Journal of International Business Studies (2016)

www.jibs.net

Racing to the bottom and racing to the top: The crucial role of firm characteristics in foreign direct investment choices

Maoliang Bu[1] and
Marcus Wagner[2]

[1] *School of Business, Nanjing University, Nanjing, China;* [2] *Faculty of Business Administration and Economics, Augsburg University, Universitätsstr. 16, 86159 Augsburg, Germany*

Correspondence:
Marcus Wagner, Faculty of Business Administration and Economics, Augsburg University, Universitätsstr. 16, 86159 Augsburg, Germany.
Tel: +49 821 598 4079;
e-mail: marcus.wagner@wiwi.uni-augsburg.de

Abstract

This study builds on the pollution haven and induced innovation arguments as explanations for firm behavior with regard to international environmental management and argues both need to be integrated. This implies that foreign direct investment is capable of facilitating a "race to the bottom" and a "race to the top" simultaneously. Using novel and detailed data, we test whether environmental capabilities and weaknesses and other characteristics affect US firms' foreign direct investment choices in Chinese provinces with more or less stringent environmental regulation. This enables a more detailed analysis by allowing country regulation to vary spatially and over time. Our study finds that heterogeneity in capabilities and firm size jointly determine foreign direct investment and in doing so shows the simultaneity of a race to the bottom and to the top. Specifically, firms with environmental capabilities invest in more stringently regulated regions and firms with weaknesses are less likely to target such regions. These diverging effects are both moderated by firm size, which further amplifies each of them. Our findings underscore the need to integrate pollution haven and induced innovation arguments in a joint analysis. They furthermore show the relevance of methodological choices when testing hypotheses integrating the above arguments empirically.

Journal of International Business Studies (2016). doi:10.1057/s41267-016-0013-4

Keywords: resource-based view or resource-based theory; pollution haven; multivariate analysis; China; United States

INTRODUCTION

Foreign direct investment (FDI) is viewed as being capable of facilitating both a "race to the bottom" and a "race to the top" (Madsen, 2009; Kolk, 2016). In this regard, the pollution haven argument suggests that multinational enterprises (MNEs) relocate to countries with weaker environmental regulations to avoid the cost of implementing expensive pollution control measures and related processes (Christmann & Taylor, 2001; Copeland & Taylor, 1994; Strike, Gao & Bansal, 2006). The opposing, the induced innovation argument, suggests that such locations will not be a barrier if MNEs have superior environmental capabilities that help them meet strict regulatory requirements at lower cost (Palmer,

Received: 3 October 2013
Revised: 19 May 2016
Accepted: 7 June 2016

Oates & Portney, 1995; Porter & van der Linde, 1995). In the latter case, environmental regulation leads to the embodied transfer of environmental capabilities – that is, the transfer of innovations from home to host countries through direct investment by foreign firms (Lanjouw & Mody, 1996), which ultimately results in additional innovation in the host countries.

Although empirical evidence exists for both arguments (Brunnermeier & Levinson, 2004; Copeland & Taylor, 2004; Jeppesen & Folmer, 2001; Kellenberg, 2009; Rezza, 2015), studies often do not sufficiently control for potential confounding influences, such as firm-specific endowments of environmental capabilities or regulatory heterogeneity. For example, individual capabilities can affect firm choices, but this may be masked if only aggregated measures (i.e., those gauging the joint influence of several capabilities, typically in an additive manner as a net sum) are used. Furthermore, capabilities can interact with other firm characteristics, and not accounting for this interaction can result in omitted variable bias, which may result in distorted assessments or even methodological artifacts that negatively affect policy design or firm strategizing. Therefore it is necessary to integrate firm characteristics into the analysis, specifically with regard to their interactions.

Similarly, studies pooling countries mask regulatory heterogeneity across administrative subunits within one country (e.g., provinces or federated states) by wrongly assuming one homogenous level of regulatory stringency across a whole country. To enable better assessment, it is necessary to account for variation of the regulatory conditions in a host country and over time. Furthermore, it is necessary to control for cultural and institutional distances and differences, for example by focusing on individual home and host countries, because such factors can produce omitted variable biases if not controlled for comprehensively in multi-country studies on FDI and regulation. That such controls are not included in many extant studies could have contributed to the inconclusive results found.

To fill the gap in the literature, our research addresses these issues in the context of United States (US) firms' FDI in China based on novel data on US MNE investments that allow us to overcome several of the shortcomings of earlier studies. Our analysis integrates the cost-based pollution haven argument (where firms evade strict regulation as an external force but are treated as behaving homogeneously in the same manner) with the benefit-based induced innovation argument. This latter argument implies that firm-specific environmental capabilities or the lack thereof (partly in interaction with other firm characteristics) nuance corporate reactions to regulation levels, in turn attenuating or amplifying the effect of regulation on FDI choices.

Based on this extended framework integrating both arguments, we hypothesize and analyze which characteristics of firms determine their location in regions with differing environmental standards. In doing so, we clarify the inconclusive empirical evidence on the pollution haven argument (due to spatial and temporal regulatory heterogeneity, cultural and institutional distances and differences or insufficiently integrated theory bases) and provide novel insights into how methodological choices affect this unsettled issue. Our focus on one home and one host country allows us to properly control for cultural and institutional heterogeneity.

We find that firm characteristics matter as determinants of FDI choice, particularly in terms of heterogeneity in environmental (in-)capabilities and size as well as their interaction. Furthermore, we show that the results depend on the aggregation level in terms of either an aggregated (net sum) index of firms' environmental strengths and weaknesses or disaggregated individual environmental capabilities and concerns (that is, measuring additively the joint influence of several capabilities versus gauging their individual effects).

The contribution of our article to the field of international business (IB) is fourfold: First, by integrating the pollution haven and induced innovation arguments, a systematic examination of these opposing arguments is facilitated which allows deriving more refined hypotheses. This helps to avoid empirical designs focused on testing only one of the arguments. Second, we contribute novel insight on the theoretical validity of the pollution haven and "race to the bottom" debates by linking them to firm capabilities. This approach enables a broader theoretical understanding at the intersection of the sustainability and IB literatures because it joins country-specific and firm-specific advantages (Christmann & Taylor, 2001; Madsen, 2009; Rugman & Verbeke, 1998a; Strike et al., 2006). Third, we contribute an assessment of the degree to which aggregation levels and firm-specific advantages captured by firm characteristics and their interactions co-determine (together with country-specific advantages) FDI choices, thus also explaining previously inconclusive evidence on the aforementioned arguments. Fourth, we contribute empirical evidence by using more comprehensive and updated data and measures to analyze the above issues. More specifically, by choosing a context of intra-country regulation differences, we are able to focus on one home and one host country and thus avoid issues raised by the literature on cultural and institutional distance, and related work on institutional context heterogeneity (Aguilera-Caracuel, Aragón-Correa, Hurtado-Torres & Rugman, 2012; Aguilera-Caracuel, Hurtado-Torres, Aragón-Correa, & Rugman, 2013; Hutzschenreuter & Voll, 2008; Rathert, 2016).

LITERATURE REVIEW

Race to the Bottom: Pollution Havens

Since the early 1970s when the first major environmental protection policies and government agencies were established in Europe and the United States, environmental regulations have much increased in industrialized countries. Accordingly, whether the environmental regulation gaps among developed and developing countries affect the flow of foreign direct investments stimulated the pollution haven argument, which maintains that MNEs relocate to countries with weaker environmental regulation to avoid the cost of implementing expensive pollution control measures and related processes (Christmann & Taylor, 2001; Copeland & Taylor, 1994; Strike et al., 2006). The basic argument in this regard is that pollution is a factor of production. In countries with low cost of pollution, producers should make intensive use of this factor (Markusen, Morey & Olewiler, 1993; Pavelin & Porter, 2011; Dong, Gong & Zhao, 2012).

Some support for the pollution haven argument has been found in the literature with different country samples. Xing and Kolstad (2002), using data from six highly polluting US industries, find a negative relationship between US investment and the stringency of environmental regulation in host countries. Similarly, Kellenberg (2009) takes into account possibly endogenous environmental policies for countries in the 80th percentile in terms of growth in US multinational affiliate value added. He finds that between 1999 and 2003 8.6% of this growth are attributable to declining relative stringency and enforcement of environmental policies. Based on data for US outward FDI for 50 host countries, Tang (2015) finds that export-oriented FDI exhibits greater sensitivity to local environmental regulations than does local market-oriented FDI. Using four-digit manufacturing industry data on South Korean outward FDI, Chung (2014) finds strong evidence that polluting industries tend to invest more in countries with laxer environmental regulations in terms of both the amount of investment and the number of new foreign affiliates. Using German panel data on outward FDI flows, Wagner and Timmins (2009) also find pollution haven evidence for the chemical industry.

Support for the pollution haven argument has been shown by using not only macro-level data but also micro-level data, with this data-level change reflecting an important trend in the literature. In one study, Surroca, Tribó and Zahra (2013) use panel data on 269 subsidiaries in 27 countries belonging to 110 MNEs from 22 countries to study the transfer of socially irresponsible corporate practices (i.e., weaknesses) from MNEs' headquarters to their overseas subsidiaries. The authors find that such transfers are more pronounced if the degree of institutional enforcement, vigilance, and sanctions for noncompliance in the subsidiary's host country is low. Similarly, using Community Reinvestment Act data for foreign bank affiliates from 32 countries in the US over the period 1990–2007, Campbell, Eden and Miller (2012) find that more distant foreign firms are less likely to engage in environmental and social activities. This suggests, despite increased strategic motivation for such activities, countervailing effects of distance on the willingness and ability to engage in host country activities. While this finding can be understood as indirect evidence for the pollution haven argument, more direct support is provided by Cole, Elliott and Okubo (2014) using data on Japanese firms. The authors find evidence of firms shifting dirtier production steps to regions with less stringent environmental regulation.

However, contrary evidence has also been found that challenges the pollution haven argument. Eskeland and Harrison (2003) find no robust correlation between environmental regulation and foreign direct investment from the US in four developing countries, namely, Mexico, Venezuela, Morocco and Cote d'Ivoire. Similarly, using data from 25 economies in Eastern Europe and the former Soviet Union, Javorcik and Wei (2005) find no evidence that supports the argument that highly polluting foreign investors are attracted by weak environmental regulation. Using inward foreign investment data for China, Dean, Lovely and Wang (2009) find that the strength of the pollution haven effect differs depending on whether the investor is ethnic Chinese, thereby suggesting that firm characteristics need to be accounted for. Finally, Bu, Liu, Wagner and Yu (2013) show that incorporating an overall social responsibility index in the analysis can have an effect that opposes the pollution haven argument.

Overall, the mixed evidence on the pollution haven argument suggests a research gap and a corresponding need to analyze whether the methodological choices of empirical studies (e.g., in terms of the set of variables included in the analysis or the measurement specifications chosen) can affect the results. For example, Husted and Allen (2006) analyze the relationship between global and country-specific corporate social responsibility (CSR, of which one component in their study is environmental management) and international strategy and find that country-specific CSR is more common among multi-domestic and transnational corporations than among global MNEs, whereas global CSR is equally common across all MNEs. This refutes assuming identical firms (i.e., not allowing for differing strategies or capabilities) with the same cost per firm to achieve a given level of regulation. Opposed to this, differing cost can be modeled if heterogeneity across firms, for example, with regard to environmental capabilities or weaknesses, is permitted.

Additionally, the methodological choice of pooling firms with greater or fewer environmental capabilities could distort the evidence for or against the pollution haven argument, as two opposing behavioral patterns are mixed in one set of data. Similarly, firm heterogeneity in environmental capabilities —if incorporated in the analysis—can, for example, be modeled by means of sum indices, threshold levels or individual item variables, again implying the possibility of results being artifacts of specific methodological choices. In sum, there is a need for further and more refined analyses of such issues to address a gap in the literature, the illumination of which can significantly contribute to resolving the empirical ambiguity surrounding the pollution haven argument.

Race to the Top: Induced Innovation

In contrast to the pollution haven argument, the induced innovation argument suggests that MNEs will not avoid regions with weak environmental regulations if they have superior environmental capabilities that help them meet strict regulatory requirements at lower cost (Palmer et al., 1995; Porter & van der Linde, 1995). In this case, strict regulation pushes firms to explore more novel ideas and search for solutions in less-known fields (thereby creating competitive advantages). Better embodied environmental capability transfer is also an implication of the validity of this argument. If environmental regulation leads to innovation (e.g., the adoption of activities that create environmental strengths or other firm-specific advantages) that makes it cheaper to achieve strict regulatory requirements in the home country, then MNEs are likely to transfer such innovation and the corresponding firm-specific advantages and related capabilities to host countries and subsidiaries (Cave, 2014).

