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Impact of environmental regulation on M&As in the manufacturing sector

Federico Carril-Caccia, Juliette Milgram Baleix

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Impact of environmental regulation on M&As in the manufacturing sector

Abstract

We test the influence of environmental regulation (ER) on the location decision of cross-border Mergers and Acquisitions (M&As) for a large sample of countries, sectors, and years using a structural gravity model. Unlike other studies, our results confirm the pollution haven hypothesis according to which more stringent ER makes countries less attractive to foreign investors planning to invest through M&As, compared with domestic investors. Policies that set quantitative limits on emissions have similar discouraging effects on cross-border investment to taxes on emissions. We find no evidence that the impact could be stronger in dirty sectors than in clean sectors. The impact of ER differs depending on country type according to their level of development, reflecting the fact that investments in developed countries and BRICS respond to different motivations. In emerging countries, lax ER could attract significantly more inward M&As. In developed countries, ER has a less discouraging effect.

JEL codes: F21, F64, Q58.
Keywords: Environmental stringency, pollution havens, M&As, structural gravity, polluting sectors.

1 Introduction

To achieve climate neutrality in 2050, countries worldwide are drawing up climate actions to reduce their greenhouse gas emissions (GHG). This transition poses several economic and political challenges. A highly debated issue concerns how stricter environmental measures could affect the competitiveness of firms and their location decisions in the context of the global supply chain. This is especially a concern in developed countries since this shift toward "green" policies could induce firms to offshore the "dirty" part of their production abroad. Developed countries remain responsible for the largest portion of GHG emissions (Kruse et al., 2022), even though emissions have decreased in these countries and have increased elsewhere over the last few decades. The relocation of production to countries with laxer environmental regulation (ER) would contribute to promoting "pollution havens" and undermine the objective of achieving global sustainable economic growth.

The motivations of multinationals (MNEs) to invest abroad vary by country and sector. Lowering production costs is only one of the many possible FDI-driving factors. In more polluting sectors, ER may adversely affect this type of investment, as it involves additional costs or even limits production. Nonetheless, this inconvenience may be compensated for by the other advantages provided by location such as lower capital costs, market access, agglomeration economies, etcetera. Stringent ER may also induce changes in technology, management practices, and consumer behaviour, which could offset the direct costs of ER. Assessing the effect of ER on the location decisions of MNEs remains an empirical question whose answer is not straightforward. This study contributes to the literature by assessing the impact of ER on MNEs' cross-border Mergers and Acquisitions (M&As) in the manufacturing sector using a structural gravity model.

Previous empirical studies that test the pollution haven hypothesis (PHH) are far from unanimous (see Cole et al. (2017) for a survey), but tend to conclude that environmental measures play a minor role in attracting foreign investment or dissuading them from entry. For instance, Javorcik and Wei (2003), List et al. (2004), Wagner and Timmins (2009), and Rivera and Oh (2013) find no support for the PHH, while Dam and Scholtens (2012) and Naughton (2014) report mixed results. As more data become available, it is now possible to use larger samples and more advanced econometric approaches to re-examine this question. This study contributes to this strand of the literature in three ways.

First, we revisit the PHH by relying on the structural gravity model for M&A extensive margins. To this end, we rely on cross-border and domestic M&A data and estimate a fully-fledged gravity model (i.e., includes a theoretically consistent rich set of fixed effects and domestic investment) to approximate the impact of ER on cross-border M&As relative to domestic M&As. This empirical strategy enables us to approximate the link between ER and M&As at the same time, minimizing the potential bias due to omitted variables and endogeneity, and controlling for the effect of globalization on M&As. Even though Saussay and Zugravu-Soilita (2023) have tackled the effect of ER on M&As, to the best of our knowledge, this is the first study that relies on a fully-fledged gravity model.

Second, in the present study, we gauge the implications that ER has on M&As depending on the level of development of the M&A origin and destination countries. We analyse the impact of ER on M&As between developed countries, from developed to emerging countries, and vice versa, and between emerging countries. In this way, our work contributes to the strand of literature on Foreign Direct Investment (FDI) determinants from emerging countries' MNEs (Amal et al., 2013; Paul and Benito, 2018, e.g.).

To accurately assess location choices in general, and in particular for studying the PHH, it is a *sine qua non* condition to analyse sector-level FDI data for a large sample of countries over an extended period of time. However, such analyses remain rare in existing literature. Thus, the third contribution of the present empirical study is that it relies on M&A data at the sectoral level for 40 countries during the period 1995-2018. These features allow us to study the effect of the significant changes in environmental policy stringency (EPS) on 80% of global M&As in the manufacturing sector. In addition, we can distinguish the implications of changes in EPS based on the pollution level of manufacturing activities. In this regard, this paper presents sector-specific estimates on the effect that ER has. Finally, we discuss the impact of two different types of ER: non-market based instruments (NMBI) and market based instruments (MBI).

We broadly confirm the PHH: adopting "green" policies makes potential target firms less attractive to foreign than to domestic investors. In other words, laxer ERs attract more cross-border M&As relative to domestic M&As. However, this effect is similar in clean and dirty sectors. The evidence obtained suggests that this negative effect is present in 10 of the 24 manufacturing activities considered, and that it affects some of the most and least polluting sectors. In turn, cross-border and domestic M&As have similar sensitivities to ER in many sectors, regardless of their contamination levels. Additionally, foreign investors have the same sensitivity towards quantitative limits (i.e. NMBI) and regarding policies that put a price on emissions (i.e. MBI). Changes in ER have different impacts depending on the development levels of investors and investees. For investors from developed countries, ER implemented in emergent countries has a larger discouraging effect than that implemented in other developed countries, all else being equal. In contrast, the decision of BRICS+ to invest in developed countries is not influenced by ER.

The following section provides a brief literature review of the FDI-environment relationship. Section 3 explains the empirical strategy, Section 4 discusses the results, and Section 5 presents a battery of robustness checks. Finally, the paper ends with concluding remarks.

2 Influence of ER on location choice of foreign investors

According to Dunning (1993), there are four main drivers of FDI: market, efficiency, resources, and asset seeking. Furthermore, in their investment decisions, MNEs consider the different locational advantages that potential host countries may have. Accordingly, FDI is also driven by country characteristics, such as institutional quality, infrastructure, labour and capital costs, taxes, and regulation. Eventually, the choice of locations implies a trade-off between the advantages and disadvantages displayed by the different locations compared with the firm's home country, and ER is only one of many elements.

In recent decades, the surge of FDI from emerging countries (in particular from China) has led researchers to conclude that MNEs from emerging countries may also seek market access and efficiency. Nevertheless, in contrast to MNEs from developed countries that invest in developed countries, MNEs from emerging countries that invest in developed countries aim to overcome competitive disadvantages related to product quality, technology, high-quality skills, recognized brands, management, and tacit knowledge (Amal et al., 2013; Brienen et al., 2010; Child and Rodrigues, 2005).

According to the PHH, a shift toward a more stringent environmental policy could push firms to relocate to countries with looser ERs in order to maximize profits. Likewise, countries with lax ERs would acquire a comparative advantage, particularly in polluting industries (Baumol and Oates, 1988; Pearson, 1987). Accordingly, weak ERs could enhance incoming FDI.

The first generation of studies intended to test the PHH failed to find conclusive results (see Cole et al., 2017) due to several limitations. Indeed, most of these studies were conducted on a country or industry basis, with aggregated FDI. Focusing on a specific host country obviates alternative locations, while separating industries according to their pollution intensity can lead to biased results due to other industry-specific trends.

This lack of robust evidence gave rise to a new generation of empirical models intended to overcome the methodological challenges that make it difficult to capture the effect of environmental measures on FDI, while other authors have drawn attention to other mechanisms that could counteract the rationale underlying the PHH. In particular, some authors have challenged the idea that investors would consider stringent environmental regulations harmful. These authors argue that some MNEs may consider environmental strictness beneficial. Given the growing demand for environmentally friendly products and services, firms may also be interested in being the first to access environmentally sensitive consumers, located in markets with stricter environmental regulations in order to obtain price premiums, hence leading to a "win-win" situation (Rivera and Oh, 2013). Tougher environmental policies may induce several greening transfers of both environmentally friendly technology (Gallagher and Zarsky, 2007) and management practices (Jin et al., 2019; Poelhekke and Van der Ploeg, 2015). Hence, the MNE could upgrade local environmental standards, contributing to a positive "pollution halo" effect (Zugravu-Soilita, 2017).[1] ER is only one aspect shaping the comparative advantage of locations. In particular, the abundance of factor endowments is another important driver of FDI (Helpman, 1984; Markusen, 1984). Abundance in capital relative to labour determines the relative price of production factors: MNEs operating in labour-intensive (capital-intensive) industries probably seek location in labour-abundant (capital-abundant) countries where labour costs (capital costs) are cheaper. To the extent that pollution-intensive activities are capital-intensive activities, relocating into a country with lax ER is only attractive if the costs of capital in this location do not offset the benefits obtained in terms of environmental compliance costs (Cole and Elliott, 2005).

Moreover, several theoretical models consider an endogenous market structure in which foreign firms benefit from technology that is better than domestic firms (Dijkstra et al., 2011) or from a first-mover advantage (Elliott and Zhou, 2013), leading to a situation in which a more stringent policy confers an advantage to foreign firms. Overall, whether the pollution haven effect or pollution halo effect predominates remains an empirical question with discrepant answers.

