution Reduction Patents* is significant for sub-sample of high-multinationality MNEs (Column 2) but not low-multinationality MNEs (Column 3), again consistent with Hypothesis 4.

Our sample contains only firm-years for which firms elected to establish a new foreign manufacturing subsidiary. However, to the extent that the decision to engage in international expansion in a given year may be influenced by firm characteristics, such as global footprint or its technological initiatives to develop pollution reduction technologies, results reported in Table 2 may suffer from sample selection bias. To address this possibility, we reestimate the main specification using a maximum-likelihood probit model that accounts for sample selection. We include all firm-level RHS variables, a set

of firm-dummies and a set of year dummies in the selection equation, relying on the nonlinear functional form for identification. Results for the outcome equation are reported in Columns 4-6 of Table 4. Results, reported in Columns 4-6 of Table 4 are again fully consistent with those reported in Columns 3-5 of Table 2.

In addition to the above alternative estimation strategies we also estimated several alternative model specifications. While we control for several country- and firm-level factors that may influence international expansion decisions, it is possible that country- or firm-level influences we are unable to measure may be salient to our analysis. We therefore reestimate the main specification and the high- and low-multinational sub-sample estimations in three ways: first, including a set of dummy variables for the 49 countries in the sample and, second, including a set of firm dummy variables for the 124 sample firms and, finally, including a set of firm-year dummies for all 357 firm-expansion years. Results for all nine estimations are fully consistent with the respective estimations reported in Columns 3-5 of Table 2.[4]

Another modification replaces the environmental regulatory stringency measure based on a *positive* indication of the quality of a country's environmental performance (*EPI*), with a *negative* measure based on the extent of pollution. Specifically we divide the total amount of carbon dioxide (CO_2) emissions from manufacturing (in metric tons) by the country's total value added in the manufacturing sector (in constant US dollars). We then log this value to account for the increasing difficulty of reducing CO_2 emissions. This negative approach to regulatory stringency measurement is similar to that used in prior management studies into the role of environmental regulation on FDI (Madsen, 2009). Results are unchanged from those reported in Table 2. To address the concern that patent counts provide an inaccurate measure of the value of firm resources, we replace our four-year patent count measure with a four-year count of the number of forward citations to the patent (Hall, Jaffe, & Trajtenberg, 2005). Again, results align with those reported in Table 2.

Finally, we address the possibility of auto-correlation in expansion decisions that is not fully controlled for by controlling for the number of firm subsidiaries in a host. We reestimate the main specifications using a restricted sample where countries hosting any firm subsidiaries in a given firm-expansion year are removed from the firm-expansion year choice set. Results are again fully consistent with those reported in Table 2.

DISCUSSION AND CONCLUSION

[4] These and all other unreported results are available from the authors

In this study we set out to better understand how environmental regulations influence firm international expansion decisions. Building on Teece's (2014) dynamic capabilities-based theory of the multinational enterprise we argued that while the costs and constraints imposed by stronger national environmental regulations would, on balance, tend to decrease the attractiveness of a potential host country for expansion of manufacturing operations, this effect would be weaker for firms possessing unique capabilities for pollution reduction. At the same time, experience with establishing new foreign subsidiaries and arbitrage advantages associated with a larger global footprint would also mitigate the entry-deterring effect of stronger environmental regulations. Finally, because more multinational firms would have greater incentives and skills for modifying capabilities to work in new host-country environments, the positive moderating effect of PR-capabilities would be strengthened yet further for high multinationality firms.

We tested our arguments using data on 523 instances of international manufacturing expansion into 49 potential host countries by 124 Japanese chemical industry firms between 2001 and 2010 confirmed our findings. By using firm pollution reduction patents to measure PR-capabilities, our methodological approach offered an advance on prior research which has relied on less objective data that may not effectively distinguish between general and firm-specific advantages. Empirical tests, provided both statistically significant and practically meaningful support for our arguments.