Some studies provide evidence that supports the induced innovation argument. Using Japanese foreign direct investment data for five dirty industries, Kirkpatrick and Shimamoto (2008) find that investment appears to be attracted by stricter environmental regulation. Using survey data from Chinese firms, Christmann and Taylor (2001) find that multinational ownership, multinational customers, and exports to developed countries increase environmental self-regulation as operationalized by ISO 14000 adoption. In a subsequent companion paper, Christmann and Taylor (2006) differentiate self-regulation into symbolic and substantive types that lead to different outcomes in terms of environmental improvements, with ISO 9000 adoption as a measure of the latter. Although these two papers contribute greatly to the understanding of IB and environmental sustainability in the institutional context of China, they do not specifically focus on the pollution haven and “race to the bottom” issues. Instead, they address the role of certifications in enabling and facilitating the export activities of Chinese firms, and therefore, as concerns FDI, a research gap remains. Although Dean et al. (2009) partly address this gap, they only use per province one constant regulatory stringency level, whereas in reality the latter changes over time. Finally, reflecting an important IB trend, namely, accounting for firm heterogeneity more comprehensively (Young & Makhija, 2014), Madsen (2009) argues that the effect of environmental regulations on investment depends on differences in firms’ environmental capabilities. Thus, high environmental standards will not automatically discourage investment.

It has been argued that if countries attract only firms with limited capabilities in environmental management, these may be exactly those firms that have no competitive advantage (Dowell, Hart & Yeung, 2000). Such firms lack firm-specific advantages in terms of specific environmental strengths or have, on balance, more weaknesses than strengths, which is a disadvantage for host countries because multinationals investing in a country account for a large share of embodied environmental capability transfer (Albornoz, Cole, Elliott & Ercolani, 2009; Lanjouw & Mody, 1996). For example, in the ex-communist block after 1990, industry was largely rebuilt by means of FDI from multinational firms, which implied considerable embodied environmental capability transfer that was largely built on firm-specific advantages in terms of environmental strengths (Rugman & Verbeke, 1998a, b). This argument suggests that multinational firms with firm-specific environmental advantages are often less concerned about strict environmental regulations than is assumed in the pollution haven argument and accelerate innovation in the host country, a notion that has more recently also been confirmed in the context of institutional voids (El Ghoul, Guedhami & Kim, 2016; Marano, Tashman & Kostova, 2016).

In sum, what emerges from the literature review is that (i) the pollution haven argument is mainly cost-based, while the induced innovation argument is largely benefit-based, and there is therefore a need to integrate these two only seemingly conflicting views; (ii) evidence on the pollution haven argument is equivocal (partly due to measurement issues); and (iii) it is thus desirable to better understand which characteristics lead firms to be willing to pursue FDI in regions with stricter environmental regulations and what the influence of omitted variables is in relation to parallel measurement issues. To do so, it is necessary to directly include firm characteristics in the analysis because the extant literature rarely accounts sufficiently for firm heterogeneity. More specifically, whilst theoretical models have begun to include firm characteristics, their interactions have not been considered so far in the context of pollution havens, which is why a need exists for developing more refined theoretical frameworks incorporating this. The remainder of this study addresses this and the other gaps identified in the literature review by developing integrated hypotheses about how capabilities and weaknesses in environmental management and other firm characteristics relate to FDI location choices and then testing these hypotheses in an enhanced manner accounting for and incorporating different measurement options.

DEVELOPMENT OF HYPOTHESES

Capabilities and Concerns in Environmental Management and Compliance

This section, which builds on the literature review above, derives our hypotheses. The general logic for these is to integrate the pollution haven and induced innovation arguments to account for FDI location choice depending on firm-specific characteristics (such as environmental capabilities) and their interaction. This approach is necessary, as Young and Makhija (2014) highlight the importance of accounting for firm heterogeneity to explain differences in behavior in the same institutional environment—in our case, China.

In line with the induced innovation argument, firms pursuing environmental activities, such as implementing environmental management systems or environmental innovations, have stronger environmental capabilities due to higher levels of knowledge stock, creation, absorption and utilization in this area (Marcus & Anderson, 2006). Through a process involving social complexity and tacit knowledge, these capabilities lead to the creation of strategic resources (Branco & Rodrigues, 2006). According to resource-based theory, strategic resources enable a sustained competitive advantage due to obstacles to imitation (Aragón-Correa & Sharma, 2003). For example, environmental management activities help to develop process knowledge of a rather tacit nature, which is difficult to imitate and allows for realizing sustainable cost advantages (Christmann & Taylor, 2001; Hart, 1995).

Home country-based development of environmental capabilities follows from the induced innovation argument. According to Strike et al. (2006), firms exposed to the home-country based development of environmental capabilities should also export the sustainability-related standards of their home country, which are not considered a requirement in a host country. In this regard, Klassen and McLaughlin (1996) suggest that firms can achieve experience-based scale economies when integrating manufacturing, marketing and legal functions around environmental issues to pursue environmental innovations or pollution prevention. In such a case, accumulation along an experience curve makes it easier for firms to address stringent regulatory demands concerning the natural environment, which in turn makes it more likely that they will locate where regulation is strict (Hunt & Auster, 1990).

Path dependencies and historic lock-ins lead to heterogeneity and to a distribution of environmental capabilities for the firm population in one host country. In sum, environmental activities create strategic resources that correspond to greater capabilities to address the requirements of strict environmental regulation and hence increase the likelihood that firms will choose to locate FDI in regions with stringent environmental regulation. These considerations lead to the first hypothesis:

Hypothesis 1a: Firms with greater environmental capabilities are more likely to locate FDI in regions with stricter environmental regulation.

Beyond the environmental capabilities (i.e., strengths) of firms that may induce FDI in locations with stringent environmental regulation, weaknesses in terms of lesser capabilities or concerns about corporate social irresponsibility also need to be considered. This follows from the logic of integrating the pollution haven and induced innovation arguments to explain FDI choices with respect to environmental regulation differences because studies suggest that strengths and weaknesses concerning environmental management are orthogonal to one another (e.g., Strike et al., 2006).

Furthermore, profitable or at least cost-effective opportunities at the firm level for pollution abatement do not always exist (Kolk & Pinkse, 2008). Thus, firms' compliance decisions are based on the probability of detection and the expected penalty if non-compliance is found (Cohen, Fenn & Naimon, 1995). It is therefore possible that firms show concerns and weaknesses with regard to environmental management, for example in terms of high emissions that exceed stringent regulatory limits and even result in fines or penalties.

For such firms, following the pollution haven argument, siting in weakly regulated locations is a means to reduce non-compliance or its detection and penalization. Thus, US MNEs with environmental concerns are more likely to locate in Chinese provinces with weak environmental regulation. These considerations lead to the second hypothesis:

Hypothesis 1b: Firms with greater environmental concerns are more likely to locate FDI in regions with weaker environmental regulation.

The Moderating Effect of Firm Size

The siting of environmentally proactive firms in locations with strict regulation can be understood as seeking intangible complementary foreign assets (i.e., country-specific advantages) in that such location choices provide positive reputation externalities and reinforce positive reputation signals (Dunning, 1998). It has been argued that the environmental activities of firms are also aimed at the creation of reputation-based intangible assets (Strike et al., 2006), and consequently, negative signals about environmental performance imply negative reputational effects, that is, the destruction of such assets (Jones & Rubin, 2001).

Firms have a significant interest in not tarnishing their reputation, which is stronger the more visible firms are, as is mainly the case for larger firms (Adams & Hardwick, 1998; Bowen, 2000) because larger and more visible firms benefit comparatively more from a good reputation and also risk greater damage if their reputation is tarnished (Young & Makhija, 2014). For example, third parties typically have more information about the actions of larger firms; thus, information asymmetries are lower than for smaller firms (Brammer & Pavelin, 2006).

To maintain their reputation, larger firms with environmental strengths therefore have disproportionally higher incentives to locate in strictly regulated regions (e.g., countries or provinces). This is because they are scrutinized more due to their greater visibility and because of the higher cost and potential reputation loss from negative spillovers due to environmental issues in firms from the same industry that are geographically co-located (Brammer & Millington, 2006). In contrast, larger firms with environmental concerns are less likely to locate in strictly regulated countries or provinces because they want to avoid stronger competitors. This is easier to achieve in regions where environmental issues are perceived to be less problematic (as reflected by weaker regulation) and which, due to co-location risks, are a less likely choice for environmentally more proactive firms from the same industry.

Furthermore, as Jiang, Lin, and Lin (2014) note, smaller firms have fewer resources and more constraints (e.g., to develop environmental capabilities), and it is from this perspective less likely that small firms will locate in regions with stricter regulation. Conversely, for smaller firms with environmental weaknesses, information asymmetries are larger, and information is often not publicly available. Such firms are therefore less visible and consequently experience less pressure. Thus, smaller firms with environmental concerns have fewer incentives to locate away from strictly regulated regions than do larger firms with environmental weaknesses (Meznar & Nigh, 1995). Even if smaller firms have environmental capabilities, locating in a strictly regulated province is comparatively less beneficial for them because they are typically less exposed to media attention and are therefore also less affected by negative reputation spillovers (Erfle & McMillan, 1990). These considerations lead to two further hypotheses:

Hypothesis 2a: Firm size positively moderates the link between environmental capabilities and locating FDI in regions with stricter environmental regulation.

Hypothesis 2b: Firm size positively moderates the link between environmental concerns and locating FDI in regions with weaker environmental regulation.

DATA AND METHOD

Data Sources and Main Variables

According to Dunning and Lundan (1993: p. 3), "a multinational […] enterprise is an enterprise that engages in foreign direct investment (FDI) and owns or controls value-adding activities in more than one country." This definition applies to those S&P 500 firms that were listed among the Fortune Global 500 (i.e., the largest US MNEs) and that, according to the Chinese Ministry of Commerce, invested in Chinese provinces between 1992 and 2009, resulting in 335 FDI events, of which 297 had complete data for the purposes of our study. We identified these events through extensive and detailed analysis by manually extracting our dataset from the China Ministry of Commerce database of the Fortune Global 500 corporations' subsidiaries in China for the above years.

Entries were cross-checked with the Oriana database of Bureau Van Dijk and, if necessary, individually based on the websites for the MNEs in the sample to confirm the industry sector of the respective subsidiaries. By focusing on China, relative and absolute institutional and cultural distances and other elements of the institutional context are kept constant, which is important given that such factors have been shown to strongly affect the relationship between FDI and environmental regulation (Madsen, 2009). Additionally, by only including firms from one home country (i.e., the US), we are able to fully control for the potentially distorting effect of MNEs benefitting differently from the environmental standards of their home countries (Porter & van der Linde, 1995). At the same time, the size of the US economy ensures high variation of firm capabilities.

By choosing China as the host country, we focus on the country with the most significant environmental challenges globally (Liu & Diamond, 2005). China is a large country with high intra-country variation in regulation, and while there are many studies on US firms in the pollution haven context, there are almost none focusing on their FDI in China. Furthermore large inter-country variation exists between the US and China with regard to environmental regulatory processes.

For our analysis, we base the operationalization of environmental capabilities and weaknesses as the central explanatory variables in our hypotheses on data compiled by the rating firm Kinder Lydenberg Domini (KLD), which is one of the most reputable sources for scholarly studies in the field (McWilliams & Siegel, 2000; Waddock & Graves, 1997).[1] As argued earlier, addressing both capabilities and weaknesses is important, as Strike et al. (2006) and Surroca et al. (2013) show that firms exhibit socially responsible and irresponsible behavior at the same time; therefore, it is necessary to account for both of these types of behavior simultaneously in an empirical analysis. Additionally, it is desirable to use in parallel individual measures for responsibility (i.e., capabilities as operationalized by KLD strengths) and irresponsibility (i.e., weaknesses as reflected in KLD concerns) because aggregated measures, such as (net) sum indices, could mask opposing effects and thus create methodological artifacts. As explained above, this approach allows novel insights into inconclusive results from empirical tests of the pollution haven argument. Finally, the strong call of Young & Makhija (2014) to account for firm heterogeneity when analyzing CSR-related behavior can be answered convincingly with KLD data, which is why the latter seem well suited for our purposes.

Of the KLD data, only those referring to environmental strengths and concerns were chosen as explanatory variables because the dependent variable in the analysis (see below) refers only to environmental regulation. Additionally, following Husted and Allen (2006), in our variable choices, we focus on global environmental management activities because doing so can control for strategy differences across firms that are very difficult to observe. Finally, we limit ourselves to those KLD measures that are available for all of the years we study to remain comparable over time. Given that the data are collected by firm-independent researchers, problems of social desirability that frequently confound empirical work on environmental management (especially in the case of self-evaluation, for example, as in surveys) are much less pronounced with the KLD data.