Another important challenge in addressing the PHH is related to other important determinants of FDI that, if omitted, could lead to a spurious relationship between FDI and environmental stringency. One noticeable determinant of FDI highlighted by the economic geographic model is market size, a major force of attraction for FDI that loses intensity when trade costs (including transport costs) are low and production can be exported to these markets (Markusen et al., 1993). Sanna-Randaccio and Sestini (2012) conclude that firms would relocate only if the regulation gap were large enough to offset re-exporting costs to the market of origin. Tang (2015) predicts that export-oriented FDI is more sensitive to stricter ERs than local-market-oriented FDI. In the case of European firms, Candau and Dienesch (2017) show that better access to a large market of origin from the host country may offset the cost of tougher ERs for export platform FDI.

Another concern in order to accurately assess the impact of ERs on FDI is the possibility of reverse causality that might arise if governments relax stringency in order to

[1] Cheng et al. (2018) cite several works that confirm that management and innovation compensation effects could offset compliance costs.

attract polluting firms, or if the increase in FDI gives foreign investors sufficient power to negotiate pollution levies with local authorities. However, some authors have found contrary evidence. Cheng et al. (2018) emphasized that FDI inflows have increased both the number and severity of local ERs. Brucal et al. (2019) concluded that FDI increases overall energy usage due to the expansion of output, while it decreases a plant's energy intensity. Overall, such effects (pressures to lessen the measures or increase stringency in response to growing FDI) are exerted once the MNE is operating in the country, which would reduce the case of two-way causality in location choice models.

An additional limitation of the previous PHH literature is that it focuses on overall FDI flows regardless of the entry mode. To the best of our knowledge, there are only a few exceptions to this. Leon-Gonzalez and Tole (2015) studied M&As in the mining industry at the global level between 1994 and 2006 and found no evidence of pollution havens in this industry. Buyers from countries with high levels of environmental stringency are more likely to invest and make larger investments in countries with similar requirements. Bialek and Weichenrieder (2021) provide robust support for the PHH for greenfield investments from Germany in polluting industries. In turn, M&A investments in low-polluting industries seem to be attracted by stricter ER, which could be explained by competitiveness effects associated with grandfathering[2] as well as the "green image" that German firms are trying to maintain. Even if the specific contexts of their analysis do not allow one to generalise their results, these two studies tend to refute the PHH hypothesis for M&As. Alternatively, Carril-Caccia and Milgram Baleix (2020) find a negative effect of ER on inward M&As, relying on a bilateral dataset for M&As, but they do not consider heterogeneity among industries, or domestic M&As. Saussay and Sato (2018) show that countries with lower energy prices attract M&As, suggesting that carbon taxes would discourage M&As even if the magnitude of the effects is small. Saussay and Zugravu-Soilita (2023) conclude that the negative influence of environmental policies on

[2]They argue that greenfield projects usually need to obey all the latest environmental requirements whereas M&As involve local firms that usually, due to grandfathering policies, remain unaffected by the latest rules and need to adhere to the older regulations only. Moreover, in the case of an M&A project, the acquisition price may already be a function of the regulation faced by the company as the purchaser of the existing plant is only willing to pay the present discounted value of future profits.

the location choice of M&A target firms is similar for horizontal, vertical, and conglomerate firms. By contrast, the pollution intensity of the target sector is more relevant in explaining these choices. This study makes an important contribution to the literature. However, the specifications of their model only control for some country-specific determinants, such as market size and differences in labour costs, but do not fully account for other characteristics of the origin and destination countries. Concerning the sectoral dimension, they only controlled for the sector-time unvarying characteristics of the origin and destination sectors separately. This leaves many possibilities for other biases related to special relationships among sectors and among sectors of countries, which are not accounted for. We go a step further by using a structural gravity model that accounts for all these effects.

The following section describes our empirical strategy. In summary, we rely on the structural gravity model, a large sample of countries over an extended period of analysis, to overcome some of the limitations of the previous literature.

3 Empirical strategy

3.1 Empirical model

The present work relies on the structural gravity model to address the PHH for cross-border M&As. Head and Ries (2008) provided a theoretical background for using the gravity equation to analyse the drivers of M&As, and this empirical strategy has been widely followed by previous literature (e.g. di Giovanni, 2005; Garrett, 2016; Hyun and Kim, 2010).

The basic intuition of the gravity model is that M&As are positively moderated by countries' economic mass and negatively moderated by their bilateral costs (e.g., transport or language differences). In addition, outward M&As depend on firms' (and countries') relative capacity to invest abroad, while inward M&As depend on firms' (or countries') relative capacity to attract them. If the PHH holds, stricter ERs should limit the relative capacity of countries to attract cross-border M&As. In other words, a country's firms should become less prone to being the target of foreign M&As. To model this, using a Poisson Pseudo-Maximum Likelihood estimator[3] (PPML), we estimate the following equation:

$$\begin{aligned} M\&A_{iojdt} = \exp\big(&\alpha EPS_{jt} \times INT_{ij} + \gamma X_{jt} \times INT_{ij} + \beta X_{ijt} + \lambda_{iojd} \\ &+ \lambda_{iot} + \lambda_{jdt} + INT_{ijdt}\big) \times \varepsilon_{iojdt} \end{aligned} \tag{1}$$

where $M\&A_{iojdt}$ is the number of M&A projects from country i originating from sector o to country j in sector d in year t. The dependent variable includes both domestic ($i = j$) and cross-border M&As ($i \neq j$).

Guided by the gravity model theory for M&As (Head and Ries, 2008) and specification recommendations (Yotov, 2022; Yotov et al., 2016), the model incorporates a wide range of fixed effects that control for different drivers of M&As. First, λ_{iojd} are fixed effects for any quadruple of country of origin, sector of origin, country of destination, or sector of destination. These fixed effects account for the bilateral time-invariant determinants of FDI, such as geographic distance or common language, which have been traditionally accounted for in the literature (e.g. di Giovanni, 2005; Head and Ries, 2008). In addition, they control for the border effect (i.e., the extent to which domestic investment is larger than foreign investment). Furthermore, the bilateral sector dimension of these fixed effects controls for the nature of M&A transactions, that is, whether these investments are horizontal, vertical, or conglomerate in nature.[4]

Second, λ_{iot} (λ_{jdt}) are fixed effects for any triple of country of origin, sector of origin, and years (respectively, for any triple of country and sector of destination and years). λ_{iot} and λ_{jdt} control for the multilateral resistance term at the sectoral level (Anderson and van Wincoop, 2003), that is, the relative capacity to invest abroad or the relative capacity

[3]The PPML estimator overcomes the heteroskedasticity issues from the OLS estimates and include in the analysis the zeros usually present in bilateral FDI databases (Santos Silva and Tenreyro, 2006). We employ Correia et al. (2020) PPML estimator.

[4]Correctly identifying the type of M&A is challenging in terms of data requirements. One would require more disaggregated sectoral data than those available for the present analysis as well as data on firms' sales and purchases of goods and services (Ahn and Park, 2022). This is a potential source of omitted variable bias that we minimize with fixed effects.

to attract M&As for firms from one sector and one country (Head and Ries, 2008). In addition, these fixed effects control for all country-sector time-varying drivers of M&As, such as economic size, taxes, institutional quality, and specific sector regulation.

Third, INT_{ijdt} is a set of indicator variables, each variable equalling one when investment in sector of destination d is international (i.e. $i \neq j$) in a given year. The associated coefficients of these dummies quantify the change, relative to the base year, in the border-sector of destination-year effect. Broadly speaking, these fixed effects control for the evolution of globalization (Bergstrand et al., 2015; Head and Mayer, 2021), that is, the increasing or decreasing cost (or capacity) of investing abroad relative to investing domestically.[5]

A limitation of including country-sector-year fixed effects (λ_{iot}, λ_{jdt}) is that these fixed effects are collinear with country-specific (or country-sector) time-varying variables such as countries' environmental policy. To overcome this limitation, we interact the country environmental policy stringency index (EPS_{jt}) and a vector of country-specific variables (X_{jt}) with a dummy (INT_{ij}) that takes the value one whenever the investment is international and zero if the investment is domestic (i.e., when $i = j$). As demonstrated by Heid et al. (2021), this strategy enables estimation of the effect of country-specific variables, such as environmental policy, while simultaneously controlling for the multilateral resistance term.

This interaction also leads to the interpretation of the estimated coefficients (α) as the effect of changes in the EPS index on foreign relative to domestic M&As. A negative sign for α would support the PHH and would indicate that ER increases the border effect on M&As (Anderson et al., 2018). That is, ER increases the likelihood of an M&A taking place between firms from the same country rather than between firms from different countries. In other words, a stricter EPS leads to a drop in cross-border M&As relative to domestic ones.