These findings build on the findings of recent studies that have drawn attention to the importance of understanding firm heterogeneity when assessing the impact of environmental regulation (Albrizio et al., 2014; Madsen, 2009). While our results confirmed the findings common to much prior research that stronger environmental regulations do not have an overall negative impact on host country investment, we also found that the effects are, in fact, meaningful when firm heterogeneity is taken into account, with some evidence that both camps—those arguing that the influence is detrimental and those that it is beneficial—being correct. Although we did find some indication that firms with low levels of capabilities for reducing pollution do seem to be discouraged from entering markets with more stringent environmental regulation, the effect is almost disappears in firms with PR-capabilities. At the same time, we found that stronger regulations work to *increase* host-country attractiveness for firms whose capabilities position them to benefit from stronger regulations.

Our study makes an important contribution to prior research highlighting the importance of paying attention to the multinational character of MNEs and considering the impact the aggregate global footprint can have on how and where firms locate activities (Madsen, 2009; Surroca et al., 2010). Although

capabilities are important, the potential and incentives to design environmental technologies to suit only local environments may lead to such advantages becoming stranded in individual locales. Firms with more global operations have the incentives and experience to ensure that such capabilities are exploited more fully—an important societal benefit in light of the potential to increase environmental as well as economic well-being. The source of such incentives may be overlooked if analyses rely solely on measures of dyadic distance between home- and host-countries.

Results of our study also hold implications for managers, who can obtain a better perspective on where competition may originate in response to environmental regulatory changes in a country where they conduct business. It also suggests the importance of being open minded to the possibilities of stricter regulation providing profitable opportunities as well as potential performance challenges. Such thinking will also be of relevance to policy makers concerned about the potential consequences of strengthening their environmental regulatory regimes.

The implications of our results for policy makers are particularly salient when considering the desire among government officials to use regulation to enhance national competitiveness. Building on the work of Porter and Van der Linde (1995) scholars have argued that stronger national regulation act to spur domestic firms to innovate, in turn developing capabilities placing them ahead of foreign rivals lacking such institutional incentives to improve environmental performance. However, the results here highlight the potential for such regulations to attract *stronger* foreign incumbents. Accordingly, depending on the level of regulatory stringency, the capabilities of domestic firms vis-à-vis foreign rivals and the extent to which increased foreign competition may act as an incentive or disincentive for environmental innovation, the outcome of stronger regulations may have the opposite effect of the hoped for effect. This problem is likely to be especially acute in courtiers with lower environmental stringency seeking to strengthen their environmental regulatory regimes. Stronger regulations may attract stronger foreign rivals, hurting domestic industry. However, as Dowell and colleagues (2000) note, intentionally maintaining weak regulations may end up attracting poor quality and less competitive firms.

Limitations and future directions

Although our results were robust to several reasonable changes in equation terms, sampling and estimation strategy, there were of course limitations to our analysis. Perhaps most apparent is the need to rely on an indirect measure of environmental regulation. The inherent challenges of developing a time-varying measure of environmental regulation that is comparable across a large number of countries have

forced the reliance on such proxy measures. Recently, Albrizio and colleagues at the OECD (2014), have made important efforts to address this problem, developing a measure of environmental policy stringency. Unfortunately, their measure only covers 24 OECD countries, less than half of those in our sample, resulting in a substantial loss of variation in our main independent variable and a loss of nearly 2/3 of instances of international manufacturing expansion that prohibited its use for our study. Although the relatively high bivariate correlation of roughly 0.60 with the *EPI* values for the same 24 countries suggests we are picking up much of the same factors, future research would undoubtedly benefit from the use of more direct measures.

The manner in which firm multinationality influences how firms choose to deploy existing PR-capabilities suggests a natural follow-up question. Namely, how does such multinationality influence the development of pollution reduction capabilities. Berrone and colleagues (2013) found that differences in regulation across US states influenced the development of PR-capabilities. Future research might build on their findings by studying how the global footprint of an MNE, which is likely to have both substantially greater variation in regulatory stringency and more opportunities for institutional arbitrage (Surroca et al., 2010) than jurisdictions within a single country.