Furthermore, the data are much more detailed and informative than single binary indicators, such as ISO 14000 or ISO 9000 certification. Moreover, for these latter two measures, interpretation is notoriously difficult for various reasons. First, the predictive value of one or a few sites of a firm out of many being certified to ISO 14000 is unclear. Second, ISO 9000 only partly signifies environmental capabilities, given that they are only understood in a very limited way as one element of quality in the context of ISO 9000.

As for the explanatory variables in this study, six KLD variables – three of which refer to strengths and three to concerns – are used to operationalize the hypotheses derived earlier. The first of the strength variables (named "environmental innovation capability") indicates that a firm has innovative products or services that protect the environment or that it is achieving significant sales with such products or services. The variable thus reflects a capability for environmental innovation. The second strength variable (named "pollution prevention capability") refers to strong pollution prevention programs and reflects a capability to utilize integrated environmental process technologies. Finally, the third strength variable (named "environmental management capability") relates to a strong commitment to management systems, voluntary programs, or other environmentally proactive activities. It thus reflects a capability of proactive and holistic environmental management.

To operationalize weaknesses, three variables corresponding to environmental concerns in the KLD data are used. The first concern variable (named "hazardous waste weakness") refers to a firm with high hazardous waste liabilities or recent substantial fines for waste violations. The second concern variable (named "regulatory problems weakness") relates to recent substantial fines for violations of air, water, or other environmental regulations or a pattern of violations of important US regulations in these areas (Cardenas, 2014).[2] Finally, the third concern variable (named "substantial emission weakness") indicates that a firm's legal emissions of toxic chemicals in the US (as defined by and reported to the US Environmental Protection Agency under the Toxic Release Inventory regulation) are among the highest of the companies followed by KLD for a specific year. Jointly, these six explanatory variables cover various and very different capability-based mechanisms and thus comprehensively operationalize firm heterogeneity for the purposes of our study. As shown in Table 1, firm heterogeneity is also empirically confirmed for the six KLD variables from the mean values and standard deviations.

We further externally validate the use of these six KLD measures for our study by correlating them with data from CSRHUB (see www.csrhub.com), which is a social and environmental governance rating that ranges between 0 and 100. For the subset of firms in our data with an available CSRHUB rating (n = 290), we correlate the ratings with each of the six variables introduced above and find that for the three strength variables, the correlation is positive and significant ($p < 0.05$) in each case. In contrast, for all three environmental concern variables, the correlation is insignificant, which suggests that the individual KLD variables can adequately discriminate between capabilities and weaknesses with regard to environmental management.

To gauge omnibus effects, in addition to estimating our models with the individual variables entered separately, we also carry out estimations with a joint sum index consisting of all six variables, (named "Environmental capability net sum index"), where concerns are subtracted from strengths, which are positive, as is frequently done with KLD data. More specifically, after adding up the three strength variables and subtracting from the result the sum of the three concern variables included in our analysis, we performed a linear positive transformation to arrive at a purely positive scale starting with a value of zero, which does not affect the estimation results.

By using these two variants of entering our explanatory variables into the analysis, we are also able to address whether aggregation to total sum scores masks individual effects. This approach contributes to clarifying whether the ambiguous empirical evidence on pollution havens is at least partly driven by methodological choices, which addresses an important gap in the literature.

The dependent variable in this study is based on provincial emission fees, as Dasgupta, Wheeler and Huq (1997) show that, for China, the pollution levying system is well developed but, at the same time, it varies considerably across provinces. The sum of pollution discharge fees normalized by the

Table 1 Descriptive statistics

Variable name	Variable mean	Standard deviation
1. Environmental regulation strictness (dep. var.)	24.97	10.17
2. Binary regulation strictness (alternative dep. var.)	0.36	0.48
3. Environmental capability net sum index	2.36	1.08
4. Environmental innovation capability	0.06	0.24
5. Pollution prevention capability	0.23	0.42
6. Environmental management capability	0.14	0.35
7. Hazardous waste weakness	0.41	0.49
8. Regulatory problems weakness	0.37	0.48
9. Substantial emission weakness	0.29	0.45
10. Employees	4.51	0.85
11. Tax rate	24.08	58.43
12. Debt-to-assets ratio	25.82	13.60
13. Return on assets (ROA)	6.42	6.07
14. Tobin's Q	5.19	3.90
15. Capital-to-sales	60.16	48.81
16. Advertising-to-sales	82.16	38.34
17. Polluting industry	0.30	0.46
18. Service industry	0.22	0.41
19. Distance-to-port	10.15	8.73
20. GDP per capita	8091.07	6061.37
21. Beijing	0.10	0.31
22. Liaoning	0.04	0.20
23. Tianjing	0.05	0.23
24. Shanghai	0.15	0.36
25. Guangxi	0.09	0.29
26. Zhejiang	0.06	0.23
27. Guangdong	0.11	0.31
28. Sichuan	0.07	0.26

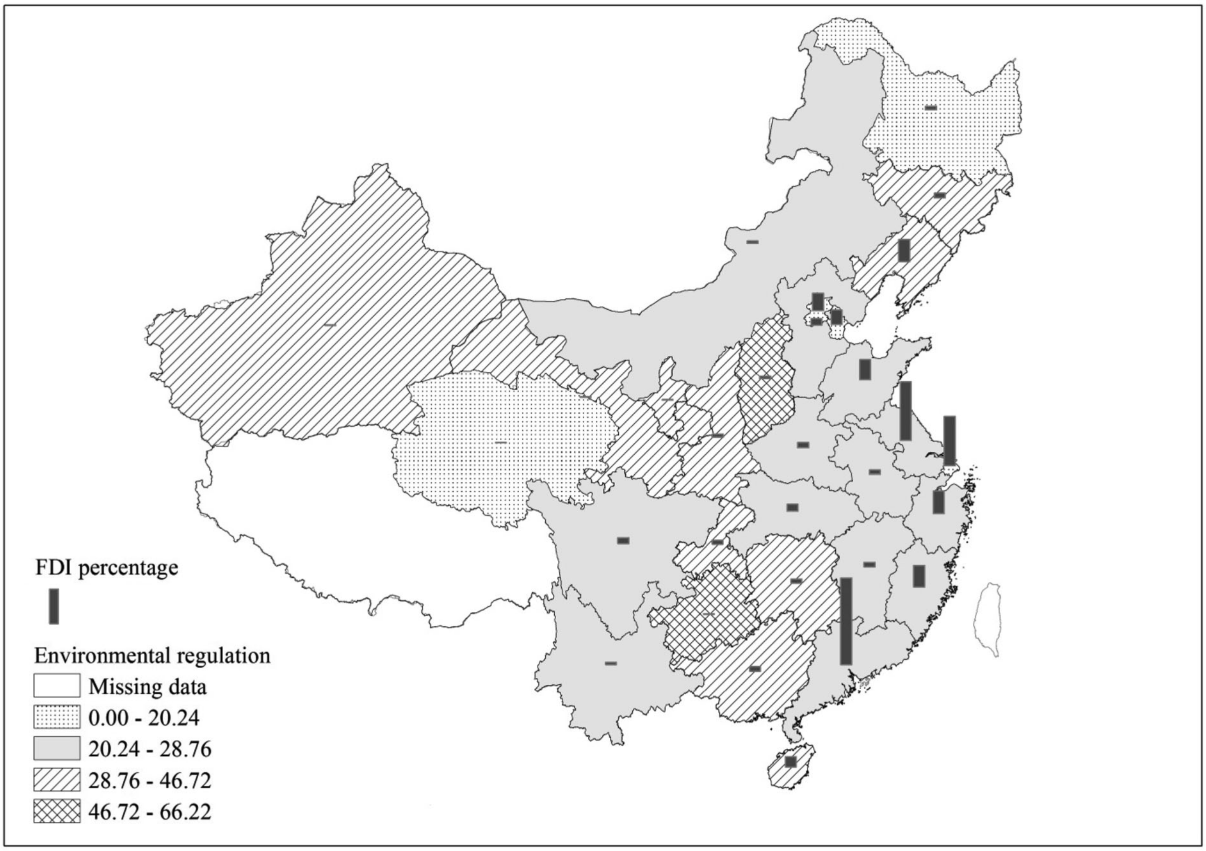
Notes: Number of observations: 297; dep. var.: dependent variable.

added value created in the manufacturing industry (to control for province size) is used to gauge the strictness of a province's environmental regulation (named "Environmental regulation strictness").[3] Importantly, we use a comprehensive measure of water, air and waste emission fees that is more encompassing than the measures used thus far in the Chinese context. Using emission fees for these different environmental media jointly as a measure of regulatory stringency is also advisable, as the relevance of different emissions is industry specific. For example, Dean et al. (2009) use only chemical oxygen demand (COD) load per ton of wastewater as an indicator of environmental stringency, but this measure has been shown to vary greatly in relevance across industries (Tyteca, Carlens, Berkhout, Hertin, Wehrmeyer & Wagner, 2002). Our measure is not affected by such a potential bias.[4] Additionally, other than Dean et al. (2009), who only use values of one baseline year in their data, our dependent variable is time-varying, that is, we account for changes in regulatory stringency over time by using annual values of our dependent variable of regulation strictness for each province. As detailed later, we also employ a binary variant of this dependent variable in one of our sensitivity analyses.

Figure 1 shows the variation of FDI and environmental regulation strictness. Across all years, the mean of the dependent variable in our data is 24.97 and the standard deviation 10.17, which suggests that the distribution of our dependent variable is not skewed. The minimum and maximum values of our dependent variable of 4.3 and 66.2, respectively, together with Figure 1 suggest sufficient inter-provincial variation of environmental regulation strictness for the purposes of our analysis. They also confirm the need to use annual regulation data (instead of fixing values to initial or mean levels) to account for temporal variation.

Control Variables and Estimation Strategy

Beyond the independent variables, several control variables are included in the estimated models to



Notes: For the Tibet province, environmental regulation stringency data are unavailable, and it thus had to be omitted from the analysis, yet its FDI is negligible.

Figure 1 Average environmental stringency and FDI levels by Chinese province (1992–2009).

account for important firm-level characteristics. First, return on assets (named "ROA") and market-to-book value (named "Tobin's Q") are included in variants of the analysis as alternative measures of profitability. These variables are used because, all else being equal, higher profits should make a firm more inclined to invest in a foreign location with more stringent environmental regulation, given that it would be in a better position to absorb any unexpected additional cost associated with the stricter regulation and would have more slack resources available (Aguilera-Caracuel, Aragón-Correa & Hurtado-Torres, 2011). Conversely, firms with high debt-to-asset ratios are less likely to pursue investments in regions with stringent environmental regulation because they either experience higher capital risk or have stronger financial restrictions. Thus, this ratio was included as a variable (named "Debt-to-assets ratio"). Firm size, in addition to being included as an interaction variable, is also added as a direct control variable because the visibility issues raised earlier may also affect firm behavior, independent of current levels of strengths and weaknesses (Henriques & Sadorsky, 1996). Firm size is measured by the logarithm of the number of employees of a firm and is named "Employees".

Several studies provide evidence that more stringent environmental regulations put firms in highly polluting industries at a competitive disadvantage (Barbera & McConnell, 1990; Brännlund, Färe & Grosskopf, 1995). Dean et al. (2009) consistently show that firms in these industries are significantly less likely to invest in regions with high levels of environmental levies. It is therefore important to distinguish highly polluting industries from others, as performed here based on the classification of Mani and Wheeler (1998) using a binary variable (named "Polluting industry"), assuming unity if a firm is operating in an industry associated with high levels of negative environmental impacts.

Furthermore, we follow Christmann and Taylor (2006) as well as Rivera and Oh (2013) and additionally control for industry effects by including a binary variable (named "Service industry"), assuming unity if a firm is operating in a service sector. We also adopt the approach of Christmann and Taylor (2001) and include dummy variables for the eight industries with the largest number of observations in our sample in all of the estimations, namely, "Chemical products", "Food products" (16% each), "Machinery and equipment", "Transport equipment" (9% each), "Electronic and electric products" (8%), "Paper products" (7%), "Diversified business" and "Food retail" (6% each). This approach controls for variation across industries in terms of export intensity, stakeholder pressure with regard to environmental performance and compliance and competitive isomorphism (DiMaggio & Powell, 1983; Makhija & Stewart, 2002).