This strategy also serves to minimize the potential endogeneity that might exist be-

[5] Estimates are robust to alternative specifications of the border-sector of destination-year (INT_{ijdt}) dummies. We have tested with border-year (INT_{ijt}), border-sector of origin-year (INT_{iojt}) and border-sector of destination and origin-year (INT_{iojdt}). Estimates are available in Table A.1 in the appendix.

tween FDI and EPS (e.g. Dam and Scholtens, 2008). Assuming that domestic and foreign firms can influence environmental policy, interacting the potentially endogenous variable with a strictly exogenous variable (INT_{ij}) turns the new variable into a diff-in-diff that limits the potential endogeneity issue (Beverelli et al., 2023; Nizalova and Murtazashvili, 2016).[6]

As can be gathered, the inclusion of the above-described fixed effects already controls for all the bilateral time-invariant and the time-varying country-sector specific determinants of M&As. Nevertheless, two additional sources of omitted variable bias may subsist: the country-sector specific factors that may differently affect cross-border M&As relative to domestic investment, and the bilateral time-variant determinants of M&As.[7]

To limit the first source of omitted variable bias, we include X_{jt} in our model, which is a vector that incorporates other destination country-specific variables that are usually included to explain cross-border M&As. We include GDP per capita, unemployment rate, and political stability since wealthier countries with labour availability and good institutional quality are expected to be able to attract cross-border M&As that seek to serve the domestic market. Additionally, we incorporate the number of patents per million inhabitants and natural resources endowment as MNEs investments abroad may seek to acquire or improve their intangible assets or to access raw materials (Dunning, 1993; Rossi and Volpin, 2004). Exchange rates may also drive cross-border M&As, although their expected impact is ambiguous. Currency depreciation may deter cross-border M&As as it also entails a depreciation of MNEs' profits. However, currency depreciation also represents an opportunity to acquire raw materials and assets at a lower cost (di Giovanni, 2005). As for EPS, X_{jt} interacts with the international dummy (INT_{ij}), and thus, the coefficients of the variables included in X_{jt} indicate the effect of the change in one of these variables on cross-border M&As relative to domestic ones. Unfortunately, due to data availability limitations, we are unable to account for factors that are country- and

[6] As a sensitivity analysis, we lag the EPS index by one period. Estimates are available in Table A.2 in the appendix. The main results remain unchanged.

[7] We also estimate alternative gravity model specifications with fewer fixed effects and cross-border M&As only. Estimates are reported in the appendix in Table A.3. The sign and significance of EPS remain unchanged, while the size of the effect diminishes in a substantial way.

sector-specific and may affect cross-border and domestic M&As.[8]

Finally, X_{ijt} refers to different bilateral time-variant determinants of M&As. Bilateral investment treaties are expected to promote bilateral FDI between signing parties and reduce expropriation risks (e.g. Bergstrand and Egger, 2013). Signing a bilateral trade agreement can incentivize vertical and export platforms and export-supporting FDI (e.g. Ekholm et al., 2007; Hanson et al., 2005; Krautheim, 2013). Nonetheless, in the context of horizontal FDI, bilateral trade liberalization is expected to have a negative impact on FDI, since trade and FDI substitute each other as alternative strategies to serving a foreign market (e.g Antràs and Yeaple, 2014; Horstmann and Markusen, 1987; Jang, 2011). The λ_{iojd} fixed effects serve to overcome the potential endogeneity issues between our dependent variable and these X_{ijt} variables (Baier and Bergstrand, 2007; Bergstrand and Egger, 2007).

Robust standard errors are clustered at the country of origin, sector of origin, country of destination and sector of destination (i.e. at the country and sector pairs). As a sensitivity analysis, we also test alternative strategies for clustering the standard errors. The significance of the estimate associated with EPS remains unchanged.[9]

3.2 Data overview

M&A database

The M&A data were retrieved from Eikon Thomson Reuters. We exploit a database covering domestic and international investments into the manufacturing sector during the period 1995-2018. Due to the availability of data on the ER index, our analysis was limited to 40 countries. However, these 40 countries host 80% of cross-border M&As realized in the manufacturing sector worldwide. As reported in Table 1, our sample

[8]Following the previously mentioned recent gravity literature, monetary variables are included in nominal terms as the country-sector-year fixed effects already control for price variations (see Baldwin and Taglioni (2006) and De Benedictis and Taglioni (2011) for an in-depth discussion).

[9]Estimates are reported in Table A.4 from the appendix. In each column, the method used to cluster standard errors is as follows: 1) at country and sector pairs as in the rest of the manuscript; 2) at the country-pair level in line with most of the previous literature; 3) by source, destination and year (i.e. multi-way clustering), as per Egger and Tarlea (2015); 4) at the origin country and sector, destination country and sector, and year. In this last case, standard errors are multiway clustered but also incorporate the sectoral dimension in the origin and destination.

includes developed, emerging, and developing countries (BRICS+).

Table 1: Country sample

Developed countries			BRICS+
Australia	Hungary	Poland	Brazil
Austria	Iceland	Portugal	Chile
Belgium	Ireland	Slovak Republic	China
Canada	Israel	Slovenia	India
Czech Republic	Italy	Spain	Indonesia
Denmark	Japan	Sweden	Mexico
Estonia	Korea, Rep.	Switzerland	Russian Federation
Finland	Luxembourg	United Kingdom	South Africa
France	Netherlands	United States	Turkey
Germany	New Zealand		
Greece	Norway		

Note: Authors' own elaboration.

A positive feature of the database is that transactions are recorded at the firm level, reducing the common bias in FDI statistics due to the use of tax-haven countries by MNEs. It also provides information on origin and destination sectors. Following the NACE Rev. 2 classification at the two-digit level, the analysis considers M&As from 84 sectors to 24 manufacturing sectors. The main drawback of this database is that the transaction value of M&As is missing for nearly 60% of all transactions, and this is not random; most correspond to small transactions or private target firms that are not fully publicly disclosed. Consequently, our analysis focuses on the number of M&A transactions.[10]

We classified sectors as clean and dirty based on the intensity of carbon emissions. To this end, we employed the OECD Indicators on Carbon dioxide (CO2) emissions embodied in international trade (TeCO2) elaborated by Yamano and Guilhoto (2020). More precisely, we used an indicator called the production carbon emission factor (PROD_EFCO2), which measures the CO2 emissions per unit of production. To divide the different manufacturing activities into clean and dirty, we first calculated the median pollution intensity in each country and year. Then we calculated the number of times, during our period of analysis, a specific manufacturing activity's pollution intensity is above the median in each country. We classified as dirty those activities that are above the median in more than half of the country-years present in our sample analysis. A list of sectors and their classifications as clean and dirty is available in the appendix (Table A.5).

As shown in Table 2, the majority of cross-border M&As (83%) take place in devel-

[10]To conserve space, results for the intensive margin of M&As are available upon request.

oped countries, and this share is higher in the case of clean industries. Twelve per cent consist of projects in which investors from developed countries acquire or merge with firms from BRICS+. It is worth pointing out that BRICS+ countries attract a higher share of worldwide M&As in dirty sectors than in clean ones. M&As between BRICS+ are residuals, but operations from BRICS+ in developed countries represent 4.4% of the total. In this case, the relevance of BRICS+ M&As to developed countries is slightly higher in manufacturing activities that are classified as clean.

Table 2: Cross-border M&As in dirty and clean sectors, shares of region pairs in total number of projects

	No. of cross-border M&As, % Mean 1995-2018		
Sectors:	**All**	**Clean**	**Dirty**
Developed to Developed	83.0	81.9	84.4
Developed to BRICS+	12.0	13.3	10.6
BRICS+ to BRICS+	0.5	0.6	0.4
BRICS+ to Developed	4.4	4.2	4.6
All sample	100	100	100

Note: Authors' own calculations based on Eikom Thomson Reuters. See Table 1 for the list of countries.

Environmental regulation

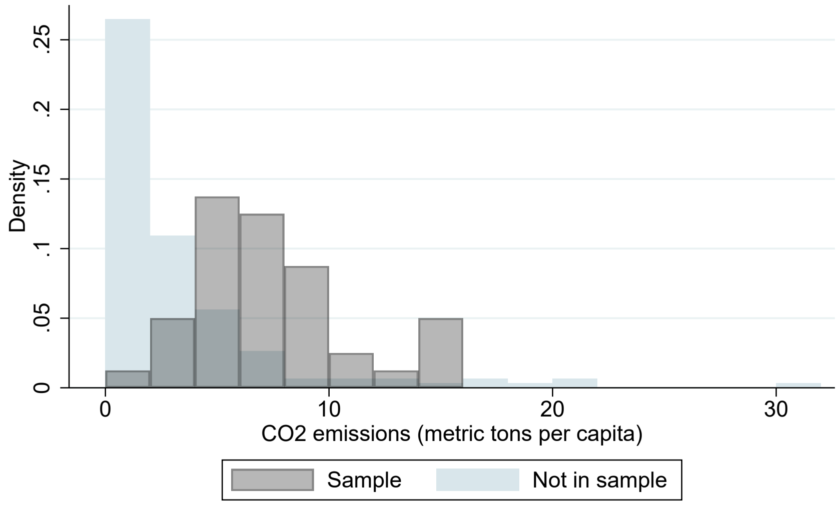
In order to measure countries' EPS, we use the index proposed by Botta and Koźluk (2014)[11], updated by Kruse et al. (2022). This index has the advantage of being available from 1990 to 2020, a period marked by substantial changes in governments' environmental policies. However, one possible drawback of EPS for our purpose is that it provides a measure of environmental stringency at the country level but not at the sectoral level. We provide results for different alternative measures for ER as robustness checks.

