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# Regulations and Corporate Environmental Responsibility: Evidence from a panel of firms in Transition Economies

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# **Regulations and Corporate Environmental Responsibility: Evidence from a panel of firms in Transition Economies**

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**ABSTRACT:** *The aim of this study is to investigate how a set of regulations influences the pro-environmental actions of firms in a panel of 25 Transition Countries. For this purpose, we use the enterprise survey data developed by the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB) and the World Bank Group (WBG). Based on a logit modeling and on the construction of different indicators characterizing the environmental actions of the firms, we find that regulation affects positively the decision of firms to implement an eco-action. Results are confirmed when we examine the different eco-action categories. Findings obtained from the interactions are also worthy of note. In particular, we find that board of directors are more prone to consider shareholder interests, and a strong network effect emerges between EU candidate countries and EU economies.*

**Keywords:** Corporate Environmental Responsibility; Manufacturing Firms; Regulation; Transition countries

**JEL Codes:** M14; L60; Q58

## INTRODUCTION

In the latest years, the acceleration of environmental problems has prompted firms to undertake their social and environmental responsibility. The attention paid to the issue of Corporate Environmental Responsibility (hereinafter CER) has increased among scholars and policymakers. According to Surroca et al. (2010), CER is defined as *“the broad array of strategies and operating practices that a company develops in its efforts to deal with and create relationships with its numerous stakeholders and the natural environment”*. In other words, CER can be viewed as a distinct component with respect to the Corporate Social Responsibility (CSR)<sup>1</sup> (Qin et al., 2019; Wang, 2016; Timpere, 2008), a form of self-regulation (Agudo-Valiente et al., 2017) since companies decide to include the environmental aspects in their business strategies.

Firms themselves are increasingly aware that CER is becoming relevant. This proactive environmental approach<sup>2</sup> is encouraged by the European Commission both within the European Union (Punzo et al., 2019) and in other external areas that aim to join the European Union (Kudlak, 2017). However, despite the EU directives, there are significant differences between the European Member States in the implementation of CER (Punzo et al., 2019; Galvez-Martos et al., 2013).

A substantial literature has explored both drivers and barriers of corporate social and environmental responsibility in developed countries (i.e. Agudo-Valiente et al., 2017; Galvez-Martos et al., 2013; Murillo-Luna et al., 2011; Laudal, 2011) recognizing their importance for business and reputation (Bux et al., 2020). Other studies have investigated the drivers and barriers of the CER and CSR in different sectors (Gohoungodji et al., 2020; Bello and Kamanga, 2018; Goyal and Kumar, 2017; Tsai et al., 2016) and in some developing countries (Bux et al., 2020; Hossain et al., 2016) such as India and China (Goyal and Kumar, 2017; Shen et al., 2015; Graafland and Zhang,

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<sup>1</sup> According to the European Commission (2011), CSR is "the responsibility of enterprises for their impacts on society". To fully meet their social responsibility, companies "should have in place a process to integrate social, environmental, ethical, human rights and consumer concerns into their business operations and core strategy in close collaboration with their stakeholders, with the aim of maximizing the creation of shared value for their owners/shareholders and civil society at large and identifying, preventing and mitigating possible adverse impacts".

<sup>2</sup> The literature on CER distinguishes between environmental reactivity approach and environmental proactivity approach of firms. According to the first, firms introduce the minimal change to comply with the regulations. The second approach states that firms voluntarily adopt strategies to reduce their effect on the environment (Gonzalez-Benito and Gonzalez-Benito, 2005).

2014). Few studies investigate the Corporate environmental strategies in other emerging economies and Transition countries (Earnhart et al., 2014; Sindhi and Kumar, 2012).

Given the lack of empirical evidence on the relationship between regulation and firms' environmental actions for Transition countries, this study aims to fill this gap by employing firm-level data drawn from the World Bank Enterprise Surveys. These surveys are conducted periodically and are a part of a joint project of the European Bank for Reconstruction and Development (EBRD) the European Investment Bank (EIB) and the World Bank Group (WBG). The surveys contain details on several topics such as business environmental indicators, innovation, organization and management practices, employees, relationship between enterprises and government, green aspects, and other general information about enterprises.

In this paper, we study empirically the influence that regulation has on the environmental actions of manufacturing firms in a panel of 25 Transition countries.

The main findings obtained through the estimation show that regulation strongly impact on the firm's decision to adopt environmental action. This result is also confirmed observing the different categories of eco-actions. Interactions also show some interesting results. When we interact the board of directors with regulation, we find that firms with board of directors are more focused on protecting shareholder interests. Furthermore, the interactions between non-EU and EU candidate countries with neighboring EU countries respectively, confirm the existence of network effects that are triggered by the proximity w to EU countries.

The remainder of this paper is organized as follows. Section 2 focuses on the literature review and conceptual background of the role of regulations on Corporate Environmental Responsibility. Section 3 describes the data and the variables, while Section 4 outlines the econometric strategy and presents the findings of baseline model. In the following section, some alternative estimations are presented. Finally, the last section concludes the article.

## **II. THEORETICAL BACKGROUND**

Most of the CER research at firm level focuses mainly on the determinants that influence pro-environmental actions (Qin et al., 2019, Jiang et al., 2018; Liu, 2018,

Leonidou et al., 2017; Nulkar, 2014; Murillo-Luna et al., 2011; Darnal et al., 2010; Aragón-Correa et al., 2008; Molina-Azorin et al., 2009; Murillo-Luna et al., 2008).

