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MNE responses to carbon pricing regulations: Theory and evidence

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Abstract
This paper develops theory suggesting that, relative to purely domestic firms, multinational enterprises (MNE) have greater incentives and strategic and operational means to respond to expanding carbon emissions constraints. We test our resulting hypotheses with data on changes in carbon emissions by over 6,000 industrial plants during Phase 2 (2008–2012) of the European Union's Emissions Trading Scheme. We find that MNE maintain: (1) consistent carbon reductions across institutional contexts, and (2) an overall carbon performance edge over domestic firms. The carbon performance gap between MNEs and domestic firms narrowed, however, in host countries transitioning towards more stringent market regulatory systems. By demonstrating that the effects of national and international carbon regulations on firm behavior interact in important ways with each other and with firm characteristics, this paper deepens understanding of how institutions are likely to shape the ongoing energy transition towards a low-carbon economy.

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INTRODUCTION

There is broad consensus around the need for economies and industries to leave behind traditional reliance on greenhouse gas–intensive fossil fuel combustion in favor of more climate-friendly energy resources. In order to overcome the considerable inertial forces impeding this grand energy transition, governments have begun to introduce regulations that provide economic incentives for companies to reduce their carbon emissions by pricing CO_2 emissions (Aldy & Stavins, 2012; Azevedo, Morgan, & Lave, 2011; Ellerman, Convery, & De Perthuis, 2010). But how are firms responding to these regulatory efforts? Does firm-type matter? In this paper, we put the firm characteristic of multinationality at center stage to explore this question.

The majority of previous conceptual and empirical studies on multinational enterprises (MNEs) and their environmental behavior in the face of regulatory constraints fall into two main camps. In one, MNEs are presented as primary sources of CO_2 emissions that actively resist the energy transition due to their profit maximization goals (Clapp & Dauvergne, 2011), either by shifting business activities to more negligent host countries, i.e., the pollution haven hypothesis (e.g., Candau & Dienesch, 2017; Grether, Mathys, & De Melo, 2012; Levinson & Taylor, 2008; Li & Zhou, 2017), or by using bargaining power to weaken regulations in their favor, i.e., through lobbying and corporate political activities (e.g., Child & Tsai, 2005; Eberlein & Matten, 2009; Pinkse & Kolk, 2007). In the other, MNEs are more positively framed as central to efforts to reduce environmental harm (Crooks, 2018; Milman, 2017; Ryle, 2016), because developing innovative "green" products and processes results in firm-specific advantages (FSAs) that they can market globally (Rugman & Verbeke, 2001). The latter scenario is especially likely for MNEs with subsidiaries in host countries with relatively strict environmental regulations (Attig, Boubakri, El Ghoul, & Guedhami, 2016; Porter, 1990a, b; Porter & Van der Linde, 1995).

Scholarly attempts to provide empirical evidence for either the positive or the negative view of the relative environmental performance of MNEs, however, remain inconclusive (e.g., Backman, Verbeke, & Schulz, 2017; Branger & Quirion, 2014; Bu & Wagner, 2016; Christmann, 2004; Eskeland & Harrison, 2003). This is likely reflective of the real world complexity and contingency that is illustrated in Rugman and Verbeke's seminal conceptual framework on the environment performance of MNEs (Rugman & Verbeke, 1998a, b), which was later applied specifically to climate change (Kolk & Pinkse, 2008; Pinkse & Kolk, 2007). It is also due to insufficient employment of large samples and a preference among scholars for focusing more on the adaptation strategies of MNEs rather than on the ultimate environmental impact of these strategies (Backman et al., 2017: 457). In our view, there are two additional factors that impede progress in this field. One is an over-emphasis on values-driven efforts to portray MNEs as either good or bad. The other is a one-sided empirical focus on MNEs that largely neglects the key comparison group, i.e., purely domestic firms.

Accordingly, the main objective of this paper is to contribute to a better understanding of the effect of expanding environmental regulations on MNEs and their carbon performance, which we measure in terms of emissions reductions, relative to their domestic-only competitors. As such, we put the explicit comparison of MNEs with domestic firms[1] at the center of our analysis. After developing a set of underlying conceptual considerations, we explore empirically how MNEs differ from domestic firms in their responses to two important international regulatory initiatives aimed at incentivizing reduced industrial CO_2 emissions within the European Union (EU): (1) emissions trading schemes (ETSs), and (2) carbon tax schemes (CTSs). We focus our analysis on the change in carbon emissions for 6,279 industrial plants in 26 European host countries from 2008 to 2012. All are operating within the EU Emissions Trading Scheme (EU ETS), the world's largest regulatory program for CO_2 emissions. We further leverage the existence of carbon tax schemes in a subset of 13 of these host countries to test the effect of additional, more comprehensive, host-country carbon emissions regulation.

Consistent with our conceptual arguments, our findings indicate that, in the face of mandatory carbon regulations, MNE-owned plants exhibit better carbon performance, as measured specifically by lower compound annual growth rates (CAGRs) for their CO_2 emissions, than plants owned by domestic firms. Moreover, the CO_2 performance edge held by MNE-owned plants is larger in host countries where market institutions are better established.

HYPOTHESES DEVELOPMENT: HOW MNES RESPOND TO CARBON PRICING REGULATIONS

Awareness of the need to safeguard the natural environment has increased in recent decades, as has work by economists and management scholars on the important role of MNEs in achieving this societal goal. Assuming that voluntary actions by MNEs remain the exception, particular attention has been paid to MNEs' responses to the introduction or tightening of environmental regulations by national policymakers.

Previous Conceptualizations of MNEs' Responses to Environmental Regulations

Among others, Nordhaus (1992) argued that the decision to pursue corporate strategies that commit substantial firm resources to reducing environmental harm is dependent on the direct economic benefits to be derived. For MNEs, this entails either developing FSAs or avoiding additional costs that would erode shareholder value (Rugman &

Verbeke, 1998a, b). The latter authors conceptualize that the co-existence of seemingly contradictory environmental strategies results from particular combinations of FSAs and country-specific advantages (CSAs). Stricter environmental regulations in a particular host country may erode a traditional CSA, creating two strategic choices for MNEs: shift operations to countries with relatively lax norms (i.e., "race to the bottom" represented by "pollution havens") or translate higher external requirements into FSAs (i.e., "race to the top") (e.g., Bu & Wagner, 2016; Dong, Gong, & Zhao, 2012; Grether et al., 2012; Li & Zhou, 2017; Porter, 1999; Porter & Van der Linde, 1995). Stressing the importance of the internationalization, Pinkse and Kolk (2009) point out that these strategic choices and their economic advantages are not available to purely domestic firms and that, among MNEs, deriving value from these choices depends on the ability to transfer firm-specific assets across borders. They further argue that MNEs achieve real strategic advantages specifically through sustainable business practices, investments in environmentally friendly products, and "green innovations."

These studies focus on criteria and conditions that provide economic explanations for the question of whether MNEs opt to defy new institutional pressures and relocate business activities or take advantage of external forces to develop new business opportunities. In a world of imperfect markets, it is argued that MNEs are particularly well positioned to gain arbitrage profits through selecting the most cost-efficient locations (a CSA) or through exploiting externally enforced, environment-friendly innovations (an FSA). Accordingly, extant frameworks have highlighted important contingency factors, such as the relevance of weak and strong institutions, the nature of regulatory regimes, transferability of FSAs, or perceived irreversibility of green investments. Rugman & Verbeke (1998b: 373–374), in particular, conclude that: "We do not find empirical support for the former (race to the bottom hypothesis), nor unambiguous conceptual support for the latter (race to the top hypothesis). Both are special cases within the more general FSA-CSA framework of MNE strategy towards environmental regulations."

Against this background, careful attention to important contingencies is needed to systematically determine the extent to which environmental regulations incentivize firms to significantly reduce their CO_2 emissions. We therefore aim to advance existing conceptualizations of how MNE environmental behavior is shaped by a shifting national and international regulatory context, and to do so by delineating in greater detail three key levels of contextual factors that shape this relationship: institutions, industry, and firm. Put succinctly, different carbon pricing instruments differ in how they shape economic incentives to reduce emissions. The economic incentives firms also face vary substantially across industries, due to their fundamentally different competitive conditions and success factors. Finally, they may also diverge with ownership type, including specifically whether or not a firm manages operations across multiple countries. We delve deeper into each of these three key levels below.

An Advanced Conceptualization of MNEs' Responses to Carbon Pricing Regulations

Variation at the Institutional Level. Beyond categorizing environmental regulations as weak or strong, it is important to specify and distinguish their features in greater detail, given the wide range of distinct approaches to steering firms towards improved ecological performance. Environmental regulations can be classified, for instance, into subsidies, prohibitions, taxes, and other levies (Wiener, 1999).

Accordingly, measures taken by subnational, national, and transnational governments to reduce CO_2 emissions and to foster long energy transitions also include: (1) support for renewable energy sources, (2) energy efficiency improvements, (3) financial aid to developing countries for climate mitigation, and (4) pricing of greenhouse gas emissions directly through carbon taxes or emissions trading schemes (Chasek, 2007; EEA, 2018; Reiner et al., 2006; Renn & Marshall, 2016; Szulecki, Fischer, Gullberg, & Sartor, 2016). In view of this variety, experts have argued that the most efficient way to change corporate decision-making and facilitate the transition to a low-carbon economy is through implementing carbon taxes and emissions trading schemes that require producers to pay for the costs to society of their emissions (e.g., Bowen, 2011; Edenhofer & Kalkuhl, 2011; Nordhaus, 1993, 2006; Nuccitelli, 2016; Sinn, 2008; World Bank, 2018). An increasing number of jurisdictions around the world have followed this guidance and have introduced CTS and/or ETS policies to put a price on carbon (see Figure 1).