Another limitation is that the EPS index focuses on climate change and air pollution but does not consider other important environmental domains such as water, biodiversity, or waste management (Kruse et al., 2022, p.11). In comparison with other measures, another possible limitation of the EPS index proposed by Botta and Koźluk (2014) is that it only covers 40 countries, and most are developed ones. Nevertheless, this is not a significant constraint for our analysis, since these 40 economies are the source and host of

[11] Stringency is defined as the degree to which environmental policies put an explicit or implicit price on polluting or environmentally harmful behaviour. The index ranges from 0 (not stringent) to 6 (highest degree of stringency). The index is based on the degree of stringency of 14 environmental policy instruments, primarily related to climate and air pollution.

80% of global cross-border M&A projects in manufacturing during the period 1995-2018. Moreover, as illustrated in Figure 1, our sample covers countries whose levels of pollution are relatively high compared with those that are not included in the analysis. Finally, this group of countries represented 81% of global CO2 emissions.[12]

Figure 1: Density of countries by level of CO2 emissions, metric tons per capita in 2018



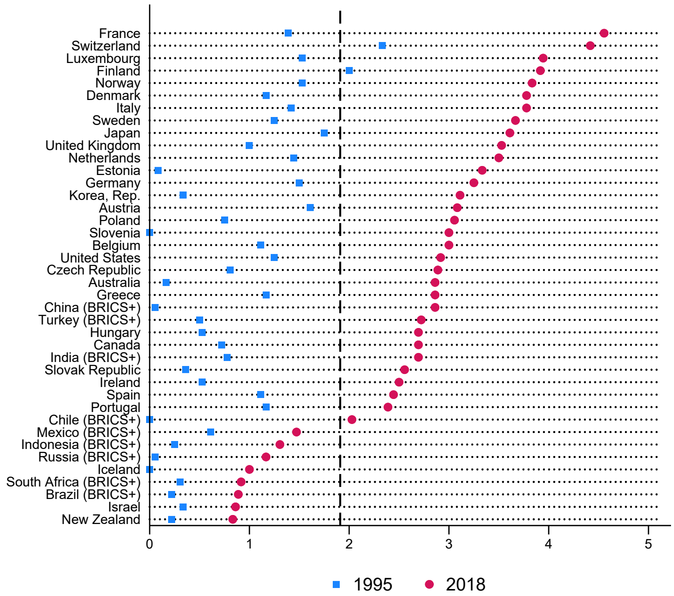
Authors' own elaboration. Data for 191 countries for 2018. Retrieved from the World Bank Development Indicators. The countries with the highest levels of CO2 emissions per capita in 2018 that are not included in our sample are Bahrain, Brunei Darussalam, Kuwait, Oman, Qatar, and United Arab Emirates.

Even when considering countries with similar levels of development, the levels of EPS differ widely. Figure 2 depicts the level of EPS in 1995 and 2018 for the countries in our sample, distinguishing between BRICS+ and developed countries (For a more detailed country-level evolution of the EPS index, see Figure A.1 in the appendix). Environmental policies have become tougher in all countries since 1995. However, the disparities remain high, echoing the fact that not all countries switch to green policies at the same pace. All the BRICS+ countries register a laxer ER than the average but some developed countries are also amongst the laggards. In 2018, the countries with the most stringent environmental policies were France, Switzerland, Luxembourg and Finland while the laxest

[12]Calculations based on the CO2 emissions data from World Bank Development indicators for the year 2018 for 191 countries.

were South Africa, Brazil, Israel and New Zealand.

Figure 2: EPS by country, 1995 and 2018



Note: the vertical line represents the average for all countries and years. Countries are ordered according to the level of the index in 2018. Source: OECD's Environmental Policy Stringency index (EPS) (Kruse et al., 2022). Authors' own elaboration.

The EPS index can be decomposed into three sub-indices, which shed light on different aspects of ER. The dimensions considered are Market-based instruments (MBI) (e.g., taxes, permits, and certificates), Non-Market-Based instruments (NMBI) (e.g., performance standards), and Technology Support (TS) policies (R&D support, feed-in tariffs, and auctions). The MBI and NMBI are policies aimed at correcting negative externalities, while TS intends to promote positive externalities arising from innovation in clean technologies. TS mainly affects energy-producing sectors, so we focus on the other two instruments.

The stringency of the NMBI increased more in absolute terms than MBI (See Figures A.2 and A.3 in the appendix). The NMBI involve policies that fix the Emission Limit Value for Nitrogen Oxides (NOx), sulphur oxides (SOx), Particulate Matter in the energy generation sector, and sulphur content limit for diesel. Comparing BRICS+ and developed countries, the difference in the NMBI is salient. These instruments have been widely adopted worldwide, with only seven countries out of the 40 considered, with indexes lower than the average. Three of the countries with the lowest levels of NMBI are BRICS+: Russia, South Africa and Indonesia; but the countries with the lowest levels of NMBI of all are New Zealand, Israel and Iceland.

MBI include policies that put a price on pollution, including CO2 Trading Schemes (average annual permit price of allowances to emit CO2), renewable energy trading schemes (percentage of electricity from green sources compulsory to obtain trade in renewable energy certificates[13]), tax rates for CO2 emissions, Nitrogen Oxides (NOx), sulphur oxides (SOx), and fuel (Diesel). Considerable improvements have been made in this area in some countries. However, the average stringency for MBI is lower than that for the NMBI. The disparity between developed countries is wide and the adoption of these instruments in BRICS+ remains low. There are OECD countries with very lax EPS, while Sweden, France, Norway and Denmark stand at the forefront of developed countries regarding these measures.

Other data sources

We retrieved countries' GDP per capita, unemployment rate, natural-resource rent as a share of GDP, and the number of patents from the World Bank Development Indicators. Using World Bank population data, we calculated the number of patents per million inhabitants. Nominal exchange rate data were obtained from the IMF. We then obtained the political stability index from the Worldwide Governance Indicators (Kaufmann et al., 2011). Data on bilateral trade agreements are from CEPII (Conte et al., 2022), and data on bilateral investment treaties are retrieved from UNCTAD's International Investment Agreement Navigator (UNCTAD, 2020). The latter two are indicator variables that take a value of one when a pair of countries has signed an agreement. Descriptive statistics for all variables are presented in Table 3.

[13]"The onset of the emissions trading scheme in the European Union and in other jurisdictions have led to increase the prominence and stringency of this policy tool since the mid-2000s. ../.. Even so, the scope for greater pricing of emissions remains large in the majority of countries." (Kruse et al., 2022, p. 24).

Table 3: Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
No. of M&As	0.29	1.97	0.00	287.00
GDP per capita (log)	6.83	4.81	0.00	11.73
Unemployment (log)	1.28	0.96	0.00	3.51
Natural resources (log)	0.42	0.60	0.00	3.14
No. of patents per million inhab. (log)	3.95	2.90	0.00	8.34
Exchange rate (log)	0.61	1.51	-3.08	9.56
Political stability	0.41	0.63	-2.09	1.76
Investment agreement	0.11	0.31	0.00	1.00
Trade agreement	0.35	0.48	0.00	1.00
EPS (log)	0.74	0.60	0.00	1.71
MBI (log)	0.48	0.44	0.00	1.61
NMBI (log)	0.96	0.78	0.00	1.95

Note: Authors' own elaboration. EPS refers to the Environmental Policy Stringency index, MBI to the market-based instruments index, and NMBI to the non-market-based instruments index. Number of observations: 558779.

4 Results

4.1 Effect of EPS on M&As

The estimates presented in Table 4 show that EPS has a negative and significant coefficient (column 1) while the interaction term for the dirty sector is not significant.[14] Therefore, our results confirm that more stringent environmental policies tend to reduce the number of new cross-border M&As compared to domestic M&As. This stands in stark contrast to the literature, since most studies do not confirm the PHH. According to our results, a one percent growth in the EPS would lead to a 0.45% drop in cross-border M&As relative to domestic ones.[15] However, we do not confirm the assumption that highly polluting sectors are more sensitive to changes in ER. We delve into the analysis of the heterogeneity to sectors in their sensitivity to ER further below.[16]

As mentioned above, a 1% increase in EPS results in a 0.45% drop in cross-border M&As relative to domestic M&As. On average, each country registers 43.6 cross-border

[14]This result is robust to alternative sector classification (see Section 4.5).

[15]We examined the potential non-linear relationship between EPS and M&As by including the squared term of the EPS (as well as the MBI and NMBI). Results suggest that the non-linear effect of EPS on cross-border M&As relative to domestic M&As is limited. To conserve space, estimates are available upon request.

[16]Additionally, to make sure that this result is not driven by the lack of sectoral variability of EPS, we have also tested whether the effect of ER is higher in high polluting sectors by introducing the level of CO2 emissions per unit of production and its interaction with EPS in the estimation. We obtain similar results. We also explore if the effect of EPS is statistically different depending on whether M&As take place within or across sectors. The effect of ER on M&As is similar for M&As taking place within and across sectors. In this test, we also confirm that ER has a similar effect on M&As in both clean and dirty sectors. To conserve space, estimates are available upon request.