Other studies investigate the association between firm's environmental and social actions with its reputation (Lloyd-Smith and An, 2019; Martin de Castro et al., 2019); the effect of CER on firm's performance (Do and Nguyen , 2020; Jo et al., 2015); the relationship between environmental strategies and firms' competitive advantage (Do and Nguyen , 2020; Sindhi and Kumar, 2012); and finally, the association among the firms' environmental activities and share price (Hussainey and Salama, 2010).

There is also a strand of literature that explores the role of regulation on the environmental proactive strategies of firms. In particular, two theories seem to emerge: the institutional and stakeholder approaches. According to the institutional literature (i.e. North, 1990; Scott, 1991; Delmas et al., 2011; Delmas and Toffel, 2008), regulation, considered as external determinants (Saleem et al., 2020; Valero-Gil et al., 2017; Sindhi and Kumar, 2012), affects the firm's environmental strategies. In addition, this literature explains the reason why firms adopt environmental decisions when rules are imposed (Do and Nguyen, 2020). The second approach namely the stakeholder theory (Freeman, 1984), emphasizes the role of regulators, included among the stakeholders and able to influence the firms' environmental decisions with its pressure (Hossain et al., 2016; Rasi et al., 2013). In other papers, regulation could be categorized as both external drivers and, in some cases the main external obstacles to the environmental strategies for its complex nature (Qin et al., 2019; Earnhart et al., 2014; Sindhi and Kumar, 2012). In fact, on one hand, regulation could be considered as an additional cost for a firm, on the other hand, it could be perceived as an opportunity to invest in environmental projects, improve firms' efficiency (Rexhauser and Rammer, 2014; Popp, 2010), and re-distribute R&D activities for decreasing firms' environmental impact (Lanoie et al., 2011). Most studies on the effect of CER are carried out on developed countries providing ambiguous results. Some studies focusing on the barriers of proactive environmental strategy find that complex or unclear regulations are a strong limitation for firm's environmental activities (González-Torre et al., 2010; Murillo-Luna et al., 2011). Other recent studies (Agudo-Valiente et al., 2017; Galvez-Martos et al., 2013) show that industrialized countries have well-defined environmental regulations as a consequence of the high-level interest, also from a social point of view, in environmental issues (Qin et al., 2019). Therefore, in these countries, regulation

(Murillo-Luna et al., 2008, 2011; Delgado-Ceballos, 2011) and regulatory stakeholder pressure (Valero-Gil et al., 2017; Murillo-Luna et al., 2008; Sarkis et al., 2010) are the most important external factor to drive the firms' environmental practices. Differently from developed economies, in some developing countries regulation as well as institutional systems are weak, and the environmental standards are low (Jamali and Karam, 2016; Sindhi and Kumar, 2012). Then, the pressure that companies receive from internal institutions is low and they are more influenced by international level (Ali et al., 2017). When the institutions are weak and influenced by corruption and industrial lobbies, many firms receive incentives to adopt environmental voluntary strategies and to participate in certification programs (Earnhart et al., 2014; Tambunlertchai et al., 2013). For this reason, in developing economies, environmental and social regulations with institutions play a crucial role in directing firms' environmental actions (Saleem et al., 2020; Chen et al., 2018; Earnhart et al., 2014; Sindhi and Kumar, 2012) even if, environmental and social regulations could be poorly enforced (Blackman, 2010). In addition, the regulation's application increases costs and constrains the managers' choices (Berchicchi et al., 2017). In other developing countries, the CER is primarily driven by the government, which plays a dominant role in enterprise environmental compliance (Qin et al., 2019) and consequently environmental legislation is strictly enforced (Bao et al., 2013).

Different forms of regulation include the legal framework that refers to compliance with industry standards (Sindhi and Kumar, 2012). Especially in developing countries findings are mixed. On the one hand, the legal framework is considered as external barrier since the costs incurred by firms to comply with the industry standards discourage mainly firms with limited financial resources to be invested in compliance equipment (Armah et al., 2011). On the other, legal framework is considered as an opportunity for firms in developing countries, when companies implement environmental strategies and increase environmental compliance (Luken et al., 2008) due to market pressure (Shindi and Kumar, 2012).

Only few papers, based on descriptive statistics focuses on the role of regulation in CER strategies of Transition economies. Harangzó et al., (2010) explore the drivers of CER in Hungarian companies. Using a database of the OECD survey (2003) based on a sample of 4,186 facilities, the authors find that among the main drivers, the international environmental policies with the consequent implementation of the EU

standards, influence firms' environmental decisions. The study of Seroka-Stolka and Lukomska-Szarek (2016) analyzes the barriers to the adoption of proactive environmental actions in 156 Polish firms through a survey. The results show that among the external barriers, "the scares flexibility in regulation compliance times" is in last position. Also, the paper of Kudlak (2017) that investigates the drivers of firms' environmental activities in Poland deserves particular attention. Using survey data collected from 283 companies which assume as legal framework a form of environmental voluntary program represented by the EU standard during the period 1996-2006, he shows that a potential barrier to international trade for a green firm is the EU standard certification. Yet, this study finds that during the transition process, the firms' effort to join the EU standards is considered a source of pressure for companies to export in these economies (Qi et al., 2011). Therefore, the aim of this study is to contribute to the literature on environmental proactive strategies of firms by enriching this particular strand examining a panel of 25 Transition countries.