While both schemes provide economic incentives for reducing CO_2 emissions, through their distinct functionalities they affect firms differently.

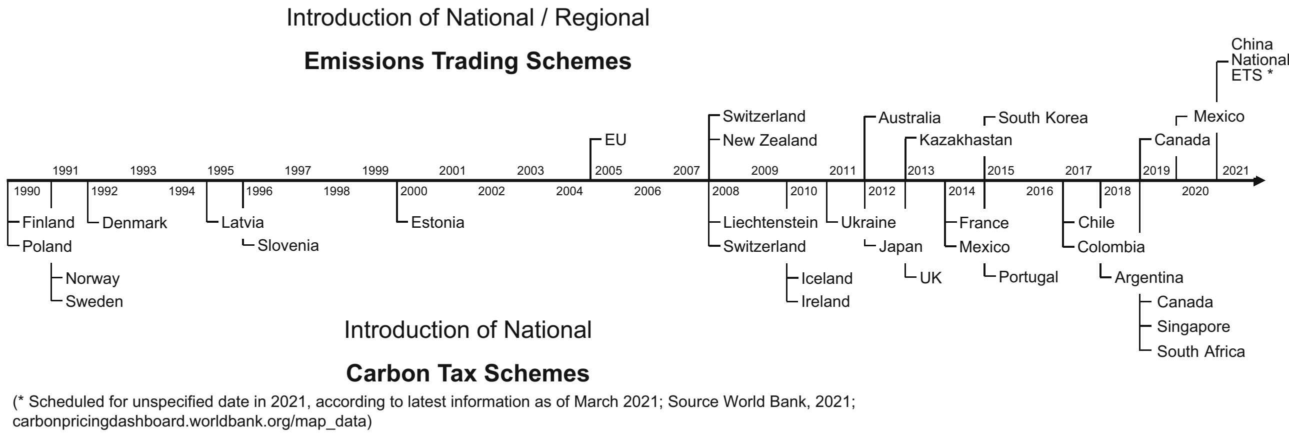

Figure 1 Timeline of carbon pricing instruments at the national level implemented or planned.

Inspired by early work by Pigou (1938), a carbon tax regime taxes each emitted ton of CO_2 and therefore has a direct effect on the emitting firm's costs and profits. Ideally, it should be set at the same level as "… the social marginal damages from an additional unit of emissions" (Metcalf & Weisbach, 2009: 511). However, if the tax is not significant enough to make reducing emissions the economically correct decision, its effect will be marginal, too.

In contrast, under an emissions trading regime, i.e., "cap-and-trade," regulators set an aggregate emissions limit for a group of firms or an industry below the current level of emissions and then create a corresponding number of emissions permits (i.e., rights to pollute). Due to the cap on emissions, these allowances, which are allotted to affected firms either for free or through regulated auctions, will create an economic scarcity. Individual firms facing a shortfall of allowances have to decide whether to reduce emissions or to buy permits on the market. Each firm decides based on its respective marginal abatement costs (i.e., the cost incurred by reducing emissions by one additional ton of CO_2) and the prevalent market price for emissions permits. In sum, ETS regulators create a new market for pollution rights and force an aggregate reduction in emissions. As long as marginal abatement costs are lower or equal to the prevalent permit price, firms are incentivized to reduce their emissions, as they are given the opportunity to profit from selling surplus permits on the market. Importantly, a successful ETS also requires setting a binding emissions cap that leads to a sufficiently high carbon price, enough liquidity in the market, and transparent market mechanisms (Ellerman et al., 2010).

Table 1 summarizes the different functionalities, advantages, and disadvantages of CTS and ETS and provides sources for more detailed descriptions and applications. From the point of view of CO_2-emitting firms, the two schemes differ in terms of their economic incentives and impact. Firms generally prefer ETSs over CTSs because of the greater emphasis on market solutions. For one, the former give managers more flexibility on how to comply and allow them to gain economic advantages by selling surplus emissions permits. Moreover, initial emissions permits are often distributed by regulators for free, allowing firms to influence the permit allocation process to their benefit (Patnaik, 2019). Finally, the opportunity to bank excess allowances in anticipation of higher prices in the future provides firms with additional flexibility. All these measures can lead to an oversupply of allowances and low spot market prices for permits (e.g., Koch, Fuss, Grosjean, & Edenhofer, 2014; Salant, 2016). For these reasons, in the EU, politicians and regulators were persuaded to refrain from establishing an EU-wide carbon tax in favor of a more flexible emissions trading scheme, and to issue important exemptions and higher allocations of emissions permits (Christiansen & Wettestad, 2003; Wettestad, 2005).

The announcement and implementation of carbon pricing schemes, whether as taxation or emissions trading, is changing the competitive environment of firms. The new regulations can be modeled as an exogenous shock that leads to extra

Table 1 Brief comparison of basic carbon pricing alternatives

	Carbon tax schemes (CTS)	Emission trading schemes (ETS)
Functionality	• Every ton of CO_2 that is emitted is taxed directly • This forces polluters to internalize negative externalities of carbon emissions • Economic reasoning: additional costs will provide emitters to reduce and minimize carbon emissions • Level of carbon tax: should ideally be equal to the social cost of carbon as measured in the marginal damage from an additional ton of CO_2 emissions	•Market-based regulatory tool • Regulators initially set an emissions cap on a group of firms • A corresponding number of emissions permits (i.e., property rights to pollute) is then distributed to these firms for free or via auctions • Due to the cap on emissions, firms should face a shortfall and decide whether to reduce or buy permits on the market • Firm decision: function of marginal abatement costs and the prevalent market price for emissions permit • If marginal abatements costs are lower than the price, firms reduce emissions and sell surplus permits • If the costs are higher, firms will buy permits on the market as long as the permit price stays below their marginal abatement costs
Economic incentives	• Since firms have to pay for each ton of CO_2 emitted, it is a direct price mechanism that is intended to raise costs for polluters. The additional costs are incorporated directly into the firm's objective function	• The economic incentives here are a bit more complex, since firms have to evaluate their marginal abatement costs relative to the allowance permit price. Firms have to weigh that trade-off to decide whether to reduce emissions or buy permits, which is also a function of their initial endowment of emissions permits
Comparative advantage	• Carbon price is directly controlled by regulators • Relatively fast and easy to implement (i.e., it is a simple mechanism) • Administering it is less complex than emissions trading • Easily adjustable tax rates • Less vulnerable to corporate political strategy efforts	• Regulators have direct control over emissions limits • In theory, it achieves emissions reductions in the most cost-effective manner • If permits are auctioned off, the income generated by selling emission certificates can be redistributed to low-income households • It provides firms with more flexibility in how to comply • Flexibility in implementing industry-specific solutions
Comparative disadvantage	• Regulators do not control emissions levels directly, only indirectly through the tax (i.e., no absolute emissions limit) • Difficult to determine the "right" level of the tax • Does not account for different abatement costs among firms • Less flexible than emissions trading and more costly to achieve emissions reductions (in theory)	• More complex to administer and implement (i.e., it requires a more sophisticated bureaucracy) • More vulnerable to corporate political strategy efforts • Theory and practical implementation often diverge • In order for emissions trading to work, emissions permit markets have to be liquid and the emissions cap has to be binding
Selective literature	Aghion et al. (2016), Metcalf (2009), Metcalf and Weisbach (2009), Nordhaus (1993), Pigou (1938), Poterba (1991), Sumner, Bird and Dobos (2011)	Ellerman (2009), Ellerman and Buchner (2007), Ellerman et al. (2010, 2016), Knopf et al. (2014), Matisoff (2010), Perdan and Azapagic (2011), Rogge, Schneider and Hoffmann (2011)
	Elkins and Baker (2001), Field and Field (2009), Tietenberg (1990), World Bank (2020)	

production costs and potentially additional income, as was partially the case within the EU ETS. The impact of this shock depends on the stringency of the constraints it imposes (Pinkse & Kolk, 2007) and the degree of pressure it exerts (Rugman & Verbeke, 1998a). Irrespective of the success of corporate political strategy efforts by companies and industry associations to prevent, delay, or mitigate the regulations, i.e., to weaken institutions, the introduction of CTS and/or ETS represents an institutional change in the competitive conditions of the affected companies.

Variation at the Industry Level. CTS and ETS in the EU did not include all firms and industries, focusing instead mostly on large emitters, such as refineries, utilities, or iron and steel. As such, it is necessary to analyze industry characteristics in order to better understand and explain potential patterns of strategic firm responses to these carbon pricing regulations. Despite extensive discussion of their importance within other streams of strategic and international management (e.g., Hambrick, 1983; Porter, 1980; Rumelt, 1991; Schmalensee, 1985), industry-specific factors are absent from most studies of how environmental regulations impact firm strategy. This may lead to wrong conclusions and inconsistent findings. For instance, carbon pricing regulations will induce different strategic responses by firms belonging to relatively more location-bound industries, such as the cement industry than of those belonging to less location-bound industries such as software or finance (De Vasconcellos e Sá & Hambrick, 1989: 368; Jokar & Mokhtar, 2018). This is because it is, on average, much harder for firms from more location-bound industries to develop transferable FSAs or to escape unfavorable national legislations. Consequently, if industry affiliation is an important predictor of firm responses to environmental regulation, one needs to take into account which industries are subject to the EU ETS.

Policymakers have targeted industries that are the biggest emitters of CO_2 in order to efficiently achieve their regional, national, or transnational CO_2 reduction commitments (EC, 2016). The nine industries that the EU Directive initially mandated to comply with the EU ETS were: Bricks and Ceramics, Cement and Lime, Coke Ovens, Combustion (including electric utilities), Glass, Iron and Steel, Paper, Refining, and Roasting and Sintering (EU, 2003). These industries can be characterized as mature, frequently dealing with commodities or standardized products, competing on a global scale largely on price and, consequently, on costs.