M&As and 124.2 domestic M&As per year, and the EPS index is on average 1.9. Assuming that the number of domestic M&As remains constant, for this representative country a 1% increase in EPS would result in a loss of 0.2 cross-border M&As per year (0.45% of 43.6). Alternatively, increasing the EPS index to the average level a country such as the one registered by France during the period of analysis entails increasing the EPS by 54%, which would result in a meaningful drop of 10.6 cross-border M&As (0.45*0.54*43.6) out of 43.6.

Table 4: Effect of EPS on M&As

	Extensive margin of M&A	
	(1)	(2)
	All	Clean-Dirty
EPS (log) x INT	-0.453***	-0.509***
	(0.100)	(0.121)
x Dirty		0.103
		(0.129)
GDP pc (log) x INT	0.287***	0.288***
	(0.081)	(0.081)
Unemployment (log) x INT	0.025	0.026
	(0.053)	(0.053)
Natural resources (log) x INT	0.345***	0.344***
	(0.065)	(0.065)
No. of patents per million inhab. (log) x INT	0.102**	0.102**
	(0.043)	(0.043)
Exchange rate (log) x INT	-0.004	-0.005
	(0.017)	(0.017)
Political stability x INT	0.235***	0.236***
	(0.061)	(0.061)
Investment agreement	0.251***	0.252***
	(0.074)	(0.074)
Trade agreement	0.111**	0.111**
	(0.051)	(0.051)
Observations	558779	558779

Note: Standard errors clustered at the country and sector pairs are reported in parentheses. All estimates include origin * sector of origin * destination * sector of destination, origin * sector of origin* year, destination * sector of destination * year fixed effects, and INT*sector of destination*year fixed effects. All country specific variables are interacted with the INT dummy. EPS refers to the Environmental Policy Stringency index. * p<0.10, **p< 0.05, *** p<0.01.

All estimations include the country-specific and bilateral time-varying determinants of FDI, as described in the previous section. Because the magnitude and significance of the coefficients of these variables remain identical among the specifications, we only comment on them for the benchmark models reported in Table 4.

Richer host countries, proxied by GDP per capita, attract more projects. Endowments in natural resources promote cross-border M&As relative to domestic M&As, which suggests that MNEs aim to acquire manufacturing firms in countries that produce raw materials. In addition, the estimates suggest that a growth in the number of patents per million inhabitants registered by the host countries leads to an increase in cross-border M&As relative to domestic investment in manufacturing. Political stability has a positive and significant effect while the host countries' rates of unemployment and exchange rates have no significant effect.

Trade agreements exert a positive and significant impact: signing a trade agreement can promote bilateral M&As in manufacturing by 11.7% ($(e^{0.111}-1)\times 100$). This result matches with vertical, export platform, and export-supporting FDI, while horizontal FDI is not the dominant feature. Finally, bilateral investment agreements foster M&As into manufacturing by 28.5% ($(e^{0.251}-1)\times 100$).

4.2 Effect of EPS on M&As: Developed countries versus BRICS+

In the previous subsection we showed that increasing the EPS reduces the number of cross-border M&As relative to domestic M&As. That is, stricter ER makes domestic M&As more likely than international ones. To approximate the direction of this effect, we now disentangle the effect of EPS for four types of source-origin flows, depending on whether they originate from developed or BRICS+ countries and are directed at developed or BRICS+. To this end, we interact the EPS index with a set of dummies that take the value one whenever investment goes from BRICS+ to BRICS+ ($BRICStoBRICS$), from BRICS+ to developed countries ($BRICStoDev$), and from Developed to BRICS+ ($DevtoBRICS$). Accordingly, the estimated model is as follows:

$$\begin{aligned} M\&A_{iojdt} = \exp\big(&\alpha_1 EPS_{jdt}\times INT_{ij} + \alpha_2 EPS_{jdt}\times INT_{ij}\times BRICStoBRICS_{ij} \\ &+\alpha_3 EPS_{jdt}\times INT_{ij}\times BRICStoDev_{ij} \\ &+\alpha_4 EPS_{jdt}\times INT_{ij}\times DevtoBRICS_{ij} + \gamma X_{jt}\times INT_{ij} + \beta X_{ijt} \\ &+\lambda_{iojd} + \lambda_{iot} + \lambda_{jdt} + INT_{ijdt}\big)\times \varepsilon_{iojdt} \end{aligned} \tag{2}$$

The estimated coefficient (α_1) gauges the effect of a change in EPS on cross-border M&As relative to domestic ones for the omitted category (Developed to Developed), while the remaining estimated coefficients (α_2, α_3 and α_4) indicate the deviation from this base category. Consequently, for instance, the magnitude of the marginal effect of a change in EPS on M&As from BRICS+ to BRICS+ (respectively from BRICS+ to developed countries) is obtained as the sum of the estimated coefficients $\hat{\alpha_1}$ and $\hat{\alpha_2}$ (respectively $\hat{\alpha_1}$ and $\hat{\alpha_3}$). The significance of the marginal effect is determined with the following test[17]:

$$t = \frac{(\hat{\alpha}_1 + \hat{\alpha}_i)}{\sqrt{\sigma_1^2 + \sigma_i^2 + 2\text{Cov}(\hat{\alpha}_1, \hat{\alpha}_i)}} \quad \text{where } i = 2, 3, \text{ or } 4.$$

An analogous strategy is followed to gauge the effect that a change in EPS would have on M&As in clean and dirty sectors. More details are provided in the Appendix C. To conserve space, in Table 5 we only report the marginal effect, and estimates are available in the appendix (see Table A.6).

Overall, the negative influence of EPS on attracting new M&A projects is confirmed for all types of flows except M&As flowing from BRICS+ to developed countries. For these investments, cost reduction is not a major concern. For investors from BRICS, the stringency of environmental policies is not a significant determinant of the decision to invest in developed countries. This finding aligns with the literature arguing that determinants of investments from emerging countries into developed countries do not seek efficiency but seek to overcome strategic disadvantages and market seeking.

Regarding investments originating from developed countries, the lion's share of worldwide projects, ER has a stronger negative impact when considering the possibility of investing in BRICS+ than when considering investing in developed countries. Environmental policies implemented by BRICS+ discourage investors from developed countries to acquire or merge with companies established in these countries. This result fits well with the hypothesis that FDI in these countries seeks to lower their production costs and, hence, also fits with the PHH. Thus, the additional costs emerging from more stringent ER may discourage investors. The results suggest that a 1% growth in EPS in BRICS+ would lead to a 1.36% drop in the number of M&As from developed countries relative to domestic M&As. In contrast, a similar change in EPS in developed countries would

[17]To calculate the significance of the marginal effect we employ the Stata command lincom.

only reduce the number of M&As from developed countries relative to domestic M&As by 0.3%. M&As between BRICS+ stand in an intermediate position: a 1% growth in EPS in BRICS+ would lead to a 0.84% drop in the number of M&As from BRICS+ relative to domestic M&As.

Again, we do not observe significant differences in the sensitivity to ER between dirty and clean sectors. However, for M&As from developed countries in BRICS, the effect of ER is significantly lower in dirty sectors than in clean sectors. We conjecture that this counterintuitive result is driven by the fact that being a high or low contaminating sector is not the sole factor that influences the sensitivity of M&As to ER. Instead, it seems that there are other characteristics that can explain the different sensitivities of cross-border M&A between sectors. We examine this analysis further in Section 4.5.

Table 5: Effect of EPS on M&As: Developed countries vs. BRICS+ (marginal effects)

	Extensive margin of M&A		
Sectors:	**All**$^{(1)}$	**Clean**$^{(2)}$	**Dirty**$^{(2)}$
EPS x Source-Destination flows			
Developed to Developed	-0.300***	-0.300**	-0.298**
	(0.105)	(0.128)	(0.124)
BRICS+ to BRICS+	-0.848**	-1.016	-0.760**
	(0.364)	(0.803)	(0.385)
BRICS+ to Developed	0.204	0.204	0.224
	(0.322)	(0.322)	(0.293)
Developed to BRICS+	-1.358***	-1.569***	-1.200***
	(0.208)	(0.232)	(0.222)

Note: Marginal effects from Table A.6. EPS refers to the Environmental Policy Stringency index. Complete estimations available in Table A.6 in the appendix. $^{(1)}$ To save space, results for All (column 1) come from column 1 of Table A.6. $^{(2)}$ Results for Clean and Dirty sectors are presented in separated columns but the coefficients come from the same estimation – column 2 of Table A.6. Coefficients are the marginal effects of EPS for each Source-Destination flows (and depending on whether the investment is in a clean or dirty sector). See page 20 for more details and Appendix C. * p<0.10, **p< 0.05, *** p<0.01

To illustrate the size of the aforementioned effects, Table 6 displays the reduction in cross-border M&As that an average developed or BRICS+ country would register following an increase in the EPS index by 1%, 20% or 50%, all else being equal. With a 20% increase in the EPS index, a developed country would on average receive 2.9 fewer cross-border M&A projects from other developed countries each year (when they used to receive 47.6). In the case of BRICS+, there would be 6.3 fewer projects from developed countries, a substantial reduction since they would previously register 23 projects.