### **III. DATA COLLECTION AND VARIABLES**

To explore the impact of regulation on firm's activities for the environment, in this paper we use firm-level data collected by the World Bank's Enterprise Surveys (hereinafter ES) and, in some specifications, we match them with other indicators taken from other databases. The ES were conducted between October 2019 and March 2020<sup>3</sup> and were a part of a joint project of the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB) and the World Bank Group (WBG).

These surveys are based on uniform sampling technics that have been applied in nearly 140 countries since 2002. Particularly, the surveys were carried out according to a two-step procedure. The first step is to apply a telephone screener questionnaire to check suitability and establish appointments. Then a face-to-face interview is conducted with the Manager/Owner/Manager of each firm.

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<sup>3</sup> For information on the period in which the surveys were carried out see table A1 in the Appendix

The survey's focus is to provide information on firms operating in the private sector. The universe of the study is represented by the non-agricultural economy<sup>4</sup> that includes: all manufacturing sectors, construction, services, transport, storage, communications and IT in accordance with the group division ISIC Revision 3.1.

The surveys provide a sample representative of firms that have been selected following the stratified random sample methodology<sup>5</sup>. The surveys also offer detail on: (i) the innovation behavior of firms, (ii) innovative activities, organization practices, management and employees and (iii) other general information on firms. In recent surveys, a new section has been included on environment aspects, this gives us the opportunity to examine and compare the effect of regulation on eco-actions for firms across transition countries. It is based on data from about 15,246 firms from 25 countries of Eastern Europe and Central Asia. At the beginning of the 1990s, all the countries examined had carried out significant changes in order to implement the transition from centrally planned economy to liberal market economies.

The changes that have involved these countries have first of all concerned the legal, institutional, market and civil society as a whole, but they have also influenced the field of environmental protection and management (Clark and Cole, 1998, Friesenbichler et al., 2016, Kudlack, 2017, Biscione et al., 2021).

Eco-action is the dependent variable equal to 1 if the firm, in the last three years, has adopted at least one environmental measure<sup>6</sup>, and 0 otherwise. The main

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<sup>4</sup> Excluded sectors are financial intermediation, real estate and renting activities and finally, public and utilities.

<sup>5</sup> The stratification levels are three and they are as follows: region, sector and firm dimension.

<sup>6</sup> The environmental measures are the following: (i) heating and cooling improvements; (ii) more climate-friendly energy generation on site; (iii) machinery and equipment upgrades; (iv) energy management; (v) waste minimization, recycling and waste management; (vi) air pollution control measures; (vii) water management; (viii) upgrades of vehicles; (ix) improvements to lighting systems and finally (x) other pollution control measures.

explanatory variable of interest is the regulation. In order to study the effect of a regulation as a whole on actions for the environment adopted by firms, we use the three variables that capture regulation: (i) occupational safety regulations, (ii) health and hygiene regulations and finally (iii) environmental regulations. According to literature (Ashford and Caldart, 2010; Aalders and Wilthagen; 1997) these three regulations are interconnected and are the basic regulations that a firm can apply. We believe that these regulations reflect the possibility to implement the environmental voluntary actions. In other words, companies that do not apply these basic regulations could hardly promote voluntary actions.

Therefore, to observe the overall effect of these three types of regulation we create a unique indicator performing the principal component analysis (PCA). We employ the PCA since it allows us to reduce the dimensionality of the data by choosing the most significant features that capture maximum information on the dataset.

Several control variables are included in the analysis to account for other factors that are likely to affect firms' eco-actions. To assess the impact of board of directors on the decision to implement an eco-action, we consider a dummy variable taking the value 1 whether the firm has a board of directors or a supervisory board, 0 otherwise. To evaluate if manager females are more sensitive to environmental issues, we add a dummy variable that shows if a firm has a top manager female. Firm age is measured as the difference between the year of that the survey and the year in which the firm start its business activity. Other characteristics are also considered: (i) size, an ordered variable that is equal to 1 for small firms (5-19 employees), 2 for medium firms (20-99 employees) and 3 for large firms (more than 100 employees); (ii) the geographic dimension of markets and (iii) whether the firm is an independent economic unit (taking the value of 1) or part of a group of firms (taking 0). We also employ a sector variable: firms are grouped in three sectors: (i) manufacturing; (ii) retail services and (iii) other services. We split our sample in four geographical regions (European Former-USSR Countries, Former Yugoslavian Countries and Albania, Eurasian Former-USSR Countries and Central European countries) to check regional differences. Finally, to investigate whether companies operating in EU member states have a greater awareness for the environment, we use a categorial variable equal to 1 for companies operating in a country that does not join to the EU, 2 for companies based in countries that belong to the EU and 3 for firms located in EU candidate countries.

Information on the opening of trade are captured by a sub-indicator of the new KOF globalization index<sup>7</sup> (Gygli et al, 2019), namely trade globalization index. Finally, details on the state of sustainability in the countries considered are summarized by the Environmental Performance Index developed by Yale University and Columbia University in collaboration with the World Economic Forum and the Joint Research Centre of the European Commission.

Table A2 in the Appendix contains the description of variables to account for factors that could affect the propensity of a firm to have a proactive behavior for the environment. Table 1 reports the descriptive statistics.