When assessing the impact of environmental regulation on business activity, the assumptions are all too often approached from a negative perspective. By contrast, this study demonstrates that stronger regulations actually encourage market entry by the most environmentally capable firms. This evidence runs against a common perception that MNEs are responsible for worsening global environmental degradation. Sharfman and colleagues (2004), in laying a convincing case for why MNEs will often have superior environmental performance, note that this perception as the MNE as vehicle for environmental destruction persists. These findings provide further evidence of the careful need to assess the positive role MNEs may play in diffusing state-of-the-art environmental technologies around the globe.

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TABLES AND FIGURES

Table 1. Descriptive statistics and pair-wise correlations

	Mean	S.D.	Min	Max	1	2	3	4	5	6	7	8	9	10	11
1. GDP per capita	20539.99	18206.15	361.97	87772.69	-										
2. GDP	788.92	1864.02	8.84	13682.00	0.23	-									
3. GDP Growth	3.52	3.46	-8.86	18.29	-0.33	-0.09	-								
4. Geographic Distance	8581.02	3201.42	1156.67	18549.61	0.14	0.11	-0.25	-							
5. Government Effectiveness	0.81	0.92	-1.11	2.43	0.83	0.19	-0.31	0.07	-						
6. FDI	23.53	52.92	-29.68	734.01	0.26	0.58	-0.03	0.06	0.23	-					
7. Number Country Subsidiaries	0.38	1.30	0.00	41.00	0.00	0.39	0.10	-0.17	0.05	0.28	-				
8. Firm Sales	23.23	24.99	0.42	124.62	0.00	0.00	0.02	0.00	0.00	0.03	0.17	-			
9. Firm R&D Intensity	0.05	0.05	0.00	0.34	0.01	0.00	-0.03	0.00	0.00	0.04	0.00	0.00	-		
10. Country Scope	7.05	4.60	1.00	21.00	0.01	0.00	0.00	0.00	0.00	0.02	0.24	0.59	-0.11	-	
11. Pollution Reduction Patents	5.37	9.96	0.00	75.00	0.00	0.00	-0.04	0.00	0.00	0.01	0.08	0.33	-0.05	0.27	-
12. Environmental Performance Index	56.01	9.42	33.66	77.99	0.66	0.06	-0.36	0.17	0.63	0.12	-0.04	0.01	0.02	0.01	0.01

Table 2. Core logistic regression results

	1 Controls	2 Main Effects	3 Interaction: PR Pats	4 Interaction: Country Scope	5 Interaction: PR Pats & Country Scope	6 Interaction: PR Pats (high country scope)	7 Interaction: PR Pats (low country scope)
GDP per capita	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000**	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP Growth	0.102***	0.111***	0.113***	0.112***	0.113***	0.092**	0.113**
	(0.021)	(0.024)	(0.023)	(0.024)	(0.024)	(0.029)	(0.040)
Geographic Distance	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Government Effectiveness	0.688***	0.635***	0.643***	0.629***	0.638***	0.419*	1.037***
	(0.133)	(0.161)	(0.161)	(0.159)	(0.160)	(0.195)	(0.242)
FDI	0.004***	0.004***	0.004***	0.004***	0.004***	0.004***	0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Number Country Subsidiaries	0.132***	0.132***	0.135***	0.141***	0.140***	0.174***	0.215***
	(0.023)	(0.023)	(0.024)	(0.022)	(0.023)	(0.026)	(0.053)
Firm Sales	0.006*	0.006*	0.006*	0.006*	0.006*	0.005†	0.007
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.007)
Firm R&D Intensity	-0.816	-0.836	-0.89	-0.812	-0.861	-0.975	-1.366
	(0.797)	(0.804)	(0.810)	(0.802)	(0.810)	(1.252)	(1.070)
Pollution Reduction Patents		-0.002	-0.103***	-0.002	-0.085***	-0.086***	0.018
		(0.009)	(0.019)	(0.009)	(0.020)	(0.018)	(0.116)
Country Scope	-0.005	-0.004	-0.005	-0.223**	-0.174*	-0.176	-0.584
	(0.013)	(0.013)	(0.013)	(0.069)	(0.078)	(0.166)	(0.382)
Environmental Performance Index		0.009	-0.001	-0.020†	-0.022†	-0.028	-0.027
		(0.010)	(0.011)	(0.012)	(0.012)	(0.036)	(0.028)
EPI x Pollution Reduction Patents			0.002***		0.002***	0.001***	-0.000
			(0.000)		(0.000)	(0.000)	(0.002)
EPI x Country Scope				0.004**	0.003*	0.002	0.011
				(0.001)	(0.002)	(0.003)	(0.007)
Constant	-2.989***	-3.522***	-3.013***	-1.973**	-1.905*	-1.088	-1.351
	(0.300)	(0.714)	(0.715)	(0.756)	(0.760)	(2.010)	(1.522)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Expansion Years	357	357	357	357	357	174	183
Observations	17,283	17,283	17,283	17,283	17,283	8,433	8850