Table 6: Drop in the number of cross-border M&As as a result of an increase in the EPS index

Source-Destination Flows[(1)]	Average No. of projects per year	Estimated Coefficient[(2)]	Increase in EPS 1%	20%	50%
			Drop in the No. of cross-border M&As[(3)]		
Developed to Developed	47.6	-0.300	0.1	2.9	7.1
BRICS+ to BRICS+	1.0	-0.848	0.0	0.2	0.4
Developed to BRICS +	23.0	-1.358	0.3	6.3	15.6

Note: (1) The case of investments from BRICS+ to Developed countries is not included since the estimated effect is non-significant. (2) The estimated coefficients are obtained from Table 5. (3) Drop in the No. of M&As is calculated as the Estimated coefficient × Increase in the EPS × Average No. of projects per year. For instance an increase by 20% in the EPS of Developed countries would result in a drop of cross-border M&As from other Developed countries of 2.9 projects (0.30 × 0.2 × 47.6) out of 47.6. EPS refers to the Environmental Policy Stringency index

4.3 Effect of NMBI and MBI on M&As

Table 7 displays the results for the sub-indexes of EPS: NMBI and MBI. As mentioned earlier, NMBI and MBI are intended to correct negative externalities regarding pollution. The results are in line with those obtained for the aggregate indicator EPS. Both quantitative limits and tax on emissions have a negative and significant effect, with no significant difference between the two measures. We would expect a more obvious effect of NMBI in dirty sectors where these measures could particularly constrain production. However, our results do not confirm this hypothesis.

Table 7: Effect of NMBI and MBI on M&As

	Extensive margin of M&A	
	(1)	(2)
	All	Clean-Dirty
NMBI (log) x INT	-0.206***	-0.227***
	(0.061)	(0.076)
x Dirty		0.038
		(0.083)
MBI (log) x INT	-0.293***	-0.350***
	(0.080)	(0.101)
x Dirty		0.103
		(0.114)
GDP pc (log) x INT	0.318***	0.319***
	(0.082)	(0.082)
Unemployment (log) x INT	0.050	0.051
	(0.054)	(0.054)
Natural resources (log) x INT	0.356***	0.356***
	(0.065)	(0.065)
No. of patents per million inhab. (log) x INT	0.074*	0.073*
	(0.043)	(0.043)
Exchange rate (log) x INT	-0.005	-0.005
	(0.017)	(0.017)
Political stability x INT	0.224***	0.224***
	(0.061)	(0.061)
Investment agreement	0.254***	0.254***
	(0.073)	(0.073)
Trade agreement	0.124**	0.124**
	(0.051)	(0.051)
Observations	558779	558779

Note: Standard errors clustered at the country and sector pairs are reported in parentheses. All estimates include origin * sector of origin * destination * sector of destination, origin * sector of origin* year, destination * sector of destination * year fixed effects, and INT*sector of destination*year fixed effects. All country specific variables are interacted with the INT dummy. NMBI refers to the non-market-based instruments index, and MBI refers to the market-based instruments index. * p<0.10, **p< 0.05, *** p<0.01.

4.4 Effect of NMBI and MBI on M&As: Developed countries versus BRICS+

In this subsection, we disentangle the effects of specific policies on investments depending on the source and destination of M&As. To this end, we interact the non-market and market environmental policy stringency indices with a set of dummies that identify the direction of investment flows. For each case, we calculate the overall marginal effect and its significance. These results are presented in Table 8, and to conserve space, the estimates are reported in the appendix.

For M&As flowing to developed countries and originating from other developed countries, which represent the bulk of M&As, and where EPS is, on average, higher, NMBI and MBI have a similar effect as observed in the whole sample. We do not observe significant differences between clean and dirty sectors for NMBI. This is expected since the limits of NOx and SOx emissions are now similar and strict in almost all developed countries. In contrast, MBI would affect clean sectors more particularly while MBI have no significant effects in dirty sectors which are more concerned by limits on emissions. M&As across developed countries are not mainly seeking efficiency gains, but are more focused on assets, strategies, and market seeking. Even so, cross-border investments are more sensitive to MBI than domestic M&As.

Concerning M&As flowing from developed countries to BRICS+, sensitivities to MBI and NMBI are similar to the whole picture. Again, the coefficients are larger than for Developed to Developed flows, reflecting the fact that these investors are particularly interested in lowering their production costs. Thus, laxer policies in BRICS+ could foster cross-border M&As more than domestic M&As. As for Developed to Developed flows, NMBI have the same influence on dirty and clean sectors while MBI that increase costs through taxes for CO2, NOx, and SOx emissions (among others) have a larger negative effect in clean sectors.

For M&As flowing to developed countries and originating from BRICS+, the previous results obtained for the EPS in general are maintained: none of the specific instruments influence the decision of BRICS+ to invest in developed markets. Regarding M&As in which both investees and investors are from BRICS+, we have mentioned that stricter EPS considerably reduces the number of projects between BRICS. This effect is driven mainly by the effect of MBI in dirty sectors.

Table 8: Effect of NMBI and MBI on M&As: Developed countries vs. BRICS+ (marginal effects)

	Extensive margin of M&A		
Sectors:	**All**[(1)]	**Clean**[(2)]	**Dirty**[(2)]
NMBI x Source-Destination flows			
Developed to Developed	-0.156**	-0.150*	-0.162**
	(0.063)	(0.078)	(0.075)
BRICS+ to BRICS+	-0.181	-0.810	0.139
	(0.261)	(0.547)	(0.292)
BRICS+ to Developed	0.064	-0.012	0.102
	(0.190)	(0.235)	(0.231)
Developed to BRICS+	-0.722***	-0.827***	-0.646***
	(0.166)	(0.196)	(0.176)
MBI x Source-Destination flows			
Developed to Developed	-0.206**	-0.248**	-0.168
	(0.086)	(0.107)	(0.103)
BRICS+ to BRICS+	-1.614***	0.216	-2.690***
	(0.623)	(0.894)	(0.736)
BRICS+ to Developed	-0.271	-0.253	-0.281
	(0.243)	(0.338)	(0.320)
Developed to BRICS+	-0.842***	-1.031***	-0.671**
	(0.276)	(0.335)	(0.306)

Note: Marginal effects from Table A.7. NMBI refers to the non-market-based instruments index, and MBI refers to the market-based instruments index. Complete estimations available in Table A.7 in the appendix. (1) To save space, results for All (column 1) come from column 1 of Table A.7. (2) Results for Clean and Dirty sectors are presented in separated columns but the coefficients come from the same estimation – column 2 of Table A.7. Coefficients are the marginal effects of NMBI (or MBI) for each Source-Destination flows (and depending on whether the investment is in a clean or dirty sector). See page 20 for more details and Appendix C. * $p<0.10$, ** $p< 0.05$, *** $p<0.01$

4.5 Effect of EPS on M&As by sectors

The previous analysis consistently suggests that the sensitivity of cross-border M&As to ER relative to domestic M&As is similar for clean and dirty sectors. In the present section we attempt to provide some further insight on the heterogeneous effect on ER at the sectoral level.

We test the sensitivity of our results to the classification into Dirty and Clean used previously, by employing another classification based on the levels of pollution abatement costs.[18] We interact the EPS, MBI and NMBI with an indicator variable that takes the value one when the destination sector has high abatement costs (HA). Estimates are presented in Table 9. Results suggest that the effect of ER on cross-border M&As is similar for sectors with high or low abatement costs. Only in the case of NMBI is the

[18]This classification was initially proposed by Low and Yeats (1992) and broadly followed by the previous trade and FDI literature (e.g. Brandi et al., 2020; Di Ubaldo and Gasiorek, 2022). The sectors which are considered to have high abatement costs are specified in Table A.5 from the appendix.

interaction negative and weakly significant.

This finding is puzzling. One would expect cross-borders M&As in dirtier sectors (or sectors with high abatement costs) to exhibit higher sensitivity to changes in ER (compared with domestic ones). To shed light on the effect of ER at the sector level, we compute the effect of EPS, NMBI and MBI for each sector. This is done by interacting the different ER indexes with a set of dummies that take the value 1 for each of the 24 manufacturing activities present in our analysis. EPS estimates are reported in Figure 3, and NMBI and MBI are reported in Figures A.4 and A.5 in the appendix. In these figures, we specify in each sector label if the sector is considered dirty (D) or faces high abatement costs (HA).

Figure 3 reveals that EPS has a negative effect on cross-border M&As relative to domestic ones in 10 out of the 24 manufacturing activities. These results emphasize the important heterogeneity of sectors. In line with the hypothesis that stricter ER would discourage more investments in dirty sectors, the negative effect is confirmed in five sectors classified as dirty (11 and 24) or that face high abatement costs (25) or both (20 and 23). Conversely, results in other sectors are at odds with the conventional prediction: estimates also point out negative effects of ER on cross-border M&As in five sectors considered as clean or that face low abatement costs (15, 26, 27, 28 and 30), and estimates are not significant in several sectors considered as dirty or that face high abatement costs. It is important to recall that the weak statistical relationship between ER and M&As here does not imply that M&As are not sensitive to ER in general, but rather signifies that, in those sectors, domestic and cross-borders M&A have similar sensitivity to ER. Similar conclusions can be drawn from estimates of the NMBI and MBI (See Figures A.4 and A.5 in the appendix).