**Table 1. Descriptive statistics of variables**

<b>Variable</b>	<b>Obs</b>	<b>Proportion</b>	<b>Mean</b>	<b>Std. Err.</b>	<b>Std.Dev</b>
<b>Eco-actions</b>	14655	0.78		0.003	
<b>Regulation</b>	14303		-9.28E-09		0.99
<b>Manager Female</b>	15226	0.21		0.003	
<b>Board Director</b>	15192	0.27		0.004	
<b>Firm Dimension</b>	15243				
Small Firms		0.46		0.004	
Medium Firms		0.32		0.004	
Large Firms		0.22		0.003	
<b>Sector activity</b>	15246				
Manufacturing		0.55		0.004	
Retail Services		0.2		0.003	
Other Services		0.25		0.003	
<b>Firm's age</b>	15099		18.16		14.16
<b>Affiliation</b>	15244	0.10		0.002	
<b>Market Sales</b>	15030				
More National Sales			0.68	0.004	
National and International Sales			0.29	0.004	
More International Sales			0.03	0.001	
<b>Trade Globalization</b>	14975		68.41		17.46
<b>Environmental Performance</b>	14975		78.51		7.40
<b>Country Regions</b>	15246				
European Former-USSR Countries		0.35		0.004	
Central European Countries		0.25		0.004	
Former Yugoslavian Countries and Albania		0.18		0.003	
Eurasian Former- USSR Countries		0.22		0.003	
<b>European Union</b>	15246				
Non-EU Countries		0.54		0.004	
European Union Countries		0.38		0.004	
Candidate EU Countries		0.08		0.002	

## IV. EMPIRICAL MODEL AND RESULTS

As mentioned above, our dependent variable has a discrete distribution, we therefore apply qualitative techniques using a probit regression model to identify the effect of

<sup>7</sup> Kof Index for overall globalization is a composite index that includes 24 economic, social and political variables. The index is between 0 (as fully closed) and 100 (as fully open). Data have been available since 1970 on an annual basis for 208 countries and they are updated annually by the KOF Swiss Economic Institute.

Differently from the original globalization index, the revised KOF globalization index allows us to observe different dimensions of globalization.

regulation on eco-actions in Transition countries. Probit model is a class of latent variable threshold models for the analysis of binary data. In this model, we assume that the binary response is the indicator of the event that a latent variable not observed exceeds a given threshold to induce the enterprise to implement an eco-action. As mentioned in the previous section, “Eco-action” is the dependent binary variable. The parameters of the probit regression are estimated with the maximum likelihood approach. We use probit estimates of the marginal effects of independent variables to give an interpretation of their related effects. Thus, the binary probit regression model can be specified as:

$$y_i = \begin{cases} 1 & \text{if } y_i^* = x_i' \beta + \varepsilon_i > 0 \\ 0 & \text{if } y_i^* = x_i' \beta + \varepsilon_i \leq 0 \end{cases}$$

where  $y_i$  is the observed binary variable for eco-action,  $y_i^*$  is an unobserved latent variable that defines the probability of engaging in eco-action,  $x_i'$  is a vector of determinants affecting firms’ decision to undertake an environmental strategy and finally  $\varepsilon_i$  represents the error term. Table 2 reports the results.

**Table 2- Estimation results: Regulation and Eco-actions**

VARIABLES	(1) Eco-actions	(2) Eco-actions	(3) Eco-actions	(4) Eco-actions
Regulation	0.045*** (0.012)	0.045*** (0.012)	0.044*** (0.012)	0.044*** (0.012)
<b>Ref. Other Services</b>				
Manufacturing	0.084** (0.030)	0.077*** (0.030)	0.124*** (0.031)	0.119*** (0.031)
Retail Services	-0.041 (0.036)	-0.034 (0.036)	-0.026 (0.036)	-0.028 (0.036)
<b>Ref. Small Firms</b>				
Medium Firms	0.122*** (0.029)	0.118*** (0.029)	0.135*** (0.029)	0.128*** (0.029)
Large Firms	0.185*** (0.037)	0.168*** (0.037)	0.223*** (0.038)	0.212*** (0.038)
Board of directors	0.335*** (0.032)	0.352*** (0.032)	0.328*** (0.032)	0.330*** (0.033)
Female Manager	-0.095*** (0.030)	-0.087*** (0.030)	-0.072** (0.030)	-0.074** (0.030)
Age of Firm	-0.000 (0.001)	0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)
Affiliation	0.124*** (0.045)	0.128*** (0.045)	0.128*** (0.045)	0.119*** (0.045)
<b>Ref. Firms sell only on national Market</b>				
Firms sell only on international market	0.079 (0.073)	0.076 (0.073)	-0.009 (0.075)	-0.012 (0.075)
Firms sell on national and international market	0.181***	0.204***	0.166*** (0.032)	0.181*** (0.032)
Trade Globalization			0.006*** (0.001)	0.010*** (0.001)
Environmental Performance			-0.023*** (0.002)	-0.0154*** (0.002)
<b>Ref. European Union Countries</b>				
Non-EU Countries	-0.165*** (0.028)		-0.258*** (0.042)	
Candidate EU Countries	-0.220*** (0.046)		-0.347*** (0.049)	
<b>Ref. Central European Countries</b>				
European Former-USSR Countries		-0.129*** (0.033)		-0.043 (0.067)
Former Yugoslavian Countries and Albania		-0.110*** (0.039)		-0.171*** (0.042)

<b>VARIABLES</b>	(1) <b>Eco-actions</b>	(2) <b>Eco-actions</b>	(3) <b>Eco-actions</b>	(4) <b>Eco-actions</b>
Eurasian Former- USSR Countries		-0.126*** (0.037)		0.041 (0.067)
Constant	0.676*** (0.037)	0.647*** (0.400)	2.115*** (0.188)	1.088*** (0.218)
Observations	13,539	13,539	13,332	13,332