Our comprehensive set of industry controls is matched by a corresponding set of province-level controls. These controls include provincial gross domestic product per capita by year (named "GDP per capita") and distance of the province to the nearest seaport (named "Distance to port"). Following the approach of Wei and Wu (2001), we calculate the distance variable based on the nearest railway distance from each province's capital city to the two main seaports (Shanghai and Hong Kong). Province-level GDP per capita and distance to port control for market and cost conditions, different skill levels and corresponding likelihoods of inhabitants voicing concerns about environmental pollution in their provinces as well as province-specific factors affecting siting.[5]

In addition, dummy variables for "Beijing" (to account for peculiarities of the capital province, which, in many ways, is unique in the Chinese context, especially concerning environmental pollution) and "Liaoning" (which simultaneously has high environmental fees and FDI) are included (see also Figure 1). To remain consistent with our industry controls, we also incorporate dummies for the six provinces that have greater shares in our data than Liaoning (named "Tianjing", "Shanghai", "Guangxi", "Zhejiang", "Sichuan", and "Guangdong"), in turn controlling for the eight provinces with the largest number of observations.

All of the estimated models also include the effective tax rate (named "Tax rate") of the firms in the sample (based on total income and taxes imposed by federal, state, and foreign governments), as this rate could vary individually across firms and thus could affect firms' FDI decisions. Furthermore, in all of the estimations, time dummies for all years in the data are included to account for temporal variation that is correlated across provinces and firms (for reasons of brevity, we only report tests of their joint significance, but detailed results are available upon request from the authors).

Following Cole et al. (2014), we include in a variant of the model the ratios of advertising expenditures to sales (named "Advertising to sales") and of property, plant, and equipment to total assets (named "Capital to sales") to account for advertising and capital intensity, respectively. These variables control for the effect of firms with higher advertising intensity potentially having unique siting motivations, such as customer access. Additionally, higher levels of capital intensity might lead to less frequent relocation and more substantial challenges for firms that are concerned about addressing regulatory requirements.[6]

Because this extensive set of control variables comprehensively accounts for spatial, firm-specific and temporal effects, any remaining significance in the explanatory environmental capability variables is unlikely to be related to omitted variable or other biases. We use non-lagged explanatory variables because the KLD scores for firms are relatively persistent over time and because temporal and spatial effects on changes in regulation are in general more short term (e.g., provincial governments acted almost immediately following the Beijing smog incidents). More specifically, for our aggregated (net sum) index, the coefficients of variation range from 0.07 to 1.41, with an average of 0.42. Furthermore, 45% of the firms for which more than one year of observations entered our data have zero variation of the aggregated index. Table 1 summarizes the descriptive statistics and Table 2 shows the correlations of the data, which are all in the usual ranges, thus providing initial evidence that multicollinearity is not an issue. Furthermore, all three individual weakness and all three individual capability items have negative associations and positive associations, respectively, with the aggregated index (five of them significantly). In addition, the individual capability items are pairwise uncorrelated with one another, which justifies the disaggregated analysis since they reflect independent strengths and because masking effects in the aggregated index are likely in this case. The correlation of environmental regulatory stringency with GDP per capita is −0.6, which confirms the

Table 2 Correlations (numbering of variables as in Table 1)

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Env. regulation	1.00												
2. Env. dummy	0.74***	1.00											
3. Env. sum index	−0.01	0.02	1.00										
4. Env. innovation	−0.02	0.02	0.14*	1.00									
5. Poll. prevention	−0.05	−0.05	0.11†	0.03	1.00								
6. Env. managem.	0.13*	0.11†	0.09	0.02	−0.02	1.00							
7. Hazard. Waste	0.05	0.04	−0.70***	0.07	0.22***	0.18**	1.00						
8. Regul. problems	0.04	0.03	−0.67***	0.18**	0.15*	0.18**	0.47***	1.00					
9. Subst. emissions	−0.03	−0.07	−0.65***	−0.04	0.26***	0.18**	0.45***	0.38***	1.00				
10. Employee	0.01	−0.0000	−0.10	0.10†	0.06	−0.02	0.15**	0.15**	−0.009	1.00			
11. Tax rate	0.13*	0.08	0.11†	0.02	−0.18**	0.003	−0.12*	−0.10†	−0.16**	0.02	1.00		
12. Debt-to-assets	0.06	0.05	−0.22***	0.10†	−0.11†	−0.02	0.12*	0.23***	0.07	0.23***	−0.06	1.00	
13. ROA	0.11†	0.11†	0.28***	−0.14*	−0.04	−0.10†	−0.29***	−0.27***	−0.23***	−0.19**	0.10†	−0.25***	1.00
14. Tobin's Q	0.14*	0.10†	0.25***	−0.10†	−0.08	−0.13*	−0.32***	−0.28***	−0.18**	−0.23***	0.03	−0.12*	0.68***
15. Capital-to-sales	0.32***	0.18**	−0.02	−0.17**	−0.07	−0.05	−0.03	−0.08	−0.02	−0.12*	0.15**	0.002	0.30***
16. Adv.-to-sales	0.28***	0.18**	−0.17**	−0.03	−0.02	−0.03	0.19***	0.05	0.08	−0.15**	−0.007	0.05	0.09
17. Polluting indus.	−0.06	−0.002	−0.27***	−0.11†	0.13*	0.23***	0.30***	0.19**	0.37***	−0.25***	−0.13*	−0.14*	0.09
18. Service indus.	−0.009	−0.09	−0.002	0.04	−0.25***	−0.10†	−0.06	−0.005	−0.21***	0.43***	0.06	0.19**	−0.14*
19. Dist.-to-port	0.46***	0.37***	0.007	−0.06	−0.03	0.03	−0.03	0.03	−0.05	−0.008	0.09	0.02	0.06
20. GDP per capita	−0.64***	−0.41***	−0.001	0.11†	0.06	−0.03	0.01	0.02	0.07	0.02	−0.14*	−0.02	−0.30***
21. Beijing	−0.04	−0.02	−0.10†	−0.04	0.0002	−0.05	0.03	0.06	0.10†	0.004	0.04	−0.08	−0.04
22. Liaoning	0.29***	0.29***	−0.07	0.08	−0.08	0.05	0.02	0.11†	0.04	0.004	0.02	0.03	0.02
23. Tianjing	−0.14*	−0.18**	0.03	0.002	0.01	−0.01	−0.05	0.06	−0.09	−0.005	0.03	0.05	0.02
24. Shanghai	−0.59***	−0.31***	0.03	0.01	0.02	−0.09	−0.001	−0.09	−0.02	−0.01	−0.11†	−0.02	−0.10†
25. Guangxi	−0.04	−0.17**	−0.05	0.01	0.05	0.06	0.06	0.01	0.15**	−0.01	0.01	0.03	−0.07
26. Zhejiang	−0.04	−0.09	0.04	0.12*	−0.03	0.02	0.0005	−0.01	−0.03	−0.01	−0.12*	0.01	−0.01
27. Guangdong	−0.03	−0.03	−0.01	0.05	−0.03	0.01	0.02	0.05	−0.03	−0.03	0.04	−0.05	0.01
28. Sichuan	0.007	−0.07	0.04	0.04	−0.02	−0.002	−0.02	−0.05	−0.03	−0.05	0.02	−0.09	0.03

Variable	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.
15. Capital-to-sales	0.28***	1.00											
16. Adv.-to-sales	0.09	0.57***	1.00										
17. Polluting indus.	0.01	−0.04	0.02	1.00									
18. Service indus.	−0.20***	−0.05	−0.03	−0.35***	1.00								
19. Distance-to-port	0.12*	0.16**	0.15**	−0.02	−0.05	1.00							
20. GDP per capita	−0.23***	−0.55***	−0.37***	0.06	−0.04	−0.46***	1.00						
21. Beijing	−0.05	0.03	0.04	0.09	−0.02	0.18**	0.26***	1.00					
22. Liaoning	−0.002	0.04	0.10†	0.11†	0.006	0.25***	−0.08	−0.07	1.00				
23. Tianjing	−0.02	0.07	0.03	−0.03	−0.05	0.09	0.03	−0.08	−0.05	1.00			
24. Shanghai	−0.11†	−0.24***	−0.23***	0.08	−0.04	−0.49***	0.69***	−0.14*	−0.09	−0.10†	1.00		
25. Guangxi	−0.08	−0.02	0.03	0.04	−0.004	−0.26***	−0.04	−0.11†	−0.07	−0.08	−0.13*	1.00	
26. Zhejiang	0.02	−0.07	−0.04	−0.005	0.04	−0.23***	0.06	−0.08	−0.05	−0.06	−0.10†	−0.08	1.00

Table 2 (*Continued*)

Variable	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.
27. Guangdong	−0.06	−0.004	−0.008	0.007	0.08	−0.34***	−0.07	−0.12*	−0.07	−0.08	−0.14*	−0.11†	−0.09
28. Sichuan	0.09	0.12*	0.06	−0.01	0.01	0.42***	−0.25***	−0.09	−0.06	−0.07	−0.12*	−0.09	−0.07

Notes: Significance levels are: † $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; number of observations: 297; correl. Guangdong-Sichuan: −0.10†; correlations of the eight industries with the largest numbers of observations and the time dummies with all other variables are available upon request.

expectation that the large majority of provinces are still on the increasing slope part of the Environmental Kuznets Curve (EKC), which further increases our confidence in the measure.[7]

Initially, an ordinary least squares (OLS) regression with robust standard errors clustered by province-year is applied to the data to test the hypotheses derived above, as suggested by Rabe-Hesketh and Skrondal (2008). In the sensitivity analyses, we employ probit models with robust standard errors clustered by province-year based on a binary dependent variable that is derived as described below (we are grateful to one reviewer for pointing this strategy out to us, and we also follow Lin, Moon and Yin (2013) in this approach). To remain parsimonious, we only report omnibus test results for industry and year controls, but detailed results of these estimations are available upon request.

RESULTS

As observed in Tables 3 and 4, all of the model variants for our continuous dependent variable have highly significant F values ($p < 0.001$), indicating high overall predictive quality. In terms of hypothesis testing, for the model with the individual capability variables, the second to fourth columns of Table 3 (which uses Tobin's Q value as a measure of firm profitability) show that Hypothesis 1a is confirmed for strengths in environmental management ($\beta = 2.16$, $p = 0.06$). This result remains unchanged when advertising and capital intensities and interactions are omitted.

With regard to weaknesses (i.e., lacking capabilities), Table 3 shows that Hypothesis 1b is confirmed for concerns about substantial emissions, where the coefficient is negative and significant in the model with advertising and capital intensities and interactions ($\beta = -2.35$, $p = 0.04$) and also in the other variants. When including our hypothesized interaction effects in the fourth column of Table 3, we find two additional interaction effects in the hypothesized direction: a significant negative interaction of concerns about hazardous waste with firm size ($\beta = -3.46$, $p = 0.05$) and a significant negative interaction of concerns about regulatory problems with firm size ($\beta = -2.03$, $p = 0.06$). Both of these results confirm Hypothesis 2b.

As for the control variables, in all of the estimations, per capita GDP has a significantly negative association with the dependent variable.