All in all, our results point out an important heterogeneity among sectors in the sensitivity of cross-borders M&As to ER compared with domestic ones. This heterogeneity is not only driven by the level of emissions by sector or by the level of abatement costs. Our empirical model controls for the multilateral resistance term at the sectoral level, and also for all country-sector time-varying drivers of M&As. As a consequence, the only source of omitted variable bias that may subsist is a sector specific factor that may differently affect cross-border M&As relative to domestic investment, such as characteristics of the sector that make its production abroad more or less easy.

All in all, these results do not alter the main conclusion: ER has a more discouraging effect on cross-border M&As than domestic M&As but the sensitivity is similar for clean and dirty sectors. Indeed, there are several possible explanations for the fact that stricter ER would have a larger discouraging effect on cross-border M&As aimed at clean sectors than on foreign investments in dirty sectors. On one hand, the factor endowments hypothesis (or capital-labour hypothesis) emphasizes that FDI, like trade flows, are also guided by factor endowments (Helpman, 1984; Markusen, 1984), and capital-intensive industries would tend to locate in capital-abundant countries where the cost of capital is lower. As Cole and Elliott (2005) point out, pollution- intensive industries are usually capital-intensive. In capital-intensive activities, benefits from lax environmental regulation could be offset by the relatively higher price of capital in the capital-scarce country.

On the other hand, Ederington et al. (2005) argue that some industries are less geographically mobile than others, due to transportation costs, plant fixed costs, or agglomeration economies. Consequently, the less mobile industries will be less sensitive to differences in regulatory stringency between countries, because they cannot afford the cost of relocation. Regarding this, the authors show that the most polluting industries (those facing the largest abatement costs) are also the least geographically mobile, while clean industries are better candidates for relocating as "footloose industries". The empirical studies by Kellenberg (2009) and Poelhekke and Van der Ploeg (2015) partially back this hypothesis.[19]

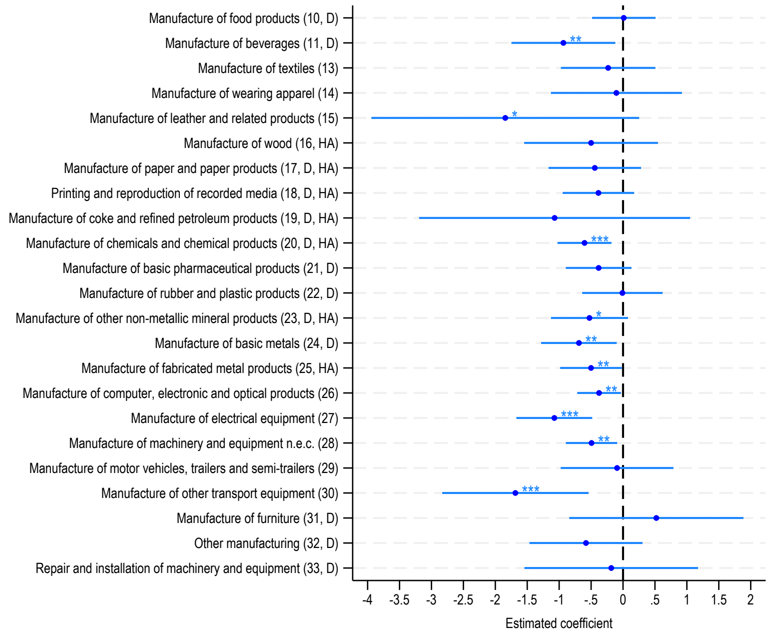
[19] However, to test this hypothesis correctly, more disaggregated sector-level data would be required. According to Ederington et al. (2005), 4-digits industrial classification is required to classify sectors into mobile (footloose) and non-mobile activities.

Table 9: Effect of ER in sectors with high levels of abatement costs

	Extensive margin of M&A	
	(1)	(2)
	EPS	NMBI-MBI
EPS (log) x INT	-0.398***	
	(0.111)	
x High abatement costs	-0.143	
	(0.132)	
NMBI (log) x INT		-0.144**
		(0.069)
x High abatement costs		-0.159*
		(0.083)
MBI (log) x INT		-0.355***
		(0.092)
x High abatement costs		0.160
		(0.115)
GDP pc (log) x INT	0.285***	0.318***
	(0.081)	(0.082)
Unemployment (log) x INT	0.024	0.050
	(0.053)	(0.054)
Natural resources (log) x INT	0.345***	0.357***
	(0.065)	(0.065)
No. of patents per million inhab. (log) x INT	0.101**	0.072*
	(0.043)	(0.043)
Exchange rate (log) x INT	-0.004	-0.005
	(0.017)	(0.017)
Political stability x INT	0.235***	0.223***
	(0.061)	(0.061)
Investment agreement	0.251***	0.254***
	(0.074)	(0.073)
Trade agreement	0.112**	0.124**
	(0.051)	(0.051)
Observations	558779	558779

Note: Standard errors clustered at the country and sector pairs are reported in parentheses. All estimates include origin * sector of origin * destination * sector of destination, origin * sector of origin* year, destination * sector of destination * year fixed effects, and INT*sector of destination*year fixed effects. All country specific variables are interacted with the INT dummy. EPS refers to the Environmental Policy Stringency index, MBI to the market-based instruments index, and NMBI to the non-market-based instruments index. * p<0.10, **p< 0.05, *** p<0.01.

Figure 3: Estimated coefficients for the EPS index at the sector level



Note: Estimated coefficient for the Environmental Policy Stringency index (EPS) for each sector with 95% confidence interval. Dirty sectors are identified with a D and sectors with high abatement costs with HA. Estimates from the manufacture of Tobacco products (12) are not reported as these resulted in large and non-significant coefficients, which are probably driven by the limited number of transactions in this sector. * p<0.10, **p< 0.05, *** p<0.01.

5 Robustness checks

Effect of EPS on M&As: Stringent versus Lax countries

Previously, we disentangled the effects of EPS for the four types of source-origin flows, depending on whether they originate from developed or BRICS+ countries, and flow to developed or BRICS+. To complement the analysis, we now split the sample according to stringency of the ER of the country. We classify as strict those countries whose average EPS index is above 2.36 (half the maximum value of the EPS index during the whole period). Countries classified as strict are: Austria, Denmark, Estonia, Finland, France, Germany, Italy, Japan, Luxembourg, Netherlands, Norway, Sweden, Switzerland, and the United Kingdom. With this classification, some developed countries and the BRICS+

countries are considered countries with lax ER. Accordingly, we expect results to be different to the ones obtained with the previous classification that stress the difference in the motivations of investors from developed and emergent countries.

Analogous to the developed-BRICS+ analysis (see specification (2)), we interact the EPS index with a set of dummies that take the value one whenever investment goes from stringent to lax, lax to stringent, and lax to lax (the omitted category being M&As originating in and flowing to countries with stringent ER). To conserve space, in Table 10 we only report the marginal effects, and estimates are available in the appendix.

Table 10: Effect of EPS on M&As: Stringent versus lax countries (marginal effects)

	Extensive margin of M&A		
Sectors:	**All**[(1)]	**Clean**[(2)]	**Dirty**[(2)]
EPS x Source-Destination flows			
Stringent to stringent	-0.631***	-0.667***	-0.603***
	(0.121)	(0.150)	(0.146)
Lax to lax	-0.329***	-0.376***	-0.290**
	(0.110)	(0.133)	(0.129)
Lax to stringent	-0.328**	-0.418**	-0.251
	(0.163)	(0.186)	(0.184)
Stringent to lax	-0.494***	-0.549***	-0.449***
	(0.125)	(0.148)	(0.144)

Note: Marginal effects from Table A.8. EPS refers to the Environmental Policy Stringency index. Complete estimations available in Table A.8 in the appendix. [(1)] To save space, results for All (column 1) come from column 1 of Table A.8. [(2)] Results for Clean and Dirty sectors are presented in separated columns but the coefficients come from the same estimation – column 2 of Table A.8. Coefficients are the marginal effects of EPS for each Source-Destination flows (and depending on whether the investment is in a clean or dirty sector). See page 20 for more details and Appendix C. * p<0.10, **p< 0.05, *** p<0.01

As displayed in Table 10, the coefficients of EPS are always negative and significant, confirming that ER discourages more cross-border M&As than domestic M&As, regardless of how strict the ER is in the source country and in the host country. However, the negative coefficients are statistically larger for investors coming from strict countries. In line with the previous results, we do not find significant difference between dirty and clean sectors.

Alternative measures to EPS

We also test the robustness of the negative relationship between ER and cross-border M&As by replacing the EPS index with three alternative proxies for countries' ER. One is retrieved from the Executive Opinion Survey of the World Economic Forum (WEF). This survey includes two different questions posed to business CEOs in several countries around the world about the stringency and enforcement of ER. The stringency of ER is measured using the question "The stringency of overall environmental regulation in your country is (1=lax compared with most other countries, 7= among the world's most stringent)". The degree of enforcement of ER is measured using the question: "Environmental regulation in your country is: (1=not enforced or enforced erratically, 7= enforced consistently and fairly)". The ER indexes based on this survey have been widely used by the previous literature (e.g. Poelhekke and Van der Ploeg, 2015; Wagner and Timmins, 2009). In the present study we employ the logarithm of the stringency and enforcement indexes (separately and combined) to test whether they have a negative effect on cross-border M&As relative to domestic ones during the period 2008-2018.[20]

The second index we employ instead of EPS is the Environmental Performance Index (EPI) in the climate change category (Wolf et al., 2022; YCELP and CIESIN, 2022). This index is based on various indicators of gas emissions by country. Since the full EPI cannot be used in a panel data setting because the underlying data and methodology change over time, we employ the EPI 2022 underlying data for calculating the index for the climate change category for the period 1995-2018. It is important to highlight that the EPI measures countries' environmental performance and not regulation. The index ranges from 0 to 100, and the higher the value, the better the country's environmental performance.[21] We expect countries' environmental performance to be positively correlated with the stringency of ER.