Standard errors in parentheses \*\*\*p<0.01, \*\*p<0.05, \*p<0.10

Table 2 collects the empirical results. Specifically, findings in columns 1 and 3 refer to a baseline model with the information concerning whether firms are localized in EU member states, in EU candidate states or in countries that do not join to the EU. Column 2 and 4 present results of the model that includes globalization and the environmental performance index and the classification of the states considered in four macro-areas. In contrast with the theoretical expectations (Jamali and Karam, 2016; Ali et al. 2017, Sindhi and Kumar, 2012), the main findings confirm the role of regulation captured by the composite regulation index, on the firm's propensity to adopt pro-active environmental strategies. This means that in Transition economies firms when adopt the regulation are more sensitive to the introduction of eco-action strategies.

Other results highlight that firms operating in manufacturing sector are willing to implement environmental actions with respect to other service sectors since manufacturing sector is highly polluting (Harangzó et al., 2010). However, a piece of literature highlights that the service sector is more sensitive to pursue environmental strategies (Do et al., 2020). Probably, findings depend on the specificity of the countries analyzed. Yet, firms with board directors have a positive effect on the propensity to implement pro-environmental strategies. Firms managed by men are more supportive of eco-actions than female-led firms. The result is in contrast with the literature that finds how female-led boards are more responsive to social and environmental actions (Lu and Herremans, 2019; Bear et al., 2010). Looking at the firm size, we find that large and medium firms are more likely to adopt environmental strategies than small ones. In particular, larger firms are associated with environmental proactiveness to a greater extent than smaller firms (Etzion, 2007) since they have greater visibility, also from a societal point of view (Etzion, 2007; Jiang and Bansal, 2003). It follows that stakeholders and regulators could intensify their requests for large companies to adopt more proactive environmental practices (Do et al., 2020; Earnhart et al., 2014; Darnall et al., 2010). In addition, larger firms have more resources to spend on environmental actions (Leonidou et al., 2017), on the contrary, smaller firms are less likely to invest in

environmental practices that have long run strategic benefits (Darnall et al., 2010; Bianchi and Noci, 1998).

Furthermore, corporate affiliation is strongly significant and positively associated to environmental strategies. It depends probably on the headquarter which transposes the regulation and applies it in the branches. Considering the geographical market, firms that sell both in domestic and international market are more aware of environmental issues and are more likely to implement eco-actions with respect to the firms that sell more domestically. In other words, in Transition countries, the local firms opened to foreign trade are re-organized themselves and have adopted EU environmental standards to be more competitive on the international market (Kudlak, 2017).

With regard to the effect of globalization on the propensity of firms to be proactive in their environmental behavior, findings show that globalization has a positive effect on firms' eco-actions. This suggests that globalization is one of the market forces that contributes to improvements in corporate governance since firms comply with standards despite the absence of government sanctions (Shindi and Kumar, 2012; Bansal and Roth, 2000). Also, the Environmental Performance Index that capture the level of sustainability in Transition economies taken into account is significant but negatively associated with the proactive environmental actions.

The plausible explanation is that, with reference to some environmental problems, there could be a process of replacement, in the sense that the more the institutions tackle this issue, the less firms have to take care of it. In other words, firms benefit from the measures introduced by the institutions without incurring any additional costs.

Moreover, findings show that companies operating in EU member states have a higher awareness for the environment. In fact, taking EU Countries as a reference, we can remark that firms in EU candidate countries and non-EU countries exhibit a strong but negative association with the eco-actions. We also obtain the same results when we consider the macro areas. We have chosen as a reference the Central European countries since that all economies in this area are already applying environmental regulations in compliance with European standards. As a result, these firms are more willing to implement the eco-actions. For the other three regions (European Former-USSR Countries, Former Yugoslavian Countries and Albania, Eurasian Former-USSR) findings show a probability of employ the firms' pro-environmental activities that decrease significantly if compared to Central European countries. In fact, in these areas

the application of environmental strategies is not influenced by EU standards. In addition, the environmental awareness is low, and the regulation is often uncertain (Sindhi and Kumar, 2012).

## V. ALTERNATIVE ESTIMATIONS

### *Interactions and other specifics*

In order to observe whether compliance with regulation is related to some of the firm characteristics, we run again the baseline model by considering how regulation interact with firm's characteristics. In particular, we take into account the following characteristics: (i) age; (ii) the presence of a female manager and (iii) a board of directors. These further estimations allow to examine the effect of these interactions on firms' propensity to introduce an eco-action. Then, to obtain information on the network effect (network externality), we interact the non-EU countries and EU candidate countries with the share of neighboring countries belonging to the EU to the total number of neighboring countries. These interactions could provide information on the network effect, in particular on the pressure that the neighboring countries belonging to the EU could exert on the two groups of countries considered. Table 3 reports the findings. For the sake of readability, coefficients of other variables used are not shown.