Table 3 Association of strengths and concerns with regulation strictness using Tobin's Q as performance measure

Variables	Coeff. (individ.)	Coeff. (individ.)	Coeff. (individ.)	Coeff. (index)	Coeff. (index)	Coeff. (index)
Environmental capability net sum index				0.46 (0.48)	0.46 (0.46)	0.23 (0.48)
Environmental capability net sum index × size						1.40 (0.59)*
Environmental innovation capability	1.82 (1.26)	1.69 (1.32)	1.84 (1.41)			
Environmental innovation capability × size			−1.52 (2.18)			
Pollution prevention capability	0.40 (0.91)	0.40 (0.93)	0.09 (0.99)			
Pollution prevention capability × size			1.05 (2.06)			
Environmental management capability	1.94 (1.13)†	2.04 (1.15)†	2.16 (1.13)†			
Environmental management capability × size			−0.14 (1.54)			
Hazardous waste weakness	1.17 (1.04)	1.01 (1.06)	0.25 (1.10)			
Hazardous waste weakness × size			−3.46 (1.78)†			
Regulatory problems weakness	0.54 (0.93)	0.66 (0.96)	1.02 (0.99)			
Regulatory problems weakness × size			−2.03 (1.08)†			
Substantial emission weakness	−2.35 (1.07)*	−2.23 (1.08)*	−2.35 (1.13)*			
Substantial emission weakness × size			0.24 (1.09)			
Size (Employees)	−0.21 (0.49)	−0.11 (0.51)	−0.67 (0.72)	−0.12 (0.47)	−0.02 (0.49)	−0.14 (0.49)
Tax rate	0.0001 (0.003)	0.001 (0.004)	−0.0005 (0.004)	0.001 (0.003)	0.003 (0.003)	0.002 (0.003)
Debt-to-assets ratio	0.05 (0.04)	0.05 (0.04)	0.07 (0.04)†	0.05 (0.04)	0.06 (0.04)	0.07 (0.04)†
Tobin's Q	0.07 (0.13)	0.07 (0.13)	0.23 (0.15)	−0.02 (0.13)	−0.008 (0.13)	0.10 (0.14)
Capital-to-sales		−0.85 (1.83)	−2.10 (1.93)		−0.27 (1.84)	−0.57 (1.79)
Advertising-to-sales		9.82 (33.13)	16.14 (35.10)		6.31 (34.82)	9.43 (35.05)
Polluting industry	−2.38 (2.20)	−2.71 (2.25)	−3.79 (2.30)	−2.79 (2.21)	−3.07 (2.21)	−3.29 (2.19)
Service industry	−1.51 (1.66)	−1.59 (1.63)	−1.48 (1.70)	−1.97 (1.40)	−2.08 (1.41)	−1.40 (1.37)
Distance-to-port	−0.006 (0.12)	−0.01 (0.12)	−0.008 (0.12)	0.004 (0.13)	−0.005 (0.12)	0.005 (0.12)
GDP per capita	−0.001 (0.0003)***	−0.001 (0.0003)***	−0.001 (0.0003)***	−0.001 (0.0003)***	−0.001 (0.0003)***	−0.001 (0.0003)***
Beijing	3.35 (3.12)	3.21 (3.13)	4.71 (3.36)	2.94 (3.19)	2.78 (3.18)	3.25 (3.19)
Liaoning	9.29 (1.73)***	9.15 (1.73)***	9.94 (1.85)***	9.68 (1.60)***	9.53 (1.56)***	9.86 (1.52)***
Tianjing	−6.75 (2.64)*	−6.68 (2.67)*	−5.60 (2.61)*	−6.62 (2.56)*	−6.56 (2.57)*	−6.33 (2.56)*
Shanghai	−3.20 (4.51)	−3.20 (4.50)	−0.48 (4.70)	−3.53 (4.64)	−3.65 (4.60)	−2.60 (4.57)
Zhejiang	−3.57 (2.77)	−3.52 (2.78)	−2.81 (2.82)	−3.31 (2.88)	−3.33 (2.89)	−3.07 (2.85)
Guangxi	−4.84 (2.40)*	−4.88 (2.37)*	−4.02 (2.33)†	−5.21 (2.50)*	−5.31 (2.46)*	−4.98 (2.41)*
Guangdong	−3.70 (2.54)	−3.72 (2.54)	−3.48 (2.52)	−3.61 (2.60)	−3.66 (2.60)	−3.31 (2.57)
Sichuan	−6.67 (1.73)***	−6.55 (1.76)***	−6.36 (1.78)***	−6.68 (1.77)***	−6.52 (1.79)***	−6.67 (1.80)***
Constant	31.49 (3.85)***	31.18 (4.75)***	32.14 (5.40)***	29.53 (3.61)***	29.58 (4.69)***	28.99 (4.49)***

Table 3 (*Continued*)

Variables	Coeff. (individ.)	Coeff. (individ.)	Coeff. (individ.)	Coeff. (index)	Coeff. (index)	Coeff. (index)
Number of observations	297	297	297	297	297	297
Joint time dummy significance test	2.49**	2.48**	2.67***	2.39**	2.36**	2.56**
Joint industrial sector dummy significance test	0.87	0.87	1.81†	0.90	0.82	1.00
R^2	0.68	0.68	0.70	0.67	0.67	0.68
F	25.30***	28.34***	22.92***	28.89***	26.28***	29.91***

Notes: Significance levels are: † $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; firm-clustered robust standard errors in parentheses; joint industrial sector dummy significance test refers to the eight industries with the largest numbers of observations.

Furthermore, the Liaoning dummy has a significant positive and the Guangxi, Sichuan and Tianjing dummies a significant negative association. In the model with interactions, the debt-to-asset ratio additionally has a significantly positive association with the dependent variable.

Concerning the model specification variant with the aggregated net sum index integrating the six individual variables described above, the fifth to seventh columns of Table 3 reveal that no omnibus effect occurs, while the effects for the control variables remain unchanged. That is, the aggregation to total sum scores masks the individual effects, or, stated another way, siting decisions with regard to the stringency of environmental regulation can be predicted better from the specific individual environmental attributes of firms. This result shows that the aggregation level can affect the empirical evidence on pollution havens and the related "race to the bottom" issue, which could thus be partly driven by methodological artifacts. When adding the size interaction with the index to the model, a significant positive interaction ($\beta = 1.40$, $p = 0.02$) is found, which confirms Hypothesis 2a.

Concerning the model variant with return on assets as the profitability variable, Table 4 shows that the results are qualitatively and in order of magnitude identical to those with Tobin's Q, except for the debt-to-asset ratio and the interaction of firm size with regulatory problems, which becomes insignificant. Specifically, the coefficient for strengths in environmental management is significantly positive ($\beta = 2.08$, $p = 0.07$), and the coefficient for substantial emissions is significantly negative ($\beta = -2.43$, $p = 0.03$), again supporting Hypotheses 1a and 1b. Additionally, the interaction of firm size with hazardous waste is again significantly negative ($\beta = -3.53$, $p = 0.05$), which supports Hypothesis 2b.

Again, the findings do not change when omitting advertising and capital intensity from the model. Furthermore, as before, GDP per capita and the mentioned four provincial dummies are significantly associated with the dependent variable in the same direction as with Tobin's Q.

Concerning the model specification with the sum index of the six variables, the fifth to seventh columns of Table 4 again reveal that no omnibus effect occurs and that the controls remain significant, as before. Furthermore, when introducing the interaction of firm size and the index, we again find a significantly positive effect ($\beta = 1.21$, $p = 0.03$), which supports Hypothesis 2a.

Table 4 Association of strengths and concerns with regulation strictness using ROA as performance measure

Variables	Coeff. (individ.)	Coeff. (individ.)	Coeff. (individ.)	Coeff. (index)	Coeff. (index)	Coeff. (index)
Environmental capability net sum index				0.46 (0.49)	0.47 (0.48)	0.30 (0.49)
Environmental capability net sum index × size						1.21 (0.55)*
Environmental innovation capability	1.78 (1.27)	1.65 (1.32)	1.85 (1.38)			
Environmental innovation capability × size			−1.72 (2.15)			
Pollution prevention capability	0.38 (0.91)	0.39 (0.94)	0.10 (1.02)			
Pollution prevention capability × size			1.20 (2.03)			
Environmental management capability	1.90 (1.14)†	2.01 (1.15)†	2.08 (1.15)†			
Environmental management capability × size			−0.06 (1.50)			
Hazardous waste weakness	1.09 (1.07)	0.91 (1.07)	0.06 (1.10)			
Hazardous waste weakness × size			−3.53 (1.78)*			
Regulatory problems weakness	0.50 (0.92)	0.61 (0.97)	0.88 (1.00)			
Regulatory problems weakness × size			−1.36 (1.00)			
Substantial emission weakness	−2.34 (1.07)*	−2.25 (1.08)*	−2.43 (1.13)*			
Substantial emission weakness × size			0.44 (1.11)			
Size (Employees)	−0.22 (0.49)	−0.11 (0.51)	−0.66 (0.73)	−0.12 (0.47)	−0.03 (0.49)	−0.13 (0.49)
Tax rate	0.00004 (0.004)	0.001 (0.004)	−0.0008 (0.004)	0.001 (0.003)	0.003 (0.003)	0.002 (0.003)
Debt-to-assets ratio	0.05 (0.04)	0.05 (0.04)	0.07 (0.04)	0.05 (0.04)	0.05 (0.04)	0.06 (0.04)
ROA	0.02 (0.08)	0.02 (0.08)	0.07 (0.09)	−0.008 (0.08)	−0.02 (0.08)	0.02 (0.08)
Capital-to-sales		−0.82 (1.83)	−1.78 (1.94)		−0.25 (1.84)	−0.51 (1.80)
Advertising-to-sales		9.20 (32.85)	14.43 (34.33)		5.94 (34.54)	8.09 (34.42)
Polluting industry	−2.44 (2.21)	−2.75 (2.25)	−3.67 (2.32)	−2.77 (2.23)	−3.02 (2.23)	−3.23 (2.21)
Service industry	−1.59 (1.67)	−1.68 (1.65)	−1.89 (1.72)	−1.97 (1.40)	−2.10 (1.43)	−1.53 (1.39)
Distance-to-port	−0.007 (0.12)	−0.01 (0.12)	−0.01 (0.12)	0.004 (0.13)	−0.004 (0.12)	0.003 (0.12)
GDP per capita	−0.001 (0.0003)***	−0.001 (0.0003)***	−0.001 (0.0003)***	−0.001 (0.0003)***	−0.001 (0.0003)***	−0.001 (0.0003)***
Beijing	3.27 (3.09)	3.14 (3.11)	4.54 (3.32)	2.94 (3.18)	2.72 (3.17)	3.12 (3.18)
Liaoning	9.26 (1.72)***	9.12 (1.72)***	9.83 (1.85)***	9.68 (1.59)***	9.51 (1.55)***	9.77 (1.52)***
Tianjing	−6.82 (2.64)*	−6.77 (2.66)*	−5.79 (2.65)*	−6.62 (2.57)*	−6.59 (2.57)*	−6.48 (2.56)*
Shanghai	−3.34 (4.53)	−3.34 (4.53)	−0.96 (4.73)	−3.52 (4.67)	−3.72 (4.62)	−2.89 (4.61)
Guangxi	−4.94 (2.41)*	−4.98 (2.38)*	−4.28 (2.38)†	−5.19 (2.51)*	−5.32 (2.47)*	−5.15 (2.44)*
Zhejiang	−3.61 (2.79)	−3.57 (2.80)	−2.94 (2.86)	−3.30 (2.89)	−3.33 (2.90)	−3.18 (2.88)
Guangdong	−3.79 (2.54)	−3.80 (2.54)	−3.75 (2.53)	−3.59 (2.61)	−3.66 (2.60)	−3.47 (2.57)
Sichuan	−6.62 (1.71)***	−6.50 (1.74)***	−6.24 (1.78)***	−6.69 (1.75)***	−6.53 (1.77)***	−6.59 (1.78)***
Constant	31.70 (3.85)***	31.13 (4.90)***	32.11 (5.65)***	29.52 (3.58)***	29.75 (4.74)***	28.97 (4.54)***

Table 4 (*Continued*)

Variables	Coeff. (individ.)	Coeff. (individ.)	Coeff. (individ.)	Coeff. (index)	Coeff. (index)	Coeff. (index)
Number of observations	297	297	297	297	297	297
Joint time dummy significance test	2.37**	2.39**	2.55**	2.24**	2.25**	2.43**
Joint industrial sector dummy significance test	0.83	0.83	1.29	0.92	0.85	0.98
R^2	0.68	0.68	0.69	0.67	0.67	0.68
F	25.17***	24.34***	21.41***	28.87***	28.91***	29.84***

Notes: Significance levels are: † p < 0.10; * p < 0.05; ** p < 0.01; *** p < 0.001; firm-clustered robust standard errors in parentheses; joint industrial sector dummy significance test refers to the eight industries with the largest numbers of observations.

We also carried out a range of sensitivity tests and robustness checks with a binary specification of our dependent variable based on the annual median of regulatory stringency. More specifically, we calculated a binary dummy variable based on the complete regulatory stringency data for all provinces in each year. It assumes unity if the environmental regulation level of a province in a given year is above the median regulation level across all provinces for that year and zero if it is below the median level. The results of these sensitivity tests are reported in Tables 5 and 6 and show that the basic results and outcomes of the hypothesis tests remain as in Tables 3 and 4.

First, all of the models are again highly significant overall ($p < 0.001$). For the models with Tobin's Q and the individual capability and concern variables (second to fourth columns in Table 5), as for the continuous dependent variable above, environmental management capabilities are significantly positively associated with the binary dependent variable (as are environmental innovation capabilities), which again confirms Hypothesis 1a. Furthermore, substantial emission concerns are, as before, significantly negatively associated with this dependent variable, thus supporting Hypothesis 1b. When including the full set of interaction effects, the interactions of firm size with regulatory problems and hazardous waste concerns are significantly negative, which again confirms Hypothesis 2b. However, in this last model, the effect for environmental innovation capabilities becomes insignificant, but at the same time, the interaction of firm size with substantial emission concerns becomes additionally significantly negative, which lends further support to Hypothesis 2b.