Robust standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, † p<0.1

Table 3. Alternative estimation of core logistic regression results employing sub-samples created by splitting at meaningful levels of independent variables

	1 High Patents	2 Low Patents	3 High MN	4 Low MN	5 High Patents / High MN	6 High Patents / Low MN	7 Low Patents / High MN	8 Low Patents / Low MN
GDP per capita	-0.000**	-0.000***	-0.000**	-0.000***	-0.000*	-0.000†	-0.000†	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP	0.000***	0.000***	0.000***	0.000***	0.000***	0.000**	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP Growth	0.105*	0.115***	0.090**	0.109**	0.134**	0.051	0.069†	0.122**
	(0.042)	(0.028)	(0.029)	(0.040)	(0.051)	(0.088)	(0.036)	(0.044)
Geographic Distance	-0.000***	-0.000***	-0.000***	-0.000***	-0.000**	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Government Effectiveness	0.381*	0.739***	0.414*	1.046***	0.388†	0.608	0.41	1.088***
	(0.160)	(0.215)	(0.194)	(0.244)	(0.215)	(0.428)	(0.298)	(0.253)
FDI	0.005***	0.004***	0.004***	0.003	0.005***	0.002	0.002***	0.004†
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)	(0.002)
Number Country Subsidiaries	0.120***	0.146***	0.170***	0.215***	0.118***	0.263**	0.211***	0.216***
	(0.023)	(0.041)	(0.026)	(0.053)	(0.021)	(0.093)	(0.057)	(0.064)
Firm Sales	0.007	0.006*	0.005†	0.007	0.001	0.041***	0.004	0.004
	(0.008)	(0.003)	(0.002)	(0.008)	(0.010)	(0.010)	(0.003)	(0.006)
Firm R&D Intensity	13.299***	-1.670*	-0.875	-1.392	18.831***	4.839	-1.966†	-1.323
	(3.984)	(0.784)	(1.231)	(1.061)	(3.601)	(5.866)	(1.179)	(1.087)
Country Scope	-0.011	-0.001	-0.045*	-0.023	-0.044	0.042	-0.053**	-0.041†
	(0.033)	(0.012)	(0.020)	(0.029)	(0.038)	(0.081)	(0.018)	(0.023)
Pollution Reduction Patents	-0.013	0.002	-0.004	0.001	-0.013	-0.048**	-0.041	0.055*
	(0.010)	(0.025)	(0.008)	(0.011)	(0.011)	(0.016)	(0.044)	(0.025)
Environmental Performance Index	0.033**	0.001	0.008	0.009	0.040**	0.017	-0.01	0.013
	(0.011)	(0.013)	(0.014)	(0.016)	(0.014)	(0.026)	(0.019)	(0.016)
Constant	-5.199***	-3.090***	-3.046**	-3.135**	-5.541***	-4.146*	-1.626	-3.717***
	(0.807)	(0.843)	(0.951)	(1.002)	(0.907)	(2.036)	(1.377)	(1.050)
EPI AME	0.09%	0.00%	0.02%	0.02%	0.11%	0.04%	-0.03%	0.02%
EPI AME/Mean Entry	2.79%	0.10%	0.77%	0.57%	3.58%	1.25%	-0.98%	0.79%
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Expansion Years	88	269	174	183	55	33	98	171
Observations	4,267	13,016	8,433	8,850	2,671	1,596	4,751	8,265