**Table 3. Interactions**

VARIABLES	(1) Eco-actions	(2) Eco-actions	(3) Eco-actions	(4) Eco-actions
Regulation	0.059*** (0.014)	0.039*** (0.014)	0.074*** (0.020)	0.046*** (0.012)
Board of Directors	0.331*** (0.033)			
Female Manager		-0.066** (0.030)		
Age of Firm			-0.000 (0.001)	
Non-Eu Countries				-0.490*** (0.091)
Candidate Eu Countries				-2.229*** (0.675)
Environmental Performance				
<b>Board of Directors* Regulation</b>	<b>-0.069** (0.030)</b>			
<b>Female Manager*Regulation</b>		<b>0.023 (0.030)</b>		
<b>Firm Age*Regulation</b>			<b>-0.002* (0.001)</b>	
<b>Non- Eu Countries* Neighboring Countries</b>				<b>0.538*** (0.115)</b>
<b>Candidate Eu Countries*Neighboring Countries</b>				<b>5.091*** (1.775)</b>
Constant	2.108*** (0.188)	2.115*** (0.188)	2.115*** (0.188)	12.834*** (1.626)
Observations	13,332	13,332	13,332	13,332

Findings related to firm characteristics are significant for the following interactions: (i) board of directors and regulation; (ii) firm age and regulation. The first interaction shows a significant but negative relationship with eco-actions. This means that the presence of board of directors reduces the possibility to implement pro-environmental actions. This unexpected result is in contrast with the literature (Shaukat et al., 2016) that shows firms which have as their part a board oriented to environmental issues and are more likely to implement actions that improve their performance in socio-environmental context. Conversely, in our countries board of directors probably prefer to protect the interests of shareholders. Also, the second interaction reveals a significant and negative association between firm age and regulation. The plausible interpretation is that the eco-actions are implemented by the younger firms because it may be easier to implement adaptation measures in recent companies. Yet, the interaction between non-EU countries and EU candidate countries with neighboring countries is strongly significant and positively associated with the firms' pro-environmental strategies. As expected, these findings confirm the existence of network effects that arise from contiguity with EU countries. In particular, the magnitude of pressure exerted by EU countries is very high, especially towards EU candidate countries since these countries have already achieved the EU standards required by the accession process.

### ***Alternative types of eco-actions***

Hereafter we describe the results of alternative estimations. We have re-run the analysis so highlighting the effect of regulation on four groups of eco-actions<sup>8</sup> namely

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<sup>8</sup> We created four categories of eco-actions by grouping them as follows:

- Machinery upgrades: (i) machinery and equipment upgrade and (ii) upgrade of vehicles.
- Energy saving: (i) more climate-friendly energy generation on site; (ii) energy management; (iii) improvements to lighting systems and (iv) heating and cooling improvements.
- Pollution control: (i) air pollution control measures and (ii) other pollution control measures.
- Recycling waste and water management: (i) waste minimization, recycling and waste management and (ii) water management.

machinery upgrades, energy save, pollution control and finally recycling waste and water management. In Table 4, we show the estimation findings.

Results are consistent with those obtained by the baseline estimate. The positive effect of regulation on the firm's decision to implement eco-actions is also confirmed when observing the different eco-action categories separately. In particular, regulation strongly impacts on air pollution control and machinery and equipment upgrade. Firm size, group affiliation, geographic dimension of market, and variable that capture the EU member state awareness show a positive and significant association with the four groups of eco-actions. Differently from the baseline results, we find that companies in the manufacturing sector are more prone to adopt eco-actions whereas retail services become significantly and positively associated with energy saving and show a negative impact on air pollution control measures and machinery upgrades. In addition, the firm age as a proxy for firm's experience accumulated over time (Santamaria et al., 2009; Balasubramanian and Lee, 2008), is relevant for the energy saving actions and pollution control. Finally, trade globalization index, a driver for the eco-actions for the considered Transition countries, becomes a barrier for the pollution control. One plausible explanation is that the measures to be adopted for pollution control are more expensive and more difficult to implement through pro-environmental actions.

In sum, with respect to the main estimation highlighted in the previous section, the main results do not change. The impact of regulation on eco-actions is always positive and significant thus confirming the baseline results.