In mature industries, firms that have only domestic production sites have fewer chances to exploit economies of scale through FSAs or CSAs outside their home market, even if they are significant exporters. Previous research has shown that being a fully domestic producer makes a firm more likely to focus on niche markets and differentiation (e.g., Parrish, Cassill, & Oxenham, 2006; Temouri, Driffield, & Higón, 2008). Success factors in niche markets, such as strong relationships, business reputation, differentiated products, or flexible service, provide these domestic firms with competitive advantages (Parrish et al., 2006) that ensure their survival *vis-à-vis* MNEs. Domestic firms are particularly likely to build on locational resources (Carpano, Rahman, Roth, & Michel, 2006), such as more locally customized products and solutions, stronger local relationships, and stronger embeddedness in the local environment (e.g., Halaszovich & Lundan, 2016). In comparison, MNEs' subsidiaries are often deficient in local embeddedness and suffer from what has been conceptualized as liability of foreignness (Zaheer, 1995). Liability of foreignness not only includes coordination and logistics costs but also transaction costs that arise due to MNEs' unfamiliarity with the host market and systematic discrimination by stakeholders of the host country (Sethi & Guisinger, 2002).

To understand the different environmental strategies of MNEs, compared to those of domestic firms, it is also necessary to identify industry-specific characteristics that influence the possibility of carbon leakage, i.e., of shifting CO_2-burden operations across borders. No major analysis is needed to establish that the industries affected by EU ETS are to a large extent location-bound. They are determined by relatively high plant costs (e.g., for refineries), availability of natural resources (e.g., power plants), high logistics costs (e.g., paper production), and economies of scale (e.g., the glass industry). Additionally, per definition, CO_2 emissions are a significant cost factor. While the financial industry can revise its decision to locate in London relatively easily after Brexit, it is much more difficult in the above-mentioned industries.

Variation in Firm-Level Characteristics. The relevance of firm-level characteristics for determining the strategic choices of MNEs has been highlighted in previous studies (Bu & Wagner, 2016; Li & Zhou, 2017; Madsen, 2009). Nevertheless, efforts to understand differences in the relative environmental performance of MNEs and domestic firms frequently overlook the systematic differences between these firm types at the corporate level.

To better understand strategic responses of MNEs and domestic firms related to carbon pricing regulations, we elaborate on how the economic rationales of MNEs differ from those of domestic firms. In order to derive our hypotheses, the introduction of environmental regulations and especially carbon pricing schemes is modeled as an exogenous shock imposed on MNEs and domestic firms competing in the relatively mature industries that are the focus of the EU ETS.

Economic Rationale for MNE Responses in the EU Carbon Pricing Context

Applying an economic perspective, as proposed by many IB scholars (e.g., Buckley & Casson, 1976; Dunning & Rugman, 1985; Rugman, 1981;

Rugman, Verbeke, & Nguyen, 2011), we suggest that firms will analyze the effects of such regulations in terms of cost–benefit evaluations. The strategic considerations that MNEs face include questions such as: (I) whether to comply with carbon pricing regulations and act at all; (II) whether and how to respond to weakened CSAs by exploiting their international network of production sites (e.g., "race to the bottom"); and (III) whether and how to develop new FSAs by introducing more environmentally-friendly technologies and production processes ("race to the top").

An MNE's first strategic alternative (I) is to continue with a business-as-usual approach (Wright & Nyberg, 2017). It turns out to only be a rational approach if the additional costs imposed by carbon pricing schemes or the expected additional profits from trading emissions allowances after deducting the additional investments in new capabilities are not expected to affect its competitive position. This could be the case, if (1) carbon prices or taxes are marginal, (2) emission allowances are available for free or at low costs, or (3) fines for not complying are either negligible or laxly enforced. Hence, in line with previous studies, one would expect a small effect of weak regulations on the willingness of MNEs to reduce their carbon emissions (Pinkse & Kolk, 2007; Rugman & Verbeke, 1998b). Consequently, such a laissez-faire strategy becomes less likely the higher the costs associated with the status quo of high CO_2 emissions and the more stringent the enforcement of carbon pricing schemes. In this regard, however, MNEs are no different from domestic firms.

The second strategic alternative for MNEs (II) is to evade the weakening of a CSA or its transformation into a country-specific disadvantage (CDA), and to shift emission-burden operations to plants in other countries. This option is no simple matter for their domestic peers – at least in the medium term. Even for MNEs, implementing such a strategy is likely more difficult than commonly assumed by scholars. As outlined in the extensive offshoring literature (e.g., Doh, 2005; Schmeisser, 2013), and even by "pollution haven" scholars (Branger & Quirion, 2014; Li & Zhou, 2017), the decision to shift parts of an MNE's production and operations from one country to another is shaped by many important contingencies (Contractor, Kumar, Kundu, & Pedersen, 2010; Mudambi & Venzin, 2010).

While intangible assets (e.g., knowledge work and services) may be easier, tangible assets (e.g., production sites and physical operations) of many firms and industries that are covered by the EU ETS are particularly difficult to relocate. High investments and location-bound factors on either the supply side (e.g., coal power plants are often located close to deposits, steel plants close to harbors) or the customer side (e.g., power plants close to industrial zones, having a connection to the electricity grid) induce high and often irreversible costs (Rugman & Verbeke, 1998a). As such, relocation is rarely short term. Even shifting parts of industrial production processes from one country to another tends to be a complex and difficult decision. It has to account for tight long-term collaborations within supply chain networks, and also for social capital constraints (Wolfolds, Taussig, Hong, & Carlsson, 2017). Furthermore, with the exception of electricity, the logistics costs faced by firms of EU ETS-affected industries limit their relocation radius and can induce new CO_2 emissions (e.g., transportation), especially if pollution havens are distant. Finally, as previous studies have emphasized, market size may play an important role with regard to a relocation decision (Rugman & Verbeke, 1998a). Due to these cost-related and strategic considerations, we argue that the potential for MNEs to shift production to their plants outside the EU in order to exploit CSAs relating to carbon pricing is likely to be limited. This viewpoint is supported by recent studies that have not found evidence for production shifts in the context of the EU ETS (aus dem Moore, Großkurth, & Themann, 2019; Naegele & Zaklan, 2019).

MNEs' third strategic alternative (III) is to actually develop and implement emissions reduction strategies in response to carbon pricing regulations. Comparing MNEs to their domestic rivals is particularly important when considering this strategic option. We argue that MNEs are both more motivated and better equipped to pursue this third strategic path than domestic firms, for the following three economic reasons.

First, MNEs are under higher pressure from other external stakeholders (Attig et al., 2016; Donaldson & Preston, 1995; Li & Zhou, 2017). Given their global brands and reach, they are more often attacked by local and international environmental activists and NGOs than relatively more 'invisible' domestic market actors (Hiatt, Grandy, & Lee, 2015). Even if they announce measures to reduce their environmental impact, they are often accused of window dressing or greenwashing (Kim & Lyon, 2015; Lyon & Maxwell, 2011; Raufflet, Cruz, & Bres, 2014), as can be witnessed recently in the case of

Glencore (Hume, Sheppard, & Sanderson, 2019; Khadem, 2019). Furthermore, MNEs depend to a higher extent on international financial markets and institutional investors, which have become increasingly sensitive to issues of corporate social responsibility and environmental, social, and governance information (Dowell, Hart, & Yeung, 2000; Konar & Cohen, 2001; van Duuren, Plantinga, & Scholtens, 2016; Yan, Ferraro, & Almandoz, 2019). As such, showing compliance and reducing CO_2 emissions might also result in lower capital costs for large MNEs. Additionally, due to the liability of foreignness, MNEs perceive not only the need to comply but also strategic benefits from investing in corporate citizenship (Gardberg & Fombrun, 2006) or corporate social responsibility (Attig et al., 2016). In the light of these economic arguments, MNEs should be more motivated than domestic firms to prove their bona fides by meeting, or even exceeding, national environmental standards in host countries.

A second important reason is that their transnational activities give MNEs a variety of resources and capabilities for developing innovative sustainability technologies. In some cases, they may have encountered similar regulations in another country, fueling organizational or technological in-house innovation (i.e., a kind of FSA that can be applied to new cases). Furthermore, MNEs have an economic incentive to apply uniform environmental standards on a global basis in order to avoid extra costs and to profit from economies of scale (Bansal, 2005; Pinkse, Kuss, & Hoffmann, 2010; Prahalad & Doz, 1987). Therefore, it is often in the economic interest of an MNE to use the highest environmental standards, i.e., the strictest environmental regulations across their portfolio of host countries, as a yardstick for its subsidiaries to meet in all other host countries, rather than to always pursue the lowest standards possible (Albornoz, Cole, Elliott, & Ercolani, 2014; Li & Zhou, 2017; Ruud, 2002). In contrast, domestic firms are incentivized to comply solely in their home countries. MNEs following this approach over-comply in at least some host countries – a behavior that is rewarded by markets (Dowell et al., 2000; Flammer, 2013). The result should be better relative environmental performance by MNEs, on average, compared to domestic firms.