Robust standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05, † p<0.1

Table 4. Robustness Analyses

	1 Penalized MLE Interaction: PR Pats & Country Scope	2 Penalized MLE Interaction: PR Pats (high country scope)	3 Penalized MLE Interaction: PR Pats (low country scope)	4 Sample Selection ML Probit Interaction: Country Scope	5 Sample Selection ML Probit Interaction: PR Pats (high country scope)	6 Sample Selection ML Probit Interaction: PR Pats (low country scope)
GDP per capita	-0.000***	-0.000**	-0.000***	-0.000***	-0.000**	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP Growth	0.112***	0.091**	0.110**	0.054***	0.045***	0.055**
	(0.023)	(0.029)	(0.041)	(0.010)	(0.012)	(0.018)
Geographic Distance	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Government Effectiveness	0.633***	0.412*	1.027***	0.255***	0.164*	0.408***
	(0.141)	(0.172)	(0.251)	(0.065)	(0.080)	(0.097)
FDI	0.004***	0.004***	0.003†	0.002***	0.002***	0.002***
	(0.001)	(0.001)	(0.002)	(0.000)	(0.000)	(0.001)
Number Country Subsidiaries	0.138***	0.171***	0.208***	0.089***	0.104***	0.146***
	(0.024)	(0.029)	(0.061)	(0.014)	(0.015)	(0.029)
Firm Sales	0.006**	0.005*	0.008	0.001	0.001	0.003
	(0.002)	(0.002)	(0.010)	(0.001)	(0.001)	(0.003)
Firm R&D Intensity	-0.808	-0.863	-1.283	-0.053	-0.110	-0.822
	(1.100)	(1.338)	(1.984)	(0.425)	(0.616)	(0.523)
Country Scope	-0.174*	-0.177	-0.578†	-0.076*	-0.086	-0.207
	(0.069)	(0.129)	(0.321)	(0.031)	(0.071)	(0.163)
Pollution Reduction Patents	-0.085**	-0.086**	0.016	-0.038***	-0.039***	0.001
	(0.030)	(0.031)	(0.117)	(0.009)	(0.009)	(0.049)
Environmental Performance Index	-0.022†	-0.029	-0.027	-0.009†	-0.014	-0.008
	(0.013)	(0.028)	(0.024)	(0.005)	(0.016)	(0.012)
EPI x Pollution Reduction Patents	0.002**	0.001**	0.000	0.001***	0.001***	0.000
	(0.001)	(0.001)	(0.002)	(0.000)	(0.000)	(0.001)
EPI x Country Scope	0.003*	0.002	0.011†	0.001*	0.001	0.004
	(0.001)	(0.002)	(0.006)	(0.001)	(0.001)	(0.003)
Constant	-1.879*	-1.044	-1.288	-0.862*	-0.577	-0.734
	(0.779)	(1.561)	(1.427)	(0.354)	(0.920)	(0.694)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Firm Expansion Years	357	174	183	357	174	183
Observations	17283	8433	8850	17283	8433	8850

Robust standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05, † p<0.1

Figure 1. Effect of stronger environmental regulation on likelihood of country entry for firms with high and low levels of pollution reduction capabilities