**Table 4. Effect of regulation on eco-action categories**

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Machinery Upgrades	Machinery Upgrades	Energy Saving	Energy Saving	Pollution Control	Pollution Control	Recycling waste and water management	Recycling waste and water management
Regulation	0.052*** (0.011)	0.052*** (0.011)	0.043*** (0.011)	0.042*** (0.012)	0.060*** (0.012)	0.059*** (0.012)	0.032*** (0.011)	0.032*** (0.011)
<b>Ref. Other Services</b>								
Manufacturing	0.205*** (0.028)	0.234*** (0.028)	0.164*** (0.028)	0.193*** (0.029)	0.163*** (0.031)	0.168*** (0.032)	0.215*** (0.028)	0.230*** (0.028)
Retail Services	-0.086** (0.034)	-0.073** (0.034)	0.116*** (0.034)	0.142*** (0.035)	-0.115*** (0.039)	-0.063 (0.040)	0.011 (0.033)	0.024 (0.034)
<b>Ref. Small Firms</b>								
Medium Firms	0.099*** (0.026)	0.105*** (0.026)	0.124*** (0.027)	0.138*** (0.027)	0.124*** (0.029)	0.142*** (0.030)	0.143*** (0.028)	0.145*** (0.026)
Large Firms	0.195*** (0.032)	0.234*** (0.033)	0.181*** (0.034)	0.215*** (0.035)	0.277*** (0.035)	0.307*** (0.035)	0.275*** (0.032)	0.290*** (0.033)
Board of directors	0.233*** (0.027)	0.224*** (0.028)	0.260*** (0.028)	0.254*** (0.029)	0.277*** (0.029)	0.241*** (0.029)	0.210*** (0.027)	0.206*** (0.027)
Female Manager	-0.115*** (0.028)	-0.099*** (0.028)	-0.046 (0.028)	-0.020 (0.029)	-0.158*** (0.032)	-0.115*** (0.032)	-0.016 (0.028)	-0.003 (0.028)
Age of Firm	-0.001 (0.001)	-0.001 (0.001)	0.001 (0.001)	0.002* (0.001)	0.000 (0.001)	0.001* (0.001)	0.001 (0.001)	0.001 (0.001)
Affiliation	0.135*** (0.038)	0.141*** (0.038)	0.124*** (0.040)	0.134*** (0.040)	0.004 (0.040)	0.028 (0.040)	0.111*** (0.037)	0.112*** (0.038)
<b>Ref. Firms sell only on national Market</b>								
Firms sell only on international market	0.211*** (0.065)	0.152** (0.066)	0.072 (0.068)	0.022 (0.068)	0.102 (0.068)	0.123* (0.070)	0.064 (0.064)	0.055 (0.065)
Firms sell on national and international market	0.217*** (0.027)	0.200*** (0.028)	0.122*** (0.028)	0.120*** (0.029)	0.150*** (0.029)	0.188*** (0.030)	0.152*** (0.027)	0.149*** (0.028)
Trade Globalization		0.005*** (0.001)		0.002** (0.001)		-0.005*** (0.001)		0.002* (0.002)
Environmental Performance		-0.012*** (0.002)		-0.025*** (0.002)		-0.028*** (0.002)		-0.010*** (0.002)
<b>Ref. European Countries</b>								
No EU Countries	-0.130*** (0.025)	-0.142*** (0.038)	-0.012 (0.026)	-0.206*** (0.039)	0.235*** (0.027)	-0.191*** (0.043)	-0.174*** (0.025)	-0.236*** (0.038)
Candidate EU Countries	-0.100** (0.041)	-0.283*** (0.045)	-0.073* (0.043)	-0.235*** (0.046)	0.146*** (0.046)	-0.093* (0.050)	-0.304*** (0.041)	-0.365*** (0.045)
Constant	-0.220*** (0.042)	0.404** (0.152)	0.153*** (0.034)	1.993*** (0.180)	-1.106*** (0.037)	1.629*** (0.192)	-0.244*** (0.033)	0.431 (0.176)
Observations	13,277	13,086	13,244	13,039	13,124	12,936	13,288	13,092

Standard errors in parentheses \*\*\*p<0.01, \*\*p<0.05, \*p<0.10

## VI.

## CONCLUSION

The purpose of this study was to investigate the relationship between regulation and firms' environmental actions examining a panel of 25 Transition countries by using firm-level data drawn from the World Bank Enterprise Surveys.

Empirical results show that regulation, regardless of the specification considered, has a strong and positive impact on eco-actions. Results also highlight that firms with certain characteristics seem to be more involved in environmental compliance. Clearly, our empirical evidence should be interpreted taking into account some limitations. These concern mainly the generalizability of the results since our analysis is based on a survey carried out over a short period. In fact, we use cross-sectional data, so nothing can be stated on causality. Future research exploiting panel data could empirically examine the direction of causality. Nevertheless, some suggestions for policy makers can be drawn from our results. In this context, the proximity to EU countries and the external pressure seems to have triggered eco-strategies much more than firm characteristics. This is a significant result since it points out that the neighbor spillover effect is crucial in the Transition economies as well as complying with EU standards. Then, public decision makers play a key role in targeting those firms that are already achieving environmental standards and they should implement incentive mechanisms for the other ones. In order to provide more detailed suggestions for policy makers on planning actions, further research should be conducted at the sectoral level. This type of analysis would allow the study of the peculiarities of each sector and define more specific measures.

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## Appendix

**Table A1. List of countries and survey information**

Country	Period when survey was carried out
Albania	January and May 2019
Belarus	October 2018 and April 2019
Bosnia-Herzegovina	January and September 2019.
Bulgaria	January 2019 and March 2020
Croatia	November 2018 and November 2019
Czech Republic	December 2018 and March 2020
Estonia	November 2018 and January 2020
Georgia	March and January 2020
Hungary	December 2018 and March 2020
Kazakhstan	January and October of 2019
Kosovo	December 2018 and October 2019
Kyrgyzstan	December 2018 and July 2019.
Lithuania	December 2018 and January 2020
Latvia	November 2018 and December 2019
Moldova	April and November 2019
Montenegro	January and July 2019
North Macedonia	December 2018 and October 2019
Poland	December 2018 and December 2019
Russia	January and July 2019
Serbia	December 2018 and September 2019
Slovakia	December 2018 and March 2020
Slovenia	December 2018 and November 2019
Tajikistan	January and August 2019
Ukraine	March and December 2019
Uzbekistan	February and August 2019