Another economic reason put forward by previous studies for why MNEs should be more inclined to reduce CO_2 emissions to a larger extent than domestic firms is that environmental regulation, including carbon pricing, may lead to new FSAs, which can subsequently be exploited across operations in different countries (Kolk & Pinkse, 2008; Rugman & Verbeke, 1998b). However, for MNEs in energy-intensive industries that are subject to the EU ETS, FSAs are often cost-reduction activities such as process innovations (e.g., new chemical processes, recycling, or use of hydrogen lorries), rather than product innovations (e.g., solar panels, hybrid drive). Different from the latter, process innovations that lower production costs are a unique source of competitive advantage *vis-à-vis* competitors, which MNEs want to keep not sell. Moreover, relative to their domestic peers, MNEs tend to be more capable of building up process technology-based FSAs for two main reasons. First, MNEs have advantages in accessing international resources (e.g., research collaborations, supply chains) and networks proven to be important drivers of environmental technologies (De Marchi, 2012; Horbach, 2008). Second, they benefit from economies of scale when developing and using new technologies, as they can utilize environmental technologies across different production facilities. Confirming these assumptions, previous research has shown that regulations trigger off mainly environment-related process innovation and less so product innovation (Cleff & Rennings, 1999; Horbach, Rammer, & Rennings, 2012).

ETSs, in particular, offer the chance for MNEs to develop another kind of internal FSA, which can be used outside their core competencies and may generate additional turnover and profits. Developing capabilities with regard to efficiently trading CO_2 certificates will ultimately generate an FSA that can be better exploited by MNEs than their purely domestic competitors. Even if some authors have suggested that transaction costs are negligible in the market for emissions permits (Jaraite, Convery, & Di Maria, 2010), building up specific capabilities and executing these complex transactions in the light of specificities of different emission trading schemes come at costs that can be borne more easily by firms with a large amount of tradeable CO_2 emission allowances (Kolk & Pinkse, 2008). Importantly, the economic rationale for MNEs to pursue a strategy of over-performing with regard to CO_2 emission reductions depends to a great extent on the price at which excess allowances can be sold. This is the case because there is a trade-off between additional costs and additional profits. According to a survey of Forbes 500 firms conducted by the Carbon Disclosure Project, a majority of firms use trading for cost compliance reasons only and refrain from building up arbitrage or speculation capabilities (Pinkse & Kolk, 2007).

Based on these lines of argumentation, we propose the following main hypothesis:

Hypothesis 1: Ceteris paribus, MNE-owned plants will exhibit superior carbon performance relative to their domestic-only competitors when facing carbon pricing regulations.

An important additional feature of carbon pricing regulations in EU member states is that some countries feature a carbon tax in addition to the EU ETS, while others are governed only by the EU ETS (EU 2019; Scharin & Wallström, 2018).[2] This difference in host-country institutional configurations provides an interesting context to study. In particular, the configuration involving overlapping carbon pricing schemes is one that should increase economic incentives to find ways to reduce emissions, both through increasing overall costs and restricting firms' ability to evade costs. This is because, while a plant that only faces emissions trading could decide to buy permits on the market instead, a plant that also faces a carbon tax will still have to pay the tax on emissions it produces. In line with our previous arguments on the greater impact of stricter environmental regulations on the strategic adaptation of MNEs, relative to that of domestic firms, this host-country-specific external cost pressure on plants to reduce emissions should also have a greater impact on incentivizing MNEs.

First and foremost, these two carbon pricing regimes will provide stakeholders of firms with even more legitimate power with which to pressure firms to improve their carbon performance. As we have already argued, such pressure is more likely to be exerted on MNEs than on purely domestic firms, as the greater public prominence of MNEs and their brands makes them more vulnerable to allegations of environmental misconduct and more useful as adversaries for activists (Kozinets & Handelman, 2004; Meyer, 2004). This reality is furthered by the fact that MNEs are often perceived as profit-maximizing organizations that are particularly prone to unethically exploiting unique FSAs or CSAs (Giuliani & Macchi, 2014). This greater exposure gives foreign MNEs greater economic incentive to identify new ways for reducing their emissions. A second main reason relates to the development and exploitation of FSAs. Specifically, MNEs have greater economic incentives than their domestic counterparts to find new ways to reduce emissions because they have the chance to leverage any new technologies or organizational capabilities that they develop in response to regulatory pressures in one place by transferring them and giving a head start to their subsidiaries in other countries (Dowell et al., 2000). Hence, we propose:

Hypothesis 2a: Ceteris paribus, the superior carbon performance of MNE-owned plants relative to their domestic-only competitors is enhanced in host countries that concurrently run multiple carbon pricing regimes.

Another feature of the development of the EU, in general, and the introduction of EU ETS in particular, allows for examining whether the effect of stricter international environmental regulations on the relative carbon performance of MNEs and domestic firms will vary with differences in the market institutions of host countries. In particular, we focus here on the significant institutional differences between, on the one hand, the countries of the long-established market economies of Western Europe, also known as the EU-15, and, on the other hand, the relatively new market economies of Eastern Europe. The latter, which we refer to as the New EU countries, joined between 2004 and 2007, only a decade after having begun their transition from Soviet-style central planning.[3] Under the previous economic system in these New EU countries, negative environmental consequences were accepted as a necessary trade-off of industrialization priorities, and this reality did not change overnight with the formal abandonment of centrally planned communism (Pavlínek & Pickles, 2004). As such, it is not surprising that previous research has framed the New EU countries as pollution havens, where relatively lax environmental regulation served as CSAs providing production cost advantages (Surroca, Tribó, & Zahra, 2013).

However, while market institutions in New EU countries are likely still, even today, not as well established as in the EU-15, it is also undeniable that – given their low starting positions – the positive within-country change in regulatory institutions towards greater stringency and quality has been far more meaningful in these transition countries than in the long-time market economies of Western Europe. Unlike with international regulations like EU ETS and even host-country-specific carbon taxes, however, the emergence of market institutions in the New EU has been less about

Table 2 Descriptive statistics and correlations

	Variable	Obs	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9
1	Plant carbon emissions CAGR	6,279	− 0.05	0.20	− 0.72	0.80	1.00								
2	MNE parent firm (dummy; Yes = 1)	6,279	0.52	0.50	0.00	1.00	− 0.00	1.00							
3	Domestic MNE parent (dummy; Yes = 1)	6,279	0.18	0.38	0.00	1.00	0.01	0.44	1.00						
4	Foreign MNE parent (dummy; Yes = 1)	6,279	0.35	0.48	0.00	1.00	− 0.02	0.70	− 0.34	1.00					
5	Foreign MNE EU-15 parent (dummy; Yes = 1)	6,279	0.25	0.43	0.00	1.00	− 0.01	0.55	− 0.26	0.78	1.00				
6	Foreign MNE EU-new parent (dummy; Yes = 1)	6,279	0.01	0.08	0.00	1.00	− 0.02	0.08	− 0.04	0.11	− 0.05	1.00			
7	Foreign MNE non-EU parent (dummy; Yes = 1)	6,279	0.09	0.29	0.00	1.00	− 0.01	0.31	− 0.15	0.44	− 0.18	− 0.03	1.00		
8	Host country = ETS Only (dummy; Yes = 1)	6,279	0.65	0.48	0.00	1.00	− 0.03	− 0.08	− 0.08	− 0.02	− 0.02	0.02	− 0.01	1.00	
9	Host country = EU-new (dummy; Yes = 1)	6,279	0.18	0.38	0.00	1.00	− 0.04	− 0.05	− 0.20	0.10	0.10	0.16	− 0.02	− 0.21	1.00

incentivizing frontier innovation than about enforcing that all firms meet minimum standards. In so doing, the New EU countries' institutional advances have eroded CSAs of lax environmental governance that had temporarily enabled domestic firms to withstand the onslaught of international competition through continued reliance on the technologies and processes of the previous era.

Up to this point, we have focused on ways in which the introduction of new climate regulation systems leads to greater strategic initiative by MNEs than by their domestic counterparts. However, in the case of systems transitioning from top–down directives from government planners to state-owned enterprise managers towards the EU's global standard for environmental regulation of the market, there is reason to expect that slow and steady evolution of host-country regulatory capacity may instead have a greater influence on previously unregulated domestic firms. In some cases, this likely involved new regulations driving true dinosaurs out of business, while in others it involved pushing more dynamic firms towards carbon emissions control measures previously deemed unnecessary.

In addition to domestic firms in New EU countries experiencing greater regulatory pressure to meet rising host-country standards than MNEs, it is also likely that these domestic firms had significantly less costly means for improving their carbon emissions than was the case for MNEs. Because of the previous system's centrally mandated production targets, domestic firms in the New EU member states have until recently been infamous for outdated and polluting technologies and inattention to the environmental harm caused by their operations. This legacy created starting positions from which there was particularly substantial room for reducing emissions by simply catching up to historical Western European standards through measures such as closing down their most inefficient and polluting production lines and transitioning the introducing of even moderately less-polluting technologies. Additionally, there is ample evidence for capital and technology transfers by the EU to support this environmental upgrading in order to reach EU objectives. Among others, the EU provided structural funds to new member states to overcome market failures that had impeded environmental protection (Streimikiene, Klevas, & Bubeliene, 2007).