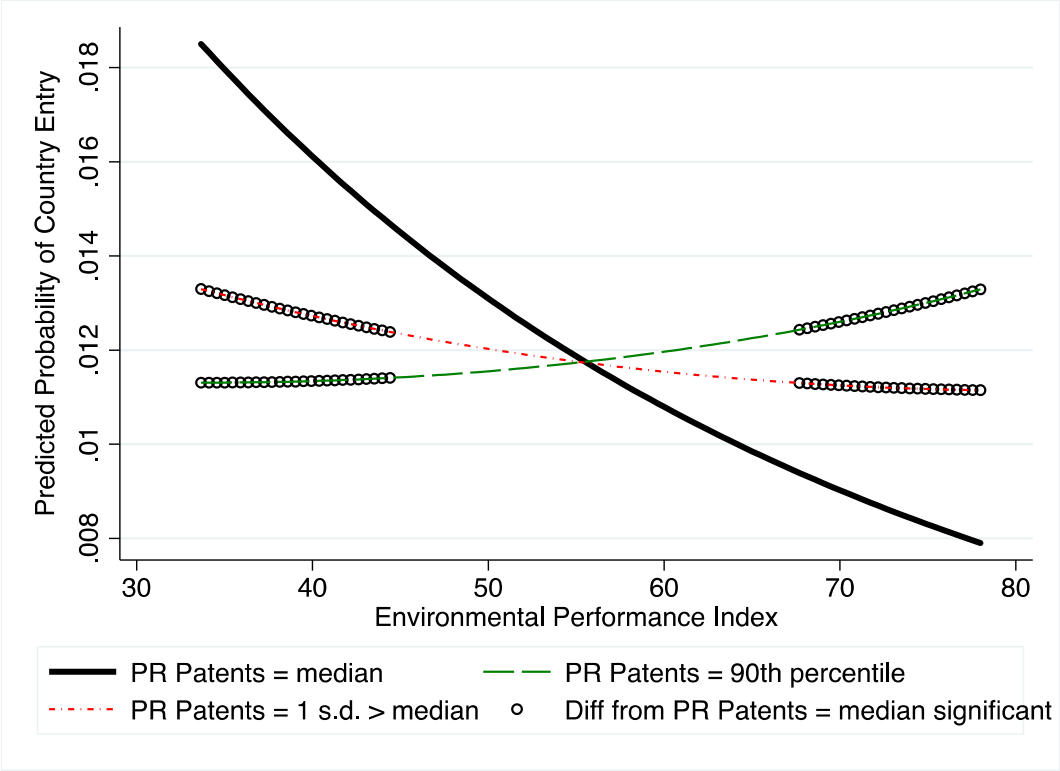

Figure 2. Effect of stronger environmental regulation on likelihood of country entry for firms with high and low levels of multinationality