The service, advertising intensity and Liaoning variables have a significant positive and the Shanghai, Sichuan and Tianjing dummies a significant negative association. Additionally, the coefficients of GDP per capita and Tobin's Q are significantly negative and positive, respectively, in the model with interactions.

For the models with Tobin's Q and the aggregated net sum index (fifth to seventh columns in Table 5), as before, the interaction of the aggregated index and firm size is significant, thus supporting Hypothesis 2a. Furthermore, the index itself is significant and positive when not including the firm size interaction, which in itself supports Hypothesis 1a but again highlights an omitted variable issue, given that the effect disappears when the interaction is included. Compared to the model

Table 5 Association of strengths and concerns with regulation strictness using Tobin's Q as performance measure (binary regulation strictness variable)

Variables	Coeff. (individ.)	Coeff. (individ.)	Coeff. (individ.)	Coeff. (index)	Coeff. (index)	Coeff. (index)
Environmental capability net sum index				0.29 (0.12)*	0.31 (0.13)*	0.20 (0.14)
Environmental capability net sum index × size						0.76 (0.19)***
Environmental innovation capability	0.99 (0.49)*	0.98 (0.56)†	0.46 (0.75)			
Environmental innovation capability × size			0.47 (0.98)			
Pollution prevention capability	0.10 (0.25)	0.09 (0.27)	−0.10 (0.33)			
Pollution prevention capability × size			0.99 (0.72)			
Environmental management capability	0.86 (0.32)**	1.04 (0.37)**	0.84 (0.34)*			
Environmental management capability × size			−0.05 (0.59)			
Hazardous waste weakness	0.21 (0.32)	0.09 (0.34)	−0.10 (0.34)			
Hazardous waste weakness × size			−1.12 (0.45)*			
Regulatory problems weakness	0.25 (0.30)	0.27 (0.33)	0.46 (0.33)			
Regulatory problems weakness × size			−0.86 (0.35)*			
Substantial emission weakness	−1.08 (0.28)***	−1.08 (0.29)***	−1.01 (0.34)**			
Substantial emission weakness × size			−0.84 (0.38)*			
Size (Employees)	−0.16 (0.15)	−0.12 (0.16)	−0.36 (0.26)	−0.10 (0.14)	−0.08 (0.15)	−0.22 (0.17)
Tax rate	0.003 (0.007)	0.004 (0.008)	0.004 (0.008)	0.004 (0.006)	0.005 (0.007)	0.007 (0.007)
Debt-to-assets ratio	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.009)	0.01 (0.009)
Tobin's Q	−0.01 (0.03)	−0.0007 (0.03)	0.07 (0.03)†	−0.04 (0.03)	−0.03 (0.03)	0.03 (0.03)
Capital-to-sales		0.11 (0.63)	−0.14 (0.69)		0.50 (0.54)	0.45 (0.56)
Advertising-to-sales		24.73 (12.23)*	34.23 (11.06)**		21.20 (11.82)†	25.10 (10.53)*
Polluting industry	0.13 (0.62)	0.12 (0.58)	−0.17 (0.62)	0.10 (0.65)	0.07 (0.59)	0.06 (0.61)
Service industry	−0.81 (0.48)†	−0.95 (0.51)†	−0.95 (0.53)†	−0.93 (0.42)*	−1.02 (0.45)*	−0.80 (0.46)†
Distance-to-port	0.03 (0.02)	0.02 (0.03)	0.03 (0.03)	0.03 (0.02)	0.03 (0.03)	0.03 (0.03)
GDP per capita	−0.0001 (0.00009)	−0.0001 (0.0001)	−0.0002 (0.00009)†	−0.0001 (0.00009)	−0.0001 (0.00009)	−0.0002 (0.00009)†
Beijing	0.42 (0.99)	0.40 (1.01)	0.60 (1.01)	0.40 (0.98)	0.42 (1.01)	0.58 (1.02)
Liaoning	6.02 (0.85)***	6.15 (1.04)***	6.51 (0.94)***	5.74 (0.49)***	5.75 (0.57)***	6.37 (0.82)***
Tianjing	−7.53 (0.85)***	−7.73 (0.84)***	−6.22 (0.73)***	−6.12 (0.57)***	−6.10 (0.56)***	−6.06 (0.57)***
Shanghai	−4.74 (1.26)***	−4.70 (1.45)**	−3.93 (1.40)**	−4.94 (1.37)***	−5.01 (1.57)**	−4.41 (1.15)***
Guangxi	−0.91 (0.71)	−1.05 (0.71)	−0.93 (0.72)	−0.85 (0.70)	−1.01 (0.68)	−0.93 (0.68)

Table 5 (*Continued*)

Variables	Coeff. (individ.)	Coeff. (individ.)	Coeff. (individ.)	Coeff. (index)	Coeff. (index)	Coeff. (index)
Zhejiang	−0.63 (0.75)	−0.63 (0.75)	−0.55 (0.79)	−0.35 (0.71)	−0.35 (0.72)	−0.21 (0.73)
Guangdong	−0.21 (0.55)	−0.26 (0.57)	−0.18 (0.59)	−0.03 (0.54)	−0.04 (0.57)	0.13 (0.57)
Sichuan	−1.50 (0.49)**	−1.46 (0.50)**	−1.42 (0.50)**	−1.39 (0.47)**	−1.31 (0.47)**	−1.37 (0.47)**
Constant	2.23 (1.17)†	0.28 (1.59)	0.38 (1.99)	0.86 (1.04)	−0.83 (1.55)	−1.06 (1.63)
Number of observations	297	297	297	297	297	297
Joint time dummy significance test	41.97***	36.70**	35.14**	45.41***	42.47***	48.12***
Joint industrial sector dummy significance test	21.01**	18.33*	16.53*	13.40†	10.72	14.19†
R^2	0.48	0.50	0.53	0.44	0.45	0.48
F	4041.07***	3157.82***	6416.96***	6761.34***	5743.26***	2593.88***

Notes: Significance levels are: † p < 0.10; * p < 0.05; ** p < 0.01; *** p < 0.001; firm-clustered robust standard errors in parentheses; joint industrial sector dummy significance test refers to the eight industries with the largest numbers of observations.

with the individual capability and concern variables, the significance of the control variables does not change, except for Tobin's Q, which becomes insignificant.

For the models with ROA and the individual capability and concern variables (second to fourth columns in Table 6), the results remain unchanged for all of the significant independent and control variables except for GDP per capita (which becomes insignificant). The interaction of regulatory problems and firm size is only marginally insignificant ($p < 0.11$). These results again support Hypotheses 1a, 1b and 2b, respectively.

For the models with ROA and the aggregated net sum index (fifth to seventh columns in Table 6), as in the model with interaction effects, the interaction of firm size with the index is significantly positive, which confirms Hypothesis 2a. As for the models with Tobin's Q, we also find the same transient effect of the index in support of Hypothesis 1a ($p = 0.10$ in the model with interaction) and for the control variables (except for GDP per capita, which again becomes insignificant).

DISCUSSION

Our research set out to clarify when FDI is undeterred from strict environmental regulation. We contribute a more nuanced perspective on this issue by integrating pollution haven and induced innovation arguments and taking into account firm heterogeneity, both (interrelated) gaps in the literature that we address based on novel data for US MNE investments in China, which overcome several of the shortcomings of earlier studies. Based on this approach, we clarify the inconclusive empirical evidence on pollution havens. In doing so, we also show how methodological choices affect the empirical results and how firm-specific and country-specific advantages interact.

In this section, we return to the description of our fourfold contribution outlined in the introduction, and we detail the specific aspects of our findings in that context. First, as a theoretical contribution, we integrate the pollution haven and induced innovation arguments in order to derive novel and more refined hypotheses addressing how firm-specific advantages in environmental management and firm-level heterogeneity make firms behave differently when facing the same absolute levels of environmental regulation. As part of this, we identify firm size as an important moderator, which can explain why larger firms with

Table 6 Association of strengths and concerns with regulation strictness using ROA as performance measure (binary regulation strictness variable)

Variables	Coeff. (individ.)	Coeff. (individ.)	Coeff. (individ.)	Coeff. (index)	Coeff. (index)	Coeff. (index)
Environmental capability net sum index				0.31 (0.12)*	0.33 (0.14)*	0.23 (0.14)
Environmental capability net sum index × size						0.67 (0.18)***
Environmental innovation capability	1.00 (0.50)*	0.99 (0.57)†	0.46 (0.71)			
Environmental innovation capability × size			0.39 (0.94)			
Pollution prevention capability	0.11 (0.25)	0.10 (0.27)	−0.06 (0.34)			
Pollution prevention capability × size			1.00 (0.73)			
Environmental management capability	0.85 (0.33)*	1.01 (0.37)**	0.82 (0.35)*			
Environmental management capability × size			−0.04 (0.58)			
Hazardous waste weakness	0.16 (0.33)	0.04 (0.35)	−0.15 (0.34)			
Hazardous waste weakness × size			−1.10 (0.43)*			
Regulatory problems weakness	0.24 (0.30)	0.25 (0.33)	0.42 (0.34)			
Regulatory problems weakness × size			−0.57 (0.35)			
Substantial emission weakness	−1.12 (0.28)***	−1.13 (0.29)***	−1.07 (0.34)**			
Substantial emission weakness × size			−0.72 (0.37)*			
Size (Employees)	−0.19 (0.15)	−0.14 (0.16)	−0.35 (0.25)	−0.11 (0.14)	−0.08 (0.15)	−0.23 (0.17)
Tax rate	0.002 (0.006)	0.003 (0.008)	0.005 (0.007)	0.003 (0.005)	0.004 (0.006)	0.007 (0.007)
Debt-to-assets ratio	0.009 (0.01)	0.008 (0.01)	0.01 (0.01)	0.008 (0.01)	0.007 (0.01)	0.01 (0.009)
ROA	−0.03 (0.03)	−0.02 (0.03)	0.01 (0.03)	−0.04 (0.02)	−0.03 (0.02)	−0.001 (0.02)
Capital-to-sales		0.13 (0.63)	0.008 (0.68)		0.47 (0.54)	0.47 (0.56)
Advertising-to-sales		23.23 (12.07)†	31.16 (11.38)**		20.34 (11.58)†	23.92 (10.40)*
Polluting industry	0.23 (0.63)	0.22 (0.59)	−0.08 (0.66)	0.19 (0.66)	0.15 (0.61)	0.13 (0.62)
Service industry	−0.90 (0.49)†	−1.03 (0.52)*	−1.05 (0.53)*	−1.01 (0.42)*	−1.10 (0.46)*	−0.85 (0.45)†
Distance-to-port	0.03 (0.02)	0.03 (0.03)	0.02 (0.02)	0.04 (0.02)	0.03 (0.03)	0.03 (0.03)
GDP per capita	−0.0001 (0.00009)	−0.0001 (0.0001)	−0.0002 (0.00009)	−0.0001 (0.00009)	−0.0001 (0.00009)	−0.0001 (0.00009)
Beijing	0.30 (0.99)	0.29 (1.01)	0.54 (1.02)	0.35 (0.98)	0.35 (1.00)	0.51 (1.02)
Liaoning	5.95 (0.67)***	6.07 (0.91)***	6.61 (1.14)***	5.69 (0.42)***	5.69 (0.48)***	6.44 (0.85)***
Tianjing	−7.66 (0.89)***	−7.80 (0.88)***	−6.38 (0.73)***	−6.22 (0.68)***	−6.18 (0.63)***	−6.15 (0.57)***
Shanghai	−4.96 (1.30)***	−4.98 (1.59)**	−4.18 (1.43)**	−5.09 (1.44)***	−5.21 (1.61)**	−4.63 (1.30)***
Guangxi	−0.97 (0.72)	−1.11 (0.71)	−0.99 (0.71)	−0.84 (0.71)	−1.01 (0.68)	−0.99 (0.68)
Zhejiang	−0.64 (0.77)	−0.66 (0.77)	−0.57 (0.80)	−0.33 (0.71)	−0.33 (0.72)	−0.23 (0.72)
Guangdong	−0.22 (0.55)	−0.28 (0.56)	−0.29 (0.58)	0.02 (0.54)	0.001 (0.56)	0.07 (0.56)
Sichuan	−1.55 (0.48)**	−1.51 (0.50)**	−1.39 (0.50)**	−1.45 (0.47)**	−1.37 (0.48)**	−1.36 (0.47)**

Table 6 (*Continued*)

Variables	Coeff. (individ.)	Coeff. (individ.)	Coeff. (individ.)	Coeff. (index)	Coeff. (index)	Coeff. (index)
Constant	2.58 (1.20)*	0.57 (1.60)	0.38 (1.95)	1.06 (1.05)	−0.58 (1.54)	−0.98 (1.58)
Number of observations	297	297	297	297	297	297
Joint time dummy significance test	40.53**	35.92**	32.92*	49.63***	43.40***	47.14***
Joint industrial sector dummy significance test	21.27**	18.37*	17.94*	13.79†	11.55	14.74†
R^2	0.48	0.50	0.52	0.44	0.46	0.48
F	5294.53***	3497.49***	4717.45***	6924.60***	6148.11***	2421.89***

Notes: Significance levels are: † $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; firm-clustered robust standard errors in parentheses; joint industrial sector dummy significance test refers to the eight industries with the largest numbers of observations.

environmental concerns are to locate in more weakly regulated provinces because they are perceived relatively better in such locations. It also clarifies why smaller firms with environmental concerns are less likely to do so, due to their lower visibility.