In short, we are examining a period during which there was far greater incentive and potential for

Table 3 Mean carbon emissions compound annual growth rates by multinational status and host-country institution categories

	Full sample (%)	EU-15 host countries (%)	New EU host countries (%)	CTS and ETS host countries (%)	ETS Only host countries (%)
MNE-owned plants	− 4.72	− 4.72	− 4.70	− 4.65	− 4.76
Domestic only-owned plants	− 4.55	− 3.74	− 7.75	− 2.81	− 5.34
Full sample	− 4.64	− 4.26	− 6.33	− 3.87	− 5.06

Table 4 The effect of multinational ownership on plant carbon emissions (Winsorized at 1%), 2008–2012

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Fully-inclusive cross-sectional sample		Core sample with stable MNEs only							
	General MNE	Disaggregated MNE	General MNE	MNE at home	Foreign MNE	MNEs at home and abroad	EU-15 MNE	New EU MNE	Non-EU MNE	All MNE subtypes
Multinational parent firm (dummy; Yes = 1)	− 0.21	− 0.02	− 0.02							
	(0.00)	(0.00)	(0.00)							
Domestic-only-to-multinational parent (dummy; Yes = 1)		0.11								
		(0.00)								
Multinational-to-domestic-only parent (dummy; Yes = 1)		− 0.08								
		(0.02)								
Multinational parent at home (dummy; Yes = 1)				− 0.02		− 0.03	− 0.03	− 0.02	− 0.02	− 0.03
				(0.02)		(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
Foreign multinational parent (dummy; Yes = 1)					− 0.00	− 0.01				
					(0.80)	(0.10)				
Foreign multinational EU-15 parent (dummy; Yes = 1)							− 0.01			− 0.01
							(0.09)			(0.09)
Foreign multinational new (East) EU parent (dummy; Yes = 1)								0.02		0.02
								(0.14)		(0.14)
Foreign multinational non-EU parent (dummy; Yes = 1)									0.04	0.03
									(0.1)	(0.21)
Observations	6,369	6,369	6,279	6,279	6,279	6,279	6,279	6,279	6,279	6,279
R-squared (Centered)	0.066	0.069	0.065	0.066	0.064	0.066	0.066	0.066	0.066	0.066
R-squared (after partialing out fixed effects)	0.002	0.005	0.001	0.001	0.000	0.002	0.002	0.001	0.001	0.002

Table 5 The effect of multinational ownership on annual carbon performance (winsorized by 1%), by host-country environmental institutions and market institutions, 2008–2012

	(1) Carbon tax host countries	(1) ETS only host countries	(3) Full core sample	(4) EU-15 host countries	(5) New EU host countries	(6) Full core sample	(7)	(8) Combustion Only	(9) Non-Combustion Industries Only
Multinational Parent Firm (dummy; Yes=1)	− 0.04	− 0.01	− 0.03	− 0.02	0.02	− 0.02	− 0.03	− 0.03	− 0.04
	(0.01)	(0.04)	(0.00)	(0.00)	(0.25)	(0.00)	(0.00)	(0.01)	(0.01)
Interaction: MNE × ETS Only			0.01				0.02	0.01	0.05
			(0.16)				(0.03)	(0.02)	(0.02)
Interaction: MNE × New EU						0.06	0.07	0.06	0.06
						(0.00)	(0.00)	(0.01)	(0.02)
Observations	2200	4079	6279	5145	1134	6279	6279	4037	2242
R-squared (centered)	0.083	0.069	0.066	0.066	0.096	0.066	0.066	0.037	0.144
R-squared (after partialing out fixed effects)	0.003	0.001	0.001	0.002	0.000	0.002	0.002	0.002	0.002

All models are OLS models with industry, home-country, and host-country fixed effects and two-way clustering of parent firm and host country, with all fixed effects partialled out; *p* values are reported in parentheses.

domestic firm-owned plants in the New EU to reap "low hanging fruit" and thereby reduce their carbon emissions to a much higher extent than was the case for either MNEs or domestic firms in EU-15 states. This is because our focus is on a period of convergence in the stringency of minimum environmental standards, leading domestic firms to lose what had been a CSA that insulated them from costs borne by their competitors. This leads us to the following hypothesis:

> **Hypothesis 2b:** Ceteris paribus, the superior carbon performance of MNE-owned plants relative to their domestic-only competitors is reduced in host countries experiencing a transition towards more stringent market regulatory institutions.

METHODOLOGY

Empirical Context and Data

EU Emissions Trading Scheme. One of the most important pillars of the EU's climate policy has been the implementation of an EU-wide regulatory program for carbon emissions, the EU ETS (Ellerman & Buchner, 2007; Ellerman, 2009; Ellerman et al., 2010; Knopf et al., 2014). After attempts to pass a European carbon tax had failed, the EU decided to pursue a market-based solution focused on cap-and-trade, i.e., the EU ETS (EC, 2016). The program's legal foundation is an EU Directive, which mandated that every plant with a certain minimum output and size in initially nine industries would have to comply with the EU ETS, while a tenth category allowed plants not covered by the EU ETS to opt-in (EU, 2003). Launched in 2005, the EU ETS subsequently established the world's largest and first multinational carbon regulatory program, covering about 45 percent of the EU's greenhouse gas emissions (EC, 2020).

The introduction of EU ETS followed three different phases, Phase 1 (2005–2007), Phase 2 (2008–2012), and Phase 3 (2013–2020), and covers currently all 27 EU member countries and the UK, as well as Iceland, Liechtenstein, and Norway, all of which joined voluntarily. In order to allow relevant stakeholders to become acquainted with emissions trading gradually, Phase 1 was a "pilot phase", whereas Phase 2 was designed to achieve the emissions reductions stipulated for EU member countries within the Kyoto Protocol.

Firms, through their plants, received free emissions permits from national regulators with supervision by the EU Commission ahead of Phases 1 and 2 on an annual basis. Since the EU ETS is meant to help EU countries reach emissions targets that were specified in the Kyoto Protocol, the emissions permit cap was reduced in Phase 2. To stay in compliance with the EU ETS, every plant had to retire the same number of emissions permits as verified emissions on an annual basis with regulators, with fines for non-compliance reaching €40 per ton of CO_2 in Phase 1 and €100 per ton of CO_2 in Phase 2.

For the purpose of our analyses, the EU ETS is an ideal setting because it has created a single transnational institutional arrangement for all plants in defined industries, whether they are owned by MNEs or domestic firms. Examining emissions changes within the EU ETS therefore allows us to test our hypotheses directly.

Data collection. The basis for our analysis is a unique dataset of all industrial plants covered by the EU ETS, which was collected manually through a six-year effort involving a team of research assistants. The primary challenge in creating the database was a need to combine information from a variety of different sources, a process that could not be automated, including the main EU ETS regulatory database (called the EU Transaction Log), the proprietary Orbis database, company documents, firm websites, annual reports, news articles, and public business listings. Key steps along the way included the following.

First, data were gathered on the entire population of industrial plants that were included in the EU ETS in Phase 2 across 25 EU countries[4] and Norway (which volunteered). The information on these plants was collected from a variety of EU sources (including from the EU Transaction Log) and encompasses the following core variables: a unique plant identifier, the plant name (in the local language), the host country in which the plant is located, the address of the plant (including street address, zip code, and city), a unique permit identifier used by the EU Commission, the industry designation for the plant, annual verified emissions, yearly allocated emissions permits, and the number and types of emissions permits submitted by each plant to the regulators.

Second, we obtained the name and address (including street address, city, zip code, and phone number) of each plant's so-called account holder, which is the legal entity registered with the EU as being responsible for that plant in the EU ETS. The account holder information was collected for the beginning of 2013, right after the end of the observation period of 2008–2012.[5]

The third step in our data collection process required the determination of the immediate corporate owner of each plant by manually matching the data on each plant and its account holder to information obtained from Bureau van Dijk's Orbis database, individual company websites, and public business listings. This became necessary because, in most cases, the account holder listed by the EU is not the same entity as the ultimate corporate owner of a plant. Depending on how each plant registered its account holder, it can either be a parent firm's local subsidiary, a legal entity managing the account (e.g., a law office or middleman), the parent company, or an employee working at the corporate entity owning the plant.

As a fourth and final step, we engaged in an effort to identify the ultimate corporate parent owner for each plant, i.e., the highest level of ownership. We used ownership data from Orbis at the beginning of 2013, as well as historic ownership data going back to 2005, to find the ultimate parent company for each plant in every year of our panel. This step involved manually checking multiple levels of partially complicated historic ownership structures to find the ultimate corporate ownership level.[6] For our main hypotheses' tests, we focus only on data for Phase 2,[7] which yielded a final sample of 6,279 plants belonging to 2,433 ultimate parent firms for 2008–2012.

Variables

Dependent variable. To account for plant-level carbon performance, we calculated the CAGR of each plant's carbon emissions. Specifically, we defined our primary dependent variable as:

$$\mathit{Plant\,Carbon\,Emissions\,CAGR}_I = \left(\frac{\mathit{Final\,year\,emissions}_I}{\mathit{Initial\,year\,emissions}_I}\right)^{\frac{1}{(n_I)}} - 1$$

with n_I = final year – initial year for each plant I.

If *Plant Carbon Emissions CAGR* is positive, carbon emissions increased, which signifies a worsening of carbon performance. If, in contrast, it is negative, emissions fell, which means a better carbon performance. If it equals zero, the plant did not experience any change to its level of emissions over the sample period. To reduce the effect of extreme outliers, *Plant Carbon Emissions CAGR* is winsorized at one percent, pulling inward the highest and lowest values to equal the values of the sample observation(s) at the one and 99 percentile levels.

Independent variables. Our most important independent variable is *MNE Parent*, a dichotomous variable measuring whether or not a plant is owned by a firm that operates across multiple countries. As such, *MNE Parent* equals zero (= domestic only) if, according to our database, the focal plant's owner operates plants only in the same country as its headquarters. *MNE Parent* equals one if it operates plants in multiple host countries or, if not, its headquarters are based in a different country than its plant(s).

We further create the following related dichotomous variables to explore the relative importance of key subcategories of *MNE Parent*. First is *Domestic MNE Parent*, which measures whether or not a plant is owned by an MNE, as defined above, which is headquartered in the same host country in which the respective plant itself is located. Second is *Foreign MNE Parent*, which measures if a plant is owned by an MNE that is *not* headquartered in the same host country in which the focal plant is based; in other words, an MNE not covered by *Domestic MNE Parent*. We further refine this variable with three additional measures of MNE subtypes based on the parent's home country: *Foreign EU-15 MNE Parent*, *Foreign EU-New MNE Parent*, and *Foreign Non-EU MNE Parent*.