The third variable we employ to proxy for ER is the sectoral Carbon dioxide (CO2) emissions in tons per unit of production, from the OECD Indicators on (CO2) emissions embodied in international trade (TeCO2) drawn up by Yamano and Guilhoto (2020). In line with Xing and Kolstad (2002), higher CO2 emissions intensity are expected to

[20]Unfortunately, this survey is only available for the years 2008, 2009, 2011, 2013, 2015, 2017 and 2019. Missing values for 2010, 2012, 2014, 2016 and 2018 are interpolated using the average of the previous and subsequent years.

[21]We choose the climate change category for two reasons. First, this category is likely to be highly correlated with countries' policies that seek to achieve a cleaner production and consequently affect FDI. Second, the underlying variables that form this category are available for most years of our period of analysis what limit the required interpolation. See Wolf et al. (2022) for further details on the EPI and its categories.

be negatively correlated with countries' ER stringency. Thus, in this case, if stricter ER deters cross-border M&As, a higher production carbon emission factor is expected to have a positive effect on cross-border M&As relative to domestic ones.

Estimates are presented in Table 11. The WEF ER stringency and enforcement indexes, the EPI for climate change, and the intensity of sectors CO2 emissions confirm that stricter ER reduces cross-border M&As relative to domestic ones. We also tested this for dirty sectors. Estimates are available in Table A.9 in the appendix. As in the main results, we do not find evidence to support the idea that stricter ER has a significantly larger negative effect on cross-border M&As into dirty sectors.

Table 11: Effect of alternative measures to EPS on M&As

	Extensive margin of M&A				
	(1) Stringency	(2) Enforcement	(3) Stringency & Enforcement	(4) Environmental Performance Index (EPI)	(5) CO2 sectoral intensity
Stringency (log) x INT	-1.049**				
	(0.482)				
Enforcement (log) x INT		-1.866***			
		(0.431)			
Stringency & enforcement (log) x INT			-0.841***		
			(0.240)		
EPI (log) x INT				-0.170**	
				(0.079)	
CO2 sectoral intensity (log) x INT					0.057**
					(0.029)
GDP pc (log) x INT	-1.489***	-1.503***	-1.479***	0.184**	0.235***
	(0.263)	(0.263)	(0.263)	(0.080)	(0.082)
Unemployment (log) x INT	-0.173*	-0.187**	-0.181**	0.047	0.027
	(0.092)	(0.092)	(0.092)	(0.053)	(0.053)
Natural resources (log) x INT	0.169	0.139	0.158	0.354***	0.386***
	(0.108)	(0.108)	(0.108)	(0.066)	(0.065)
No. of patents per million inhab. (log) x INT	0.280**	0.226*	0.269**	0.095**	0.099**
	(0.136)	(0.134)	(0.134)	(0.043)	(0.043)
Exchange rate (log) x INT	-1.588***	-1.624***	-1.602***	-0.001	-0.004
	(0.273)	(0.276)	(0.274)	(0.017)	(0.017)
Political stability x INT	0.249**	0.319***	0.297**	0.217***	0.223***
	(0.119)	(0.120)	(0.120)	(0.061)	(0.061)
Investment agreement	0.126	0.085	0.104	0.252***	0.255***
	(0.123)	(0.124)	(0.124)	(0.074)	(0.074)
Trade agreement	0.043	0.017	0.026	0.109**	0.108**
	(0.086)	(0.086)	(0.086)	(0.051)	(0.051)
Observations	173462	173462	173462	558706	558779

Note: Columns (1)-(3) the period of analysis is 2008-2018. In column (1), Stringency index (in log) from the World Economic Forum (WEF). In column (2), Enforcement index (in log) from the World Economic Forum (WEF). In column (3), Stringency (in log) × Enforcement (in log). In column (4), EPI refers to the Environmental Performance Index in the climate change category (YCELP and CIESIN, 2022). In column (5) sectoral Carbon dioxide (CO2) emissions in tons per unit of production, from the OECD Indicators on CO2 emissions embodied in international trade (TeCO2) drawn up by Yamano and Guilhoto (2020). Standard errors clustered at the country and sector pairs are reported in parentheses. All estimates include origin * sector of origin * destination * sector of destination, origin * sector of origin* year, destination * sector of destination * year fixed effects, and INT*sector of destination*year fixed effects. All country specific variables are interacted with the INT dummy. * p<0.10, **p< 0.05, *** p<0.01.

6 Conclusions

The present study is one of the few empirical tests of the PHH for a large sample of countries, sectors, and years. It also contributes to the literature by focusing on the case of cross-border M&As, which is relevant considering that environmental policy can affect greenfield investment and M&As differently, and since most FDI flowing from and to developed countries consists of M&As. An important contribution of this study is the implementation of a structural gravity approach that minimizes omitted bias and simultaneity bias, while controlling for the evolution of the border effect. This empirical approach accurately isolates the effect of unilateral ER on M&A decisions and allows us to test whether ER has a different effect on cross-border and domestic M&A. Additionally, to the best of our knowledge, this is the first study to apply this method to bilateral FDI at the sector level.

Unlike most previous studies, we confirm a reduced version of the PHH: adopting "green" policies has a larger discouraging impact on investors from abroad than on local investors. However, we do not confirm that this negative effect is mainly driven by the most polluting sectors. We also demonstrate that policies that place quantitative limits on emissions have the same negative impact as policies that increase the price of emissions, regardless of the emission levels of the sectors.

Another contribution of our study is that it disentangles the effects of ER according to the development levels of investors and investees. For investors from developed countries and for investors from BRICS investing in other BRICS, we always find that foreign investors are more sensitive to ER than domestic ones. In particular, when developed and emerging countries invest in emerging countries, the negative effects of ER are large. In these cases, an important objective of investments is to lower production costs, and the costs of stringent ER are not compensated by other location advantages, as in developed countries.

From a policy perspective, our findings emphasize that ERs are not only a concern in highly polluting sectors, but also influence cross-border M&As in clean sectors. More importantly, the responses to ER differ if taken by developed countries or emergent countries, being larger in the case of the latter. This is a reassuring result for richer countries since the fear of massive reallocation is not backed by our results. However, current regulations will not make a net-zero transition possible in 2050. Developed countries that are responsible for the largest proportion of GHG will have to move to an even more stringent policy affecting cross-border M&As significantly. In particular, heterogeneity in the price of pollution is still high between countries. Thus, taxes on pollution are expected to increase. However, this policy would have a limited effect on the number of M&As among developed countries.

In contrast, the situation in emerging countries is worrisome because our findings demonstrate that investors from developed countries are sensitive to the environmental policies implemented in these countries, regardless of the contamination level of the sectors. Emergent countries could then compete to attract capital flows by maintaining lax ERs. This would contribute to creating a pollution haven, increasing carbon leakage, and making it more difficult to achieve climate goals. This effect may be underestimated in our analysis, which does not consider greenfield investments as an alternative strategy to M&A abroad, a strategy that is more commonly used in emerging and developing countries and represents an interesting avenue for future research. Another important phenomenon to consider is that ER stringency may differ across states/provinces within countries. Addressing the regional dimension of environmental instruments certainly deserves further investigation.

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Impact of environmental regulation on M&As in the manufacturing sector

Federico Carril-Caccia[1] and Juliette Milgram Baleix[*2]

[1]Department of International and Spanish Economics, University of Granada[†]

[2]Department of Economic Theory and Economic History, University of Granada[‡]

Abstract

We test the influence of environmental regulation (ER) on the location decision of cross-border Mergers and Acquisitions (M&As) for a large sample of countries, sectors, and years using a structural gravity model. Unlike other studies, our results confirm the pollution haven hypothesis according to which more stringent ER makes countries less attractive to foreign investors planning to invest through M&As, compared with domestic investors. Policies that set quantitative limits on emissions have similar discouraging effects on cross-border investment to taxes on emissions. We find no evidence that the impact could be stronger in dirty sectors than in clean sectors. The impact of ER differs depending on country type according to their level of development, reflecting the fact that investments in developed countries and BRICS respond to different motivations. In emerging countries, lax ER could attract significantly more inward M&As. In developed countries, ER has a less discouraging effect.

JEL codes: F21, F64, Q58.

Keywords: Environmental stringency, pollution havens, M&As, structural gravity, polluting sectors.

[*]Corresponding author. E-mail:jmilgram@ugr.es.

[†]Facultad de Ciencias Económicas y Empresariales Campus de Cartuja, s/n, 18011 Granada, Spain.

[‡]Facultad de Ciencias Económicas y Empresariales Campus de Cartuja, s/n, 18011 Granada, Spain.

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Conflict on Interest

Dear Editor,

Declarations of conflict of interest: none

Sincerely,

Federico Carril-Caccia and Juliette Milgram Baleix