Therefore, our findings suggest that firms are aware of (and as a result implement rational strategic choices conditional on) their endowments and characteristics when accounting for the stringency of environmental regulation as part of siting decisions. Consistent with this approach, larger firms with lesser environmental capabilities are choosing, *ceteris paribus*, provinces with weaker environmental regulations, whereas smaller ones with the same characteristic are less deterred from locating in provinces with comparatively stricter regulations.

Second, as a conceptual contribution, we point out that intra-country differences in regulation exist which, strictly speaking, prohibit testing the pollution haven argument in an inter-country setting. Our research design shows and at the same time avoids this issue. By confining our analysis to US firms and keeping the host and home country constant, we reduce, with our intra-country setting, the effects of unobserved heterogeneity even further and filter out any influence of cultural and institutional distance. This approach is especially important because of the debate about the validity of established distance measures (Hutzschenreuter & Voll, 2008; Kogut & Singh, 1988).

Based on our enhanced research design, we find support for all our hypotheses which nuance and integrate the pollution haven and induced innovation arguments in different ways by accounting for heterogeneity across multinational firms, especially with regard to environmental capabilities, and thus contribute novel insights to the existing body of IB literature. Consistent with the pollution haven argument, a lack of capabilities, leads to a “race to the bottom”, that is, firms with such weaknesses experience strict environmental regulation as a pressure and try to evade it by locating in regions with weak regulation, which consequently accumulate firms with this characteristic. Conversely, firms with environmental capabilities are in a better position to address strict environmental regulation at lower cost, and are thus not deterred by it.

Therefore, these latter firms “race to the top”, that is, they accumulate in provinces with stringent regulation because the cost to do so is lower for them (i.e., regulation is not a barrier to them) but also because they reap greater benefits from avoiding the threat of negative publicity emerging from incidents at polluting firms in regions with weaker environmental regulation (and the more so, the larger they are). As explained before and differentiating further, larger firms without environmental capabilities are locating in provinces with very weak environmental regulation, to be co-located with even more polluting firms which make them appear relatively better. Overall, we provide a refinement of the pollution haven argument by incorporating firm heterogeneity and induced innovation aspects. As a novelty, we show that, next to a “race to the bottom”, a “race to the top” occurs simultaneously and that both are intensified by firm size, insights which are important for both researching scholars and practicing managers deciding on FDI.

Third, the reported findings contribute by providing a methodological explanation for why empirical evidence on the “race to the bottom” has been contradictory when not accounting enough for heterogeneity of environmental capabilities and weaknesses at the firm level and over time. More specifically, we decompose these characteristics by using different variables that operationalize for narrower capabilities or the lack thereof. We then compare the measurement of narrow capabilities and weaknesses based on individual items with an aggregated measurement, namely, the net sum index specification frequently applied to KLD data. It is important to note that individual KLD items still reflect complex combinations of organizational routines and structures, which justifies referring to them as capabilities. In addition, a sum index makes much stronger assumptions about how capabilities and weaknesses offset one another. The disaggregated level of individual items representing single (in-) capabilities and not requiring such substitutability is found to perform better in our analysis.

Another reason for the insignificance of the aggregated net sum index is that the individual items fluctuate more because their change over time can compensate to zero and thus leave the aggregate index value unaffected. This effect may be at work for any aggregated index and thus could be an important methodological influence explaining at least part of the inconclusiveness in prior studies. We analyze this in a comparative manner by utilizing both individual items and an aggregated index.

Using KLD data in different specifications reveals that a sum index has no significant association with regulatory stringency (as shown in our analysis, even a significant index might be due to omitted variable issues if interactions are not accounted for at the same time). In contrast, an operationalization of environmental capabilities based on individual KLD items finds that several of these items are significantly associated with the stringency of environmental regulation. Furthermore, the opposing effects of capabilities and weaknesses interact with firm size, which further highlights the need to account for moderation effects in the context of the pollution haven argument. Therefore, we contribute to the pollution haven and “race to the bottom” debates by suggesting a possible methodological explanation for the divergent results of earlier empirical studies, as well as ways to improve on them and the aforementioned assumptions.

Fourth, we contribute by using novel data to address pollution haven issues in the IB context. Specifically, whereas very few studies choose an intra-country setting, we do so using more comprehensive data as well as more control variables and more comprehensive firm characteristics than earlier work (e.g., Dean et al., 2009). Additionally, we account for the heterogeneity and time-variance of intra-country environmental regulation more extensively than do prior studies. For example, Dean et al. (2009) fix the regulation level to one baseline year and hence cannot account for regulatory changes over time that might affect US multinational firms’ FDI decisions. Overall, we are therefore able to provide a more stringent and methodologically enhanced test of the pollution haven argument that integrates induced innovation aspects and firm heterogeneity. This approach allows us to show the simultaneity of a “race to the top” and “race to the bottom” as well as the amplifying moderation effect of firm size for each of them.

CONCLUSIONS AND FUTURE RESEARCH

In summary, as the results of our empirical analysis show, firms with environmental capabilities invest in more stringently regulated regions. Conversely, firms with weaknesses are less likely to target such regions. These diverging effects are both moderated by firm size, which further amplifies each of them. Jointly, these findings underscore the need to analyze pollution haven and induced innovation issues in a more fine-grained and integrated manner, which is a research need that has also been highlighted more generally by Young and Makhija (2014). Their study and our findings also raise new questions by revealing behavioral complexities. For example, the fact that GDP per capita is negatively associated with the stringency of environmental regulation could mean that firms trade off human resources and regulation costs (beyond the EKC effect discussed earlier), which should be addressed in future research.

Furthermore, we only find very limited industry effects. Future research should analyze in more depth why industry effects have a less pronounced role in the IB context than in less globalized settings. Specifically, since recent work found that MNEs might be more likely to implement national (rather than international) certification schemes in their subsidiaries (Husted, Montiel & Christmann, 2016), further research might clarify if this is a possible explanation.

Furthermore, while using a subset of KLD items that were externally validated with CSRHUB data, we have to note that recent studies find differences with some other ratings for aggregated measures comprising a large number of environmental items (Chatterji, Durand, Levine & Touboul, 2015). Although this measure only concerns a minority of three of the years included, is not directly comparable with our aggregated net sum index and refers to other raters that are all younger than KLD (suggesting that the latter's methodology benefited most from learning-by-doing) studies using data from other raters are an important area for future research to validate our findings.

Still, our subset of KLD items comprehensively covers the different aspects of environmental management, which implies high internal consistency and construct validity. In addition, and as a result of our research design, we additionally use narrow and well-defined individual items to which these issues relate—if at all—to a lesser degree. Therefore, and due to our own validation steps, we are confident that our results are reliable despite the concerns of Chatterji et al. (2015).

The general unavailability of some country-level variables (such as benevolence or egalitarianism from the GLOBE survey) for individual Chinese provinces must be acknowledged as a limitation. This is clearly another topic for future research, as is the analysis of samples other than US firms. Finally, future studies should analyze the period from 2010 onward for US firms (which, due to the change in ownership of KLD, was beyond the scope of our study) to confirm our findings with more recent data.

ACKNOWLEDGMENTS

We are grateful for the invaluable comments of two anonymous reviewers and of our always constructive editor, Mona Makhija. Furthermore, we thank Jon Moon, Chang-Hoon Oh and Till Talaulicar as well as seminar participants at the Centre of European Economic Research in Mannheim (especially Timo Goeschl) for very helpful feedback on earlier versions. Maoliang Bu acknowledges support of the Humboldt Foundation and the Science Foundation of the Ministry of Education of China (Grant No. 14JHQ017). The authors are in alphabetical order.

NOTES

[1]When KLD was acquired by RiskMetrics in 2009, the structure of the KLD database changed, which made use of data from 2010 onward impossible.

[2]Only relying on US regulations in this context makes sense because, according to Strike et al. (2006), MNE activities are ultimately evaluated by home-country stakeholders.

[3]The data source for pollution discharge fees for each province is the China Environment Yearbook series from 1992 to 2009, whereas that of manufacturing added value by province is the China Industry Economy Statistical Yearbook series from 1992 to 2009. Our dependent variable gauges fees, not fines, to assess regulatory stringency, which is an important difference because fees apply to legally permitted emissions (where the size of the unit fee reflects the stringency of regulation), whereas fines apply to illegal emissions.

[4]Another possible bias from only looking at wastewater cost relates to quantitative aspects. For example, in 2004, wastewater discharge fees only accounted for approximately one-third of the total cost of air, water and waste discharges jointly, according to data from the China Environment Yearbook, which implies higher reliability for a joint dependent variable.

[5]The data source for provincial per capita GDP is the China Statistics Yearbook series, with values calculated for each sample year individually and deflated to the 1991 price level. All firm-level and industry data other than KLD ratings were sourced from the Compustat database.

[6]Given the more limited data availability for these two additional variables, we have to resort to including

two dummies for missing values for each of them, following Mohnen, Mairesse and Dagenais (2006). To remain parsimonious, we omit these variables in our tables because they only have technical meaning for unbiased estimations of the coefficients for capital and advertising intensity, where the method yields conservative estimates.

[7]This result is in accordance with the conventional EKC turning point, which is between approximately \$5000 and \$8000 of per capita income, whereas China's per capita GDP was \$5445 in 2011 according to the World Bank. Hence, most of the provinces in our sample have not reached levels where pollution starts to stagnate or decline.

REFERENCES

Adams, M., & Hardwick, P. 1998. An analysis of corporate donations: United Kingdom evidence. *Journal of Management Studies,* 35(5): 641–654.

Aguilera-Caracuel, J., Aragón-Correa, J. A., & Hurtado-Torres, N. E. 2011. Extending the literature on the environmental strategy of MNEs. *Multinational Business Review,* 19(4): 299–310.

Aguilera-Caracuel, J., Aragón-Correa, J. A., Hurtado-Torres, N. E., & Rugman, A. M. 2012. The effects of institutional distance and headquarters' financial performance on the generation of environmental standards in multinational companies. *Journal of Business Ethics,* 105(4): 461–474.

Aguilera-Caracuel, J., Hurtado-Torres, N. E., Aragón-Correa, J. A., & Rugman, A. M. 2013. Differentiated effects of formal and informal institutional distance between countries on the environmental performance of multinational enterprises. *Journal of Business Research,* 66(12): 2657–2665.

Albornoz, F., Cole, M. A., Elliott, R. J. R., & Ercolani, M. G. 2009. In search of environmental spillovers. *World Economy,* 32(1): 136–163.

Aragón-Correa, J. A., & Sharma, S. 2003. A contingent resource-based view of proactive corporate environmental strategy. *Academy of Management Review,* 28(1): 71–88.

Barbera, A. J., & McConnell, V. D. 1990. The impact of environmental regulations on industry productivity: Direct and indirect effects. *Journal of Environmental Economics and Management,* 18(1): 50–65.

Bowen, F. E. 2000. Environmental visibility: A trigger of green organizational response? *Business Strategy and the Environment,* 9(2): 92–107.

Brammer, S., & Millington, A. 2006. Firm size, organizational visibility and corporate philanthropy: An empirical analysis. *Business Ethics: A European Review,* 15(1): 6–18.

Brammer, S. J., & Pavelin, S. 2006. Corporate reputation and social performance: The importance of fit. *Journal of Management Studies,* 43(3): 435–455.

Branco, M. C., & Rodrigues, L. L. 2006. Corporate social responsibility and resource-based perspectives. *Journal of Business Ethics,* 69(2): 111–132.

Brännlund, R., Färe, R., & Grosskopf, S. 1995. Environmental regulation and profitability: An application to Swedish pulp and paper mills. *Environmental & Resource Economics,* 6(1): 23–36.