In order to test Hypothesis 2a, we create a dichotomous variable that we term *Host Country with ETS Only*. The variable equals one if a host country did *not* layer a carbon tax system on top of the base of the EU ETS system in which all countries in our database are participants. The key variable for testing Hypothesis 2a, however, is not the direct effect of this variable, but rather the interaction term between it and *MNE Parent*. For maximum clarity, we label this variable *Interaction: MNE × ETS Only*.

Similarly, to test Hypothesis 2b, we create another host-country-based variable, which we label *Host Country = EU-New*. This is based on a division of the countries in our database into two groups based on their differing histories: the 15 original EU members (EU-15) and the new members that joined the EU and the EU ETS in 2004 and 2007, respectively. As with Hypothesis 2a, the true test of Hypothesis 2b is based on the interaction of this variable with *MNE Parent*, which we term *Interaction: MNE × EU-New*.

Control variables. Finally, we apply industry fixed effects to account for the differences between ten main industries. We also use fixed effects to control for home- and host-country characteristics.

Empirical Approach and Model

In implementing our analyses, we run standard ordinary least squares (OLS) with two-way clustering of errors for parent firm and host country (Cameron, Gelbach, and Miller, 2006; Desai, Foley, and Hines, 2008). These are the two most important groups within which plant observations are embedded, with each relating to a key group-level independent variable.

Our main model is specified as:

$$\begin{aligned} &\mathit{Plant\,Carbon\,Emissions\,CAGR}_I \\ &\quad = \alpha + \beta_1 * \mathit{MNE\,Parent}_I + X_I + \varepsilon_I, \end{aligned}$$

where $\mathit{PlantCarbonEmissionsCAGR}_I$ is plant *I*'s carbon emissions CAGR over the sample period, as described in the previous section, $\mathit{MNE\_Parent}_{I}$ marks whether or not plant *I* is owned by a MNE and is interchangeable for variables representing each of the earlier-defined MNE subtypes, X_I is a vector of control variables, and ε_I is the error term. We include fixed effects for plant industry, plant host country, and parent firm home country in all the models.[8]

RESULTS

Descriptive Statistics

We present summary statistics and correlations for all variables in Table 2 for our main sample of 6,279 plants that did not change multi-nationality status over the sample period. Note that about half (52%) of all the plants in this sample are associated with an MNE owner, with 18 percent based in the MNE's home country (*Domestic MNE Parent*), and 35 percent based in a foreign host country (*Foreign MNE Parent*). Furthermore, while 11 percent of the plants are associated with an MNE owner from a new EU country, only one percent are affiliated with *Foreign EU-New MNE Parent*. This shows that MNEs from new EU countries are still primarily domestically-oriented firms, as most of their plants are based in their home country. In fact, association with an MNE from a non-EU home country (9%) – all of which are, of course, foreign – is far more common than association with the *Foreign New–EU MNE Parent* category.

Table 3 presents the mean values for our dependent variable, carbon emissions CAGR, across both MNEs and their domestic-only counterparts, on the one hand, and all four groupings of host-country institution types (EU-15, New EU, CTS & ETS, and ETS Only). Here, we see initial support for Hypothesis 1, with MNE-owned plants exhibiting 0.17 percent lower CAGRs, on average, than domestic-owned plants. Also consistent with the argumentation underlying Hypothesis 1 is the fact that MNE-affiliated CAGRs are strikingly consistent across all four main categories for host country institutions. Domestic firms, in contrast, show, on average, lower reductions than MNE-affiliated plants of nearly a full percentage point in EU-15 host countries and close to two full percentage points in CTS and ETS host countries, while actually showing higher reductions in New EU host countries and in ETS Only host countries. The higher reductions of domestic firms in the New EU countries, in particular, hint at the "low hanging fruit" mechanism mentioned in our development of Hypothesis 2b. The higher reduction in ETS Only host countries, in turn, points towards the possibility of other factor at work that we, first, try to control for in our regression analyses, and, second, delve into further in our Discussion section.

Main Regression Results

Table 4 presents evidence consistent with Hypothesis 1, which holds that MNE ownership of a plant is associated with superior carbon performance, i.e., a lower emissions CAGR relative to domestic peers. Before narrowing our analysis to our main sample in Model 3 and the remainder of our analyses, we consider a broader sample in Models 1 and 2, inclusive of plants that actually did change their multi-nationality status over the sample period. Model 2 provides a check on the difference between the effect of multi-nationality for plants whose owner went from domestic only to multinational and those whose owner's multinational status went in the opposite direction. Consistent with a logic that going from domestic only to multinational will generally be associated with an expansion in carbon-producing operations, the former is associated with a large, statistically significant increase in carbon emissions growth, while the latter is associated with a large, statistically significant fall in carbon emissions growth. Across Models 1–3, the coefficients on our primary independent variable, *MNE Parent*, are negative, of similar size, and statistically highly significant. As such, dropping the 90 plants that changed their multinational status during the sample period seems reasonable, as doing so does not substantially change the results.

Model 3 indicates that, holding all else constant, MNE ownership is associated with a 1.8 percentage points lower emissions growth rate than domestic ownership. Models 4–6 dig deeper by separately considering categories of MNEs at home and MNEs abroad. Model 4 produces a negative and significant ($p = 0.016$) coefficient for *Domestic MNE Parent* when testing it on its own, while, when *Foreign MNE Parent* is added in Model 6, the size and significance ($p = 0.005$) of this coefficient grows larger. As for *Foreign MNE Parent* itself, its coefficient is indistinguishable from zero when tested separately in Model 5 but reaches $p = 0.096$ when tested together with *Domestic MNE Parent* in Model 6. Even so, the size of the coefficient on *MNE at Home* is 2.5 times larger than that of *Foreign MNE Parent* in Model 6. As such, Table 3 provides support for Hypothesis 1, whether MNEs are at home or abroad, but also indicates that carbon performance benefits of multi-nationality may be larger when MNEs are at home.

Finally, for Table 4, Models 7–9 look more closely at the origins of foreign MNEs and indicate that this better carbon performance relative to domestic-only owners is accounted for primarily by plants associated with MNEs from EU-15 home countries. In particular, Model 7 produces a p value of 0.085 on the coefficient for *Foreign EU-15 MNE Parent*, whereas coefficients on *Foreign EU-New MNE Parent* and *Foreign Non-EU MNE Parent* in Models 8 and 9, respectively, are both indistinguishable from zero. Model 10 includes all these sub-types and produces results consistent with the earlier models.

Table 5 presents evidence in support of Hypotheses 2a and 2b, albeit stronger support for the latter than for the former. In Model 1, we constrain our sample to include only observations based in host countries that apply both the EU ETS and an additional CTS. The coefficient on *MNE Parent* in this model nearly doubles in size, indicating a 3.5 percentage points lower emissions CAGR than plants owned by non-MNEs, while improving in significance ($p = 0.011$). In Model 2, we consider the remaining plants in host countries with only the ETS, and the coefficient on *MNE Parent* remains negative and significant ($p = 0.044$) but shrinks in size by more than half. In Model 3, we introduce an interaction of *MNE Parent* and our dichotomous variable for *Host Country with ETS Only* to test the difference between the coefficients on *MNE Parent* in Models 1 and 2, and thereby to test Hypothesis 2a. The coefficient on this interaction is not statistically significant and so does not provide support for Hypothesis 2a. However, when, in Model 7, we combine this interaction with the interaction testing Hypothesis 2b, its significance increases substantially ($p = 0.033$), and indicates that the carbon emissions CAGR for MNE-owned plants in host countries with both forms of carbon regulation are, on average, two percentage points lower than those of MNE-owned plants in host countries governed by ETS alone. As such, Table 5 provides some support for our Hypothesis 2a that MNEs will exhibit better carbon performance than domestic competitors in host countries with overlapping carbon regulations.

Table 5's Model 4 constrains the sample to only plant observations based in an EU-15 host country. For this sample, the coefficient on *MNE Parent* is negative, though not as large as in the host countries with multi-layered carbon regulations, and highly significant ($p < 0.001$). Model 5 restricts the sample to only plants in the New EU region, and the coefficient on *MNE Parent* is indistinguishable from zero, with its coefficient actually flipping to positive. To test Hypothesis 2b, which predicts that the more deeply embedded market institutions of Western Europe should have a particularly significant effect on MNEs, Model 6 introduces a new interaction between *EU-New Host Country* and *MNE Parent*. In this case, the coefficient on the interaction is highly significant ($p < 0.001$) and indicates that, in EU-15 host countries, the emissions CAGRs of MNEs are 5.5 percentage points lower than those of domestic firms. The size and significance of this coefficient only increases further in the full Model 7, where we add in the West versus East interaction. In sum, Table 5 provides strong support for our Hypothesis 2b, which holds that the carbon performance edge of MNEs over domestic firms will be heightened in EU-15 countries.

While we stress industry's important role in our development of our theory on how MNEs respond differently from domestic firms to carbon regulation, industry is a variable that we merely control for in all of the empirical analyses presented to this point. With our final two models in Table 5, we take an initial look at how relationships may actually vary across industries. In Model 9, we replicate Model 8 for just the combustion industry – an industry that accounts for nearly two-thirds of all plant observations in our sample. Model 10 then reruns the same analysis on the remaining 10 non-combustion industry categories. The main difference we see is that the MNE carbon performance advantage in host countries with carbon taxes loses significance when we look at just the combustion industry (Model 9). For other industries, in contrast, this interaction effect increases in size and significance. This difference supports the general claim that these relationships vary importantly by industry.