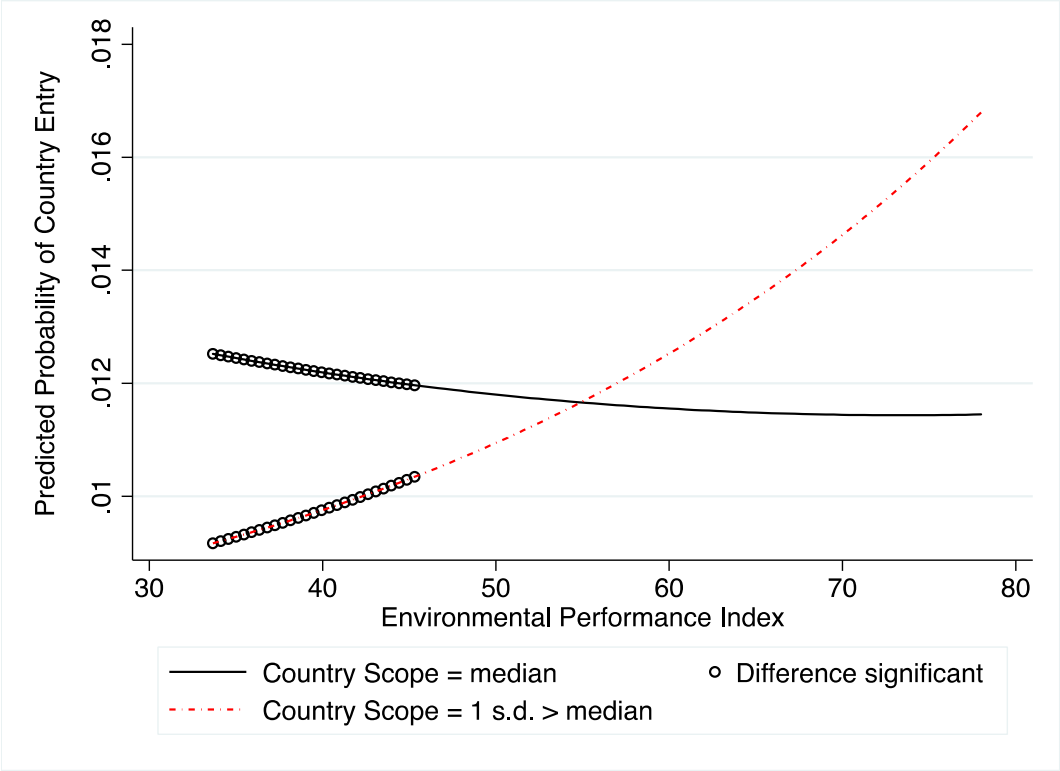

Figure 3a. Effect of stronger environmental regulation on likelihood of country entry in high multinationality firms with high versus low levels of pollution reduction patents

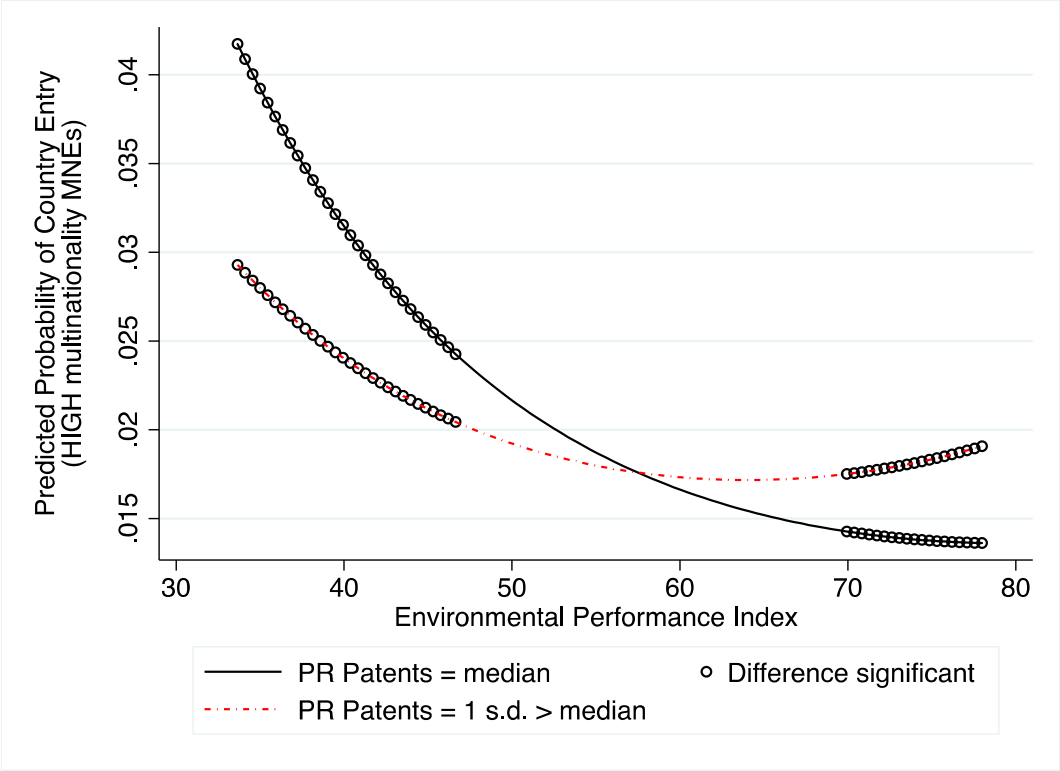

Figure 3b. Effect of stronger environmental regulation on likelihood of country entry in low multinationality firms with high versus low levels of pollution reduction patents