Brunnermeier, S. B., & Levinson, A. 2004. Examining the evidence on environmental regulations and industry location. *The Journal of Environment & Development,* 13(1): 6–41.

Bu, M., Liu, Z., Wagner, M., & Yu, X. 2013. Corporate social responsibility and the pollution haven hypothesis: Evidence from multinationals' investment decision in China. *Asia-Pacific Journal of Accounting & Economics,* 20(1): 85–99.

Campbell, J. T., Eden, L., & Miller, S. R. 2012. Multinationals and corporate social responsibility in host countries: Does distance matter? *Journal of International Business Studies,* 43(1): 84–106.

Cardenas, L. 2014. Personal email communication, 14 July, MSCI ESG client service.

Cave, A. H. 2014. Environmentally responsible management in international business: A literature review. *Multinational Business Review,* 22(1): 78–102.

Chatterji, A. K., Durand, R., Levine, D. I., & Touboul, S. 2015. Do ratings of firms converge? Implications for managers, investors, and strategy researchers. *Strategic Management Journal*, advance online publication August 11. doi:10.1002/smj.2407.

Christmann, P., & Taylor, G. 2001. Globalization and the environment: Determinants of firm self-regulation in China. *Journal of International Business Studies,* 32(3): 439–458.

Christmann, P., & Taylor, G. 2006. Firm self-regulation through international certifiable standards: Determinants of symbolic versus substantive implementation. *Journal of International Business Studies,* 37(6): 863–878.

Chung, S. 2014. Environmental regulation and foreign direct investment: Evidence from South Korea. *Journal of Development Economics,* 108(May): 222–236.

Cohen, M. A., Fenn, S., & Naimon, J. 1995. *Environmental and financial performance: Are they related?* Working Paper, Nashville, TN, Vanderbilt University.

Cole, M. A., Elliott, R. J. R., & Okubo, T. 2014. International environmental outsourcing. *Review of World Economics,* 150(4): 639–664.

Copeland, B. R., & Taylor, M. S. 1994. North-south trade and the environment. *Quarterly Journal of Economics,* 109(3): 755–787.

Copeland, B. R., & Taylor, M. S. 2004. Trade, growth, and the environment. *Journal of Economic Literature,* 42(1): 7–71.

Dasgupta, S., Wheeler, D., & Huq, M. 1997. *Bending the rules: Discretionary pollution control in China*. Working Paper, World Bank, New York.

Dean, J. M., Lovely, M. E., & Wang, H. 2009. Are foreign investors attracted to weak environmental regulations? Evaluating the evidence from China. *Journal of Development Economics,* 90(1): 1–13.

DiMaggio, P. J., & Powell, W. W. 1983. The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review,* 48(2): 147–160.

Dong, B., Gong, J., & Zhao, X. 2012. FDI and environmental regulation: pollution haven or a race to the top? *Journal of Regulatory Economics,* 41(2): 216–237.

Dowell, G., Hart, S., & Yeung, B. 2000. Do corporate global environmental standards create or destroy market value? *Management Science,* 46(8): 1059–1074.

Dunning, J. H. 1998. Location and the multinational enterprise: A neglected factor? *Journal of International Business Studies,* 29(1): 45–66.

Dunning, J. H., & Lundan, S. M. 1993. *Multinational enterprises and the global economy*. Wokingham: Addison-Wesley.

El Ghoul, S., Guedhami, O., & Kim, Y. 2016. Country-level institutions, firm value, and the role of corporate social responsibility initiatives. *Journal of International Business Studies*, advance online publication March 3. doi:10.1057/jibs.2016.4.

Erfle, S., & McMillan, H. 1990. Media, political pressure, and the firm: The case of petroleum pricing in the late 1970s. *Quarterly Journal of Economics,* 105(1): 115–134.

Eskeland, G. S., & Harrison, A. E. 2003. Moving to greener pastures? Multinationals and the pollution haven hypothesis. *Journal of Development Economics,* 70(1): 1–23.

Hart, S. L. 1995. A natural-resource-based view of the firm. *Academy of Management Review,* 20(4): 986–1014.

Henriques, I., & Sadorsky, P. 1996. The determinants of an environmentally responsive firm: An empirical approach. *Journal of Environmental Economics and Management,* 30(3): 381–395.

Hunt, C. B., & Auster, E. R. 1990. Proactive environmental management: Avoiding the toxic trap. *Sloan Management Review,* 31(2): 7–18.

Husted, B. W., & Allen, D. B. 2006. Corporate social responsibility in the multinational enterprise: Strategic and institutional approaches. *Journal of International Business Studies,* 37(6): 838–849.

Husted, B. W., Montiel, I., & Christmann, P. 2016. Effects of local legitimacy on certification decisions to global and national CSR standards by multinational subsidiaries and domestic firms. *Journal of International Business Studies,* 47(3): 382–397.

Hutzschenreuter, T., & Voll, J. C. 2008. Performance effects of "added cultural distance" in the path of international expansion: The case of German multinational enterprises. *Journal of International Business Studies,* 39(1): 53–70.

Javorcik, B. S., & Wei, S. 2005. Pollution havens and foreign direct investment: Dirty secret or popular myth? *Contributions in Economic Analysis & Policy,* 3(2): 1244.

Jeppesen, T., & Folmer, H. 2001. The confusing relationship between environmental policy and location behaviour of firms: A methodological review of selected case studies. *Annals of Regional Science,* 35(4): 523–546.

Jiang, L., Lin, C., & Lin, P. 2014. The determinants of pollution levels: Firm-level evidence from Chinese manufacturing. *Journal of Comparative Economics,* 42(1): 118–142.

Jones, K., & Rubin, P. H. 2001. Effects of harmful environmental events on reputations of firms. *Advances in Financial Economics,* 6: 161–182.

Kellenberg, D. K. 2009. An empirical investigation of the pollution haven effect with strategic environment and trade policy. *Journal of International Economics,* 78(2): 242–255.

Kirkpatrick, C., & Shimamoto, K. 2008. The effect of environmental regulation on the locational choice of Japanese foreign direct investment. *Applied Economics, 40*(11): 1399–1409.

Klassen, R. D., & McLaughlin, C. P. 1996. The impact of environmental management on firm performance. *Management Science,* 42(8): 1199–1214.

Kogut, B., & Singh, H. 1988. The effect of national culture on the choice of entry mode. *Journal of International Business Studies,* 19(3): 411–432.

Kolk, A. 2016. The social responsibility of international business: From ethics and the environment to CSR and sustainable development. *Journal of World Business,* 51(1): 23–34.

Kolk, A., & Pinkse, J. 2008. A perspective on multinational enterprises and climate change: learning from 'an inconvenient truth'? *Journal of International Business Studies,* 39(8): 1359–1378.

Lanjouw, J. O., & Mody, A. 1996. Innovation and the international diffusion of environmentally responsive technology. *Research Policy,* 25(4): 549–571.

Lin, L., Moon, J. J., & Yin, H. 2013. Does international economic integration lead to a cleaner production in China? *Production and Operations Management,* 23(4): 525–536.

Liu, J., & Diamond, J. 2005. China's environment in a globalizing world. *Nature,* 435(7046): 1179–1186.

Madsen, P. M. 2009. Does corporate investment drive a "race to the bottom" in environmental protection? A reexamination of the effect of environmental regulation on investment. *Academy of Management Journal,* 52(6): 1297–1318.

Makhija, M. V., & Stewart, A. C. 2002. The effect of national context on perceptions of risk: A comparison of planned versus free-market managers. *Journal of International Business Studies,* 33(4): 737–757.

Mani, M., & Wheeler, D. 1998. In search of pollution havens? Dirty industry in the world economy, 1960 to 1995. *Journal of Environment and Development,* 7(3): 215–247.

Marano, V., Tashman, P., & Kostova, T. 2016. Escaping the iron cage: Liabilities of origin and CSR reporting of emerging market multinational enterprises. *Journal of International Business Studies*, advance online publication April 14. doi:10.1057/jibs.2016.17.

Marcus, A. A., & Anderson, M. H. 2006. A general dynamic capability: Does it propagate business and social competencies in the retail food industry? *Journal of Management Studies,* 43(1): 19–46.

Markusen, J. R., Morey, E. R., & Olewiler, N. D. 1993. Environmental policy when market structure and plant locations are endogenous. *Journal of Environmental Economics and Management,* 24(1): 69–86.

McWilliams, A., & Siegel, D. 2000. Corporate social responsibility and financial performance: Correlation or misspecification? *Strategic Management Journal,* 21(5): 603–609.

Meznar, M. B., & Nigh, D. 1995. Buffer or bridge? Environmental and organizational determinants of public affairs activities in American firms. *Academy of Management Journal,* 38(4): 975–996.

Mohnen, P., Mairesse, J., & Dagenais, M. 2006. *Innovativity: A comparison across seven European countries.* Working Paper, United Nations University, Maastricht.

Palmer, K., Oates, W. E., & Portney, P. R. 1995. Tightening environmental standards: The benefit-cost or the no-cost paradigm? *Journal of Economic Perspectives,* 9(4): 119–132.

Pavelin, S., & Porter, L. 2011. Race-to-the-bottom or -top at home or abroad: Health and safety standards and the multinational firm. *Economic and Social Review,* 42(3): 289–311.

Porter, M. E., & van der Linde, C. 1995. Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives,* 9(4): 97–118.

Rabe-Hesketh, R., & Skrondal, A. 2008. *Multilevel and longitudinal modeling using Stata*. College Station, TX: Stata Press.

Rathert, N. 2016. Strategies of legitimation: MNEs and the adoption of CSR in response to host-country institutions. *Journal of International Business Studies*, advance online publication May 12. doi:10.1057/jibs.2016.19.

Rezza, A. A. 2015. A meta-analysis of FDI and environmental regulations. *Environment and Development Economics,* 20(2): 185–208.

Rivera, J., & Oh, C. H. 2013. Environmental regulations and multinational corporations' foreign market entry investments. *Policy Studies Journal,* 41(2): 243–272.

Rugman, A. M., & Verbeke, A. 1998a. Corporate strategies and environmental regulations: An organizing framework. *Strategic Management Journal,* 19(4): 363–375.

Rugman, A. M., & Verbeke, A. 1998b. Corporate strategy and international environmental policy. *Journal of International Business Studies,* 29(4): 819–833.

Strike, V. M., Gao, J., & Bansal, P. 2006. Being good while being bad: Social responsibility and the international diversification of US firms. *Journal of International Business Studies,* 37(6): 850–862.

Surroca, J., Tribó, J. A., & Zahra, S. A. 2013. Stakeholder pressure on MNEs and the transfer of socially irresponsible practices to subsidiaries. *Academy of Management Journal,* 56(2): 549–572.

Tang, J. 2015. Testing the pollution haven effect: Does the type of FDI matter? *Environmental & Resource Economics,* 60(4): 549–578.

Tyteca, D., Carlens, J., Berkhout, F., Hertin, J., Wehrmeyer, W., & Wagner, M. 2002. Corporate environmental performance evaluation: Evidence from the MEPI project. *Business Strategy and the Environment,* 11(1): 1–13.

Waddock, S. A., & Graves, S. B. 1997. The corporate social performance–financial performance link. *Strategic Management Journal,* 18(3): 303–319.

Wagner, U. J., & Timmins, C. D. 2009. Agglomeration effects in foreign direct investment and the pollution haven hypothesis. *Environmental & Resource Economics,* 43(2): 231–256.

Wei, S.-J., & Wu, Y. 2001. *Globalization and inequality: Evidence from within China.* Working Paper, National Bureau of Economic Research, Boston.

Xing, Y., & Kolstad, C. D. 2002. Do lax environmental regulations attract foreign investment? *Environmental & Resource Economics,* 21(1): 1–22.

Young, S. L., & Makhija, M. V. 2014. Firms' corporate social responsibility behavior: An integration of institutional and profit maximization approaches. *Journal of International Business Studies,* 45(6): 670–698.

ABOUT THE AUTHORS

Maoliang Bu is Associate Professor at the School of Business, Nanjing University and Adjunct Professor of International Economics at Hopkins-Nanjing Center. His research is mainly on globalization and environmental sustainability. He is an Alexander von Humboldt Fellow.

Marcus Wagner is Professor of Management, Innovation and International Business at Augsburg University and Associate Member of the Bureau d'Economie Théorique et Appliquée, Strasbourg, where he was a Marie Curie Fellow. His research focuses on innovation, global sustainability and strategic management, and has been published, *inter alia*, in Journal of Business Venturing, Long Range Planning, and Research Policy.

Accepted by Mona Makhija, Area Editor, 7 June 2016. This article has been with the authors for four revisions.