DISCUSSION

MNEs Exhibit Superior Carbon Performance Relative to Domestic Firms

The central thesis of our paper is that economic incentives emanating from carbon pricing regulations shape the environmental strategies and thereby the related operational behavior of MNEs across their portfolios of international production sites—especially as it compares to their domestic counterparts in each host country. Based on this conceptual perspective, we push back on popular arguments identifying MNEs as primary impediments to a much needed transition towards a more climate-friendly global economy. Specifically, we argue that MNEs are incentivized to achieve, on average, superior carbon performance (Hypothesis 1), relative to competitors who only produce domestically. Consistent with this prediction, our analysis indicates that – after one controls for industry and country factors – the carbon emissions of plants associated with MNE parents did indeed, on average, fall more than did emissions of plants owned by domestic only firms during Phase 2 of the EU ETS (2008 to 2012).

Reflections on Hypothesis 1. We see three main alternative explanations to ours that merit review to consider their potential validity. First, the time period of our analysis includes the economic recession following the subprime mortgage crisis and its subsequent recovery. Because CO_2 emissions are strongly linked to economic growth patterns and employment, it is conceivable that MNE-owned plants might have been slower to ramp up their operations in the aftermath of the crisis than were plants owned by their domestic peers. While our data do not allow us to test this possibility, broader empirical evidence does not point in this direction. According to Varum and Rocha (2011), who looked at manufacturing firms across multiple economic downturns, the employment growth rates of MNEs have not differed significantly from those of domestic firms. Furthermore, we can think of no clear theoretical rationale for why MNEs should perform systematically different in recovering from economic shocks.

A second potentially reasonable alternative explanation is that MNEs inflated their CO_2

emissions in the early stages of the EU ETS, to a significantly higher extent than indigenous firms, in order to reap the rewards during the emissions permit allocation in the EU ETS Phase 2. However, while there is ample evidence of a general oversupply of allowances in the first years of the EU ETS, there does not appear to be any evidence of MNEs being privileged in their access to allowances over domestic firms (Anger & Oberndorfer, 2008). On the contrary, given the fact that the allocation of allowances was at the discretion of member state governments, there is reason to suspect allocation processes would have been more likely to favor domestically-focused firms embedded in host-country-specific institutions (e.g., Ellerman & Buchner, 2007).

Third, one could argue that MNEs' better carbon performance stems, first and foremost, from shifting CO_2 emissions-burden operations to laxer carbon pricing regimes in order to exploit CSAs, as predicted by the "race to the bottom" hypothesis. As the underlying emissions data from the EU were not designed for, and hence our dataset does not allow for, explicitly testing this assumption either, our paper lays out a set of arguments, based on cost–benefit considerations and important contingencies of the EU ETS and its focus on industry specifics, that render this strategic behavior unlikely. Our arguments are supported by two recently published empirical studies, using related data, that conclude: "We find no evidence that the EU ETS has induced carbon leakage in European manufacturing sectors: …" (Naegele & Zaklan, 2019: 138) and "To conclude, the magnitude of asset erosion in phases I and II of the EU ETS appears to be very limited if not negligible." (aus dem Moore et al., 2019: 16).[9]

To conclude, it appears that the greater impact of regulations on the incentives of MNEs, relative to domestic firms, is the most viable explanation for our finding of the former's superior carbon performance. Although considered by some environmental economists as still too lax (Ellerman & Buchner, 2007; Koch et al., 2014; de Perthuis & Trotignon, 2014), the EU ETS nevertheless offers MNEs more economic incentives to reduce their CO_2 emissions than domestic producers – at least in those industries that are subject to emission regulations.

The Peculiar Case of Domestic MNEs. Particularly interesting, although not hypothesized, is our finding that MNEs' carbon performance is better in those plants which are located in the same country as their headquarters, i.e., what we call domestic MNEs. In other words, domestic plants of an MNE based in this country show superior carbon performance compared to not only domestic competitors but seemingly also plants associated with MNEs headquartered in foreign countries. This finding could be seen as surprising, given that others, including, for example, Ellerman and Buchner (2007), have found that MNEs have similar, if not even greater, sway over their home-country governments, as compared to domestic firms. Such political power might be expected to translate into regulatory conditions specifically tailored to minimize requirements for domestic MNEs to improve their carbon performance, and yet we find the opposite. It is our supposition that our finding that domestic MNEs are especially strong in their carbon performance likely reflects a confluence of factors. We suspect that the most important of these factors is that, for historical and economic reasons, MNEs' plants in their home countries are frequently what are termed as international lead factories, which tend to be their largest, and are located close to headquarters and R&D (e.g., Rudberg & West, 2008). Consequently, these are the plants where MNEs are first likely to experiment with the carbon emissions reduction strategies and technologies that they will later roll out across their international portfolios of foreign plants. However, future research may investigate this phenomenon more specifically.

The Moderating Effects of Host-Country Institutions

An important contingency emphasized in previous studies on MNEs and environmental performance is the extent of pressure exerted by environmental regulations in particular jurisdictions (Rugman & Verbeke, 1998a; Kolk & Pinkse, 2007). Our findings indicate that MNEs' carbon performance is most clearly superior to that of domestic firms in host countries where incentives for improving performance are most comprehensive due to the added presence of a carbon tax scheme (Hypothesis 2a). Furthermore, we find that the MNE advantage is also enhanced in the more long-established market economies of Western Europe, when comparing it with the likely only temporary catch-up situation of domestic firms in Eastern Europe (Hypothesis 2b). The empirical evidence we find in support of both of our moderating hypotheses point to a persistent but dynamic role for host-country institutions.

Reflections on Hypotheses 2a and 2b There is an interesting tension between our argumentation for the general carbon performance advantages of MNEs (FSAs) over domestic firms (Hypothesis 1) and the moderation of this advantage by host-country institutional conditions (CSAs and CDAs) that warrants further discussion. In particular, MNEs' potential for developing FSAs – i.e., emission and consequently cost-reducing process technologies – that are transferable across their global portfolios of country-specific operations is an important element of our development of Hypothesis 1. It would be fair to expect for these same FSAs to mean that MNEs' carbon performance should be relatively even across host-country environments and, as such, not vary with host-country institutions. Some may see this as undermining the rationale for both of our hypothesized host-country moderating effects.

However, we see two paths for reconciling this tension. First, FSAs do take time to build up. As Kolk and Pinkse (2008: 1373) write: "Most climate-induced FSAs are therefore likely to stay location-bound, at least for the near future." Our study period certainly could represent a relatively nascent period in this regard. This interpretation is also consistent with our earlier finding on the carbon reductions achieved by MNEs in their home countries, which we suggested was potentially also the result of MNEs having developed FSAs in home-based lead factories but not yet transferred them to foreign subsidiaries. Second, as we have heavily emphasized, our focus is not just on the behavior of MNEs but also on the behavior of MNEs relative to that of domestic firms. This can be affected both by how institutions shape the behavior of MNEs and how they shape the behavior of domestic firms.

Seen together, our Hypotheses 2a and 2b findings underline the importance of the breadth and depth of environmental institutions at the host-country level. This does not take away from the importance of international regulations, but is a reminder of the complementary role of national regulatory context. In particular, our findings are consistent with a vision that international institutions can push up the ceiling of environmental performance and host-country institutions can push up the floor.

Policy Implications

As our paper focuses on a topic of pressing importance for business leaders, governments, and the broader public policy community, it has several meaningful implications for environmental policy. First, one of the central debates among policymakers on how to achieve a transition to a low-carbon economy through carbon pricing often revolves around the question of whether to implement either emissions trading or a carbon tax. Our findings suggest that implementing *both* policies simultaneously may further heighten incentives for MNEs, in particular, to improve their carbon performance. This is noteworthy, in that it highlights the need for governments to use all the policy tools at their disposal, rather than seeking to identify a single best individual tool for motivating emissions reductions.

Second, our study indicates that, rather than being the scapegoats they are often portrayed as, MNEs could and should be considered natural partners by governments for efforts to transition to a low-carbon economy. As is evident to most experts on climate change, a significant reduction in emissions will require the efforts at all levels of society, but especially at the cross-cutting governmental and business levels. Therefore, there is significant potential for public–private partnerships (PPPs) between MNEs and governments to engage in joint efforts to address climate change with a meaningful impact. For instance, governments could work with MNEs to disseminate best practices for improving carbon performance to a wider swath of firms through innovative grant and development programs. Of course, governments should not enter such PPPs with naïveté about whether or not firms are fundamentally economically driven. Governments must remember that firms originally develop FSAs with an intent to reap benefits through internal transfers and concerted efforts to prevent spillover to competitors. However, the industries of focus here are generally relatively more regulated industries, which means that governments have sticks and carrots at their disposal for reshaping the incentives that guide firm behavior. As such, creative governments will hopefully find new ways to counteract the incentives that lead firms to resist broader spillover of their most environmentally beneficial capabilities and thereby motivate participation in PPPs.

Third, our analysis re-emphasizes the importance of institutions at not only the transnational level but also the host-country level. Our findings suggest that transnational institutions and regulations can and should play an important role in the transition to a low-carbon economy, since they provide an overarching framework to affect firms' carbon performance (e.g., our average CAGR was -0.05 across our entire sample). This also points to the importance of international agreements such as the UN Paris Climate Agreement as a platform for the development of transnational regulations with regard to climate change. However, at the same time, our work is a reminder for policymakers at both the transnational and national level that host-country institutions still matter a lot, even for climate concerns. This implies that the realities of variation in country-level institutions should probably be factored more explicitly into the design of new transnational regulatory efforts, and potentially even that more consultative processes in the development of new international regulations would be beneficial (Tyler, 2006). The fact that the UN Paris Agreement strongly emphasizes a bottom–up approach to emissions reduction goals and climate regulations, providing room for cross-country institutional idiosyncrasies, is consistent with this implication of our findings.

Fourth, while our conceptualization emphasizes the need to control for differences across industries, we highlighted the fact that industries that were subject to EU ETS showed rather homogeneous characteristics. Hence, our empirics primarily just control for industry (with fixed effects) rather than delving into possible differences, and how the influence of multinationality may vary across even these assumed to be rather homogeneous industries. An initial look at how combustion and other industries differ is consistent with our argument that industry moderates the impact that institutions have on carbon performance across countries and firms. However, more empirical investigation is needed to better comprehend how industry-specific factors impact carbon emissions and environmental strategies and how this varies across industries.

Reflections on the FSA-CSA Conceptual Framework

Although our study is positioned primarily as an empirical paper, we believe that it provides ideas and support for several distinct avenues for extending the explanatory power of the widely used FSA-CSA conceptual framework – especially in the realm of firms' impact on climate change.

First, we propose to further specify FSAs and CSAs. To better explain generic MNE responses to environmental regulations, it is necessary to distinguish more explicitly whether FSAs result from differentiation advantages (e.g., 'green' products) – frequently in the center of previous applications – or from cost advantages (e.g., low-emissions production technologies) as in the case of the EU ETS. Additionally, we propose to introduce country-specific disadvantages (CSDs). As shown with regard to the New EU member states, CSDs (e.g., transition towards international standards) can translate into competitive disadvantages of domestic firms, which induce a temporary catch-up response. In some cases, it is not the weakening of CSAs but the emergence of CSDs that leads to a better explanation for the emergence of FSAs in these markets.

Second, we advocate for a stronger conceptual consideration of temporal effects in the reference framework, building on Rugman & Verbeke's (1998b) original arguments in this regard. Dynamic competitive forces both create and eliminate (dis-)advantages. We show that the introduction of carbon pricing schemes can be seen as an exogenous shock to which MNEs and domestic firms respond with different strategies after implementation.

Third, we flesh out important dimensions of the FSA-CSA framework at three levels of analysis (institutions, industries, firms). Future research can build on these in order to provide an explanation for the lack of empirical support for the race to the bottom/race to the top hypotheses, as stated by Rugman and Verbeke (1998b).

Finally, although only indirectly related to the conceptual framework, our study highlights the need not only to distinguish between weak and strong environmental regulations but also to differentiate between specific regulatory instruments, in order to better explain past policy and business decisions and to better predict future decisions.

Limitations and Future Research

Our paper is, as usual, not without its important limitations. We list here several limitations that can be seen as starting points for future research building on our work. First, our analysis focuses only on the EU ETS. While the EU ETS is indeed the largest and the first multinational cap-and-trade program in the world, it is still evolving and being continually improved by regulators, especially in light of some early "childhood" challenges. Furthermore, it is now one of multiple carbon pricing regimes in the world, with more yet to come. It will be very interesting for future work to examine other carbon pricing programs as they are being implemented in potentially more challenging contexts, e.g., developing countries like China, or even more regulation-averse countries like the US, where introduction of more stringent measures appears likely under a new, more climate friendly presidential administration.

Second, the depth of our dataset did not allow for separating and directly analyzing, for example, cross-border production shifts or changes in production output as important determinants of MNEs' responses to carbon pricing regulations. We hope that future research can extend our study with more in-depth analyses, e.g., gathering additional institutional, industry- and firm-level data or combining it with primary survey data collected by other authors (e.g., Backman et al. 2017; Engels, 2009; Pinkse & Kolk, 2007).

Third, some critics of the EU ETS have already pointed out that political lobbying activities eroded initially intended economic incentives which may have a lasting effect on the emissions data and our interpretation of the results (Pinkse & Kolk, 2012). While our work indicates that MNEs have nevertheless still exhibited superior carbon performance, relative to domestic firms, more targeted research is needed to identify which particular firm types have indeed invested the most into lobbying for weaker requirements, and whether those types of firms have ultimately then lagged in their relative carbon performance. Fourth, and relatedly, conceptualizations and frameworks of MNEs responses to environmental policies to date, including our study, have been too static and neglect dynamic strategy development and adaptation. Even if the introduction of carbon pricing schemes is modeled as an exogenous shock, such shocks are often debated, negotiated, introduced, and implemented over a period of time. Similarly, FSAs and CSAs are not simply switched on and off, but require time and even experimentation to identify, develop, and, ultimately, to roll out throughout organizations. As a result, future IB research should aim to apply more longitudinal, process-oriented methodological approaches that can help to deepen our understanding of how and when national and international environmental regulations come to influence firm behavior. The potential of such approaches should grow substantially in the near future, as carbon regulations continue to deepen in their comprehensiveness and stringency, to spread across countries, and to involve requirements for more transparent and broadly available data.

CONCLUSIONS

Our theory and empirics indicate that MNEs, on average, are performing better with regard to their carbon performance than their domestic competitors within the emerging regulatory context of the EU ETS. This is relevant for academic and popular debates about MNEs as saviors or culprits. The precise ultimate objective of these debates has never been entirely clear, and, as such, we wish to caution against use of our work here as evidence that MNEs are indeed "good guys" that can be passively counted on to innovate the world through its grand climate challenge. Reality is much more complicated, and the most important variation in carbon performance is quite clearly at the firm and manager levels, as reflected in the ample evidence of MNE behavior on both sides of the savior versus culprit debate.

On the one hand, consistent with our overall positive finding on the carbon performance of MNEs, relative to domestic firms, MNEs in our specific context of the EU ETS have been shown to engage in very positive behaviors. These include MNEs (1) abstaining from engaging in speculative behavior (Pinkse & Kolk, 2007; Engels, Knoll, & Huth, 2008; Engels, 2009), (2) refraining from shifting production to emissions havens (Naegele & Zaklan, 2019), and (3) reducing carbon emissions at a higher rate than they reduced their economic activities during the EU ETS Phase 2 (Abrell, Ndoye-Faye, & Zachmann, 2011). Importantly, however, in each of these cases, the positive behavior of MNEs appears to be largely the result of economic assessments.

On the other hand, MNEs in the EU ETS setting have exhibited plenty of less laudable climate behavior. Such acts include (1) corporate political strategy efforts against stricter environmental regulations (Engels, 2009), (2) inflating of initial CO_2 emissions in anticipation of receiving more allowances (Martin, Muûls, & Wagner, 2015), and (3) banking surplus allowances for more rigid systems of the future (Laing, Sato, Grubb, & Comberti, 2013). It has been shown, for instance, that the majority of EU countries had an oversupply of allowances, leading to net long positions for most affected industries (Kettner, Köppl, Schleicher, & Thenius, 2008).[10] However, none of this behavior is unique to MNEs, and all of it represents economically rational behavior within existing institutional incentives.

We believe that, instead of settling whether or not MNEs are innately virtuous, the most important takeaway from this paper is the importance of broad attention to the "rules of the game," as North (1990) defined institutions, and the degree to which they are oriented towards the public interest. In particular, we believe the paper presents further evidence of the critical role of existing government institutions and current and future policy decisions about how precisely to regulate firms. Our paper indicates that recent increases in carbon regulation have had a particularly significant effect on MNEs and even hold out the possibility that the host-country level regulation successes in places like Western Europe may benefit countries around the world, as MNEs increasingly disseminate their climate-related FSAs across subsidiaries. However, our results also highlights the importance of greater attention to what needs to be done to more effectively influence domestic firms. To state the obvious, there is no shortage of work still to be done for our field to constructively contribute to accelerating transition towards a world where more sustainable business practices are the norm.

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NOTES

[1]We define domestic firms as those that: (1) own production plants based in only one host country in the EU ETS; and (2) have their headquarters (i.e., the plants' home country) in the same host country as all of their plants.

[2]Countries in the EU that featured a Carbon Tax in addition to the ETS during the period of 2008–2012 included Denmark, Estonia, Finland, France, Ireland, Latvia, Norway, Poland, Portugal, Slovenia, Sweden, and the United Kingdom. Countries that did not have a Carbon Tax on top of the ETS during the period of 2008–2012 included Austria, Belgium, Bulgaria, Czech Republic, Germany, Greece, Hungary, Italy, Lithuania, Luxembourg, Netherlands, Romania, Slovakia, and Spain.

[3]The EU15 includes the following countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and the United Kingdom. The new EU members that joined in 2004 were: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia. In 2007, the following countries joined the EU: Bulgaria and Romania.

[4]Excluding Croatia, which only joined the EU in 2013, and Cyprus and Malta, which had too few installations.

[5]The data from EU sources capture account holders only at a given point in time (i.e., they do not provide data on account holders for each year in the past, in contrast to allowances or emissions). The account holders at the beginning of 2013 were chosen because of data availability, and because they encompassed the most complete data on account holders for all plants in the period 2005–2012.

[6]We only considered a firm to be majority-owned by another company if the ownership stake was greater than 50%.

[7]The decision to focus on Phase 2 was because this period was the first real commitment period for EU member countries, and it followed suggestions from our reviewers.

[8]Note that we do our two-way clustering in Stata, using the ivreg2 command. When we do so with our full model of fixed effects, we get an error noting that "estimated covariance matrix of moment conditions not of full rank" and suggesting partialing out of control variables as a solution. We follow this advice, partialing out our fixed effects, which has no effect on the size or significance of coefficients on our independent variables, but does eliminate the error message. In the end, we report both the R^2 after partialing out, which focuses just on the variance explained by our key independent variables and the Centered R^2 taken from models that did not include partialing out of fixed effects.

[9]Interestingly, according to a recent large-scale study MNEs might be even attracted by "… countries with environmental regulations that are more stringent than those of their home countries" (Rivera & Oh, 2013: 243), whereby the authors acknowledge a strong effect of uncertainty avoidance. Studying such an effect might be of interest for future research in this field.

[10]It is important to add that these studies primarily focus on Phase 1 of the EU ETS, which as a pilot phase showed several run-up problems, many of which were subsequently addressed by policymakers.

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