**Table A2. Description of variables**

Variable	Description
<b>Eco-actions</b>	1 if firm, in the last three years, has introduced a eco-action, 0 otherwise
<b>Regulation</b>	Index that captures three types of regulation: (i) occupational safety regulations, (ii) health and hygiene regulations and finally (iii) environmental regulations.
<b>Manager Female</b>	1 if the firm has a top manager female, 0 otherwise
<b>Board Director</b>	1 if the firm have a board directors or supervisory board, 0 otherwise
<b>Firm Dimension</b>	
Small Firms	1 if a firm has $\geq 5$ and $\leq 19$ employees
Medium Firms	2 if a firm has $\geq 20$ and $\leq 99$ employees
Large Firms	3 if a firm has $\geq 100$ employees
<b>Sector activity</b>	
Manufacturing	1 if a firm is a part of manufacturing sector
Retail Services	2 if a firm is a part of retail services sector
Other Services	3 if a firm is a part of other services sector
<b>Firm's Age</b>	Difference between the current year and the year the firm registers to start the business activity
<b>Market Sales</b>	
More National Sales	1 if a firm, in the fiscal year, sold its products more in national market
National and International Sales	2 if a firm, in the fiscal year, sold its products both in national and international market
More International Sales	3 if a firm, in the fiscal year, sold its products more in international market
<b>Market Sales</b>	
More National Sales	1 if a firm, in the fiscal year, sold its products more in national market
National and International Sales	2 if a firm, in the fiscal year, sold its products both in national and international market
More International Sales	3 if a firm, in the fiscal year, sold its products more in international market
<b>Trade Globalization</b>	Trade Globalization Index Average 2016-2018
<b>Environmental Performance</b>	Environmental performance Index of 2016
<b>Country Regions</b>	
European Former-USSR Countries	1 for European Former-USSR Countries
Central European Countries	2 for Central European Countries
Former Yugoslavian Countries and Albania	3 for Former Yugoslavian Countries and Albania
Eurasian Former- USSR Countries	4 for Eurasian Former- USSR Countries
<b>European Union</b>	
Non-EU Countries	0 for non-EU countries
European Union Countries	1 for EU countries
Candidate EU Countries	2 for EU candidate countries

**Table A3. Marginal effect: Regulation and Eco-actions**

VARIABLES	(1) Eco-actions	(2) Eco-actions	(3) Eco-actions	(4) Eco-actions
Regulation	0.013*** (0.003)	0.013*** (0.003)	0.012*** (0.003)	0.012*** (0.003)
<b>Ref. Other Services</b>				
Manufacturing	0.024*** (0.008)	0.021*** (0.009)	0.035*** (0.009)	0.033*** (0.009)
Retail Services	-0.012 (0.243)	-0.010 (0.100)	-0.007 (0.010)	-0.008 (0.010)
<b>Ref: Small Firms</b>				
Medium Firms	0.034*** (0.008)	0.033*** (0.008)	0.038*** (0.008)	0.036*** (0.008)
Large Firms	0.052*** (0.010)	0.047*** (0.010)	0.062*** (0.011)	0.059*** (0.011)
Board of directors	0.094*** (0.009)	0.100*** (0.009)	0.092*** (0.009)	0.093*** (0.009)
Female Manager	-0.267*** (0.008)	-0.024*** (0.008)	-0.020** (0.008)	-0.021** (0.008)
Age of Firm	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Affiliation	0.035*** (0.013)	0.036*** (0.013)	0.036*** (0.013)	0.034*** (0.013)
<b>Ref. Firms sell only on national Market</b>				
Firms sell only on international market	0.019 (0.021)	0.021 (0.021)	-0.003 (0.021)	-0.003 (0.021)
Firms sell on national and international market	0.051*** (0.009)	0.058*** (0.009)	0.046*** (0.009)	0.051*** (0.009)
Trade Globalization			0.002*** (0.000)	0.003*** (0.000)
Environmental Performance			-0.006*** (0.001)	-0.004*** (0.001)
<b>Ref. European Union Countries</b>				
Non-EU Countries	-0.046*** (0.008)		-0.072*** (0.012)	
Candidate EU Countries	-0.062*** (0.013)		-0.097*** (0.014)	
<b>Ref. Central European Countries</b>				
European Former-USSR Countries		-0.036*** (0.009)		-0.011 (0.010)
Former Yugoslavian Countries and Albania		-0.031*** (0.011)		-0.048*** (0.012)
Eurasian Former- USSR Countries		-0.036*** (0.010)		0.011 (0.019)

Standard errors in parentheses \*\*\*p<0.01, \*\*p<0.05, \*p<0.10

**Table A4. Marginal effect: Interactions**

VARIABLES	(1) Eco-actions	(2) Eco-actions	(3) Eco-actions	(4) Eco-actions
Regulation	0.016*** (0.004)	0.011*** (0.004)	0.021*** (0.006)	0.012*** (0.003)
Board of Directors	0.093*** (0.009)			
Female Manager		-0.019** (0.008)		
Age of Firm			-0.000 (0.000)	
Non-Eu Countries				-0.183*** (0.023)
Candidate Eu Countries				-0.600*** (0.188)
Environmental Performance				
Board of Directors* Regulation	-0.019** (0.008)			
Female Manager*Regulation		0.006 (0.008)		
Firm's Age*Regulation			-0.000* (0.000)	
Non- Eu Countries* Neighboring Countries				0.178*** (0.031)
Candidate Eu Countries*Neighboring Countries				1.249** (0.494)

Standard errors in parentheses \*\*\*p<0.01, \*\*p<0.05, \*p<0.10

**Table 4. Marginal Effect: Effect of regulation on eco-action categories**

<b>VARIABLES</b>	(1) Machinery Upgrades	(2) Machinery Upgrades	(3) Energy Saving	(4) Energy Saving	(5) Pollution Control	(6) Pollution Control	(7) Recycling waste and water management	(8) Recycling waste and water management
Regulation	0.020*** (0.004)	0.020*** (0.004)	0.015*** (0.004)	0.015*** (0.004)	0.018*** (0.004)	0.018*** (0.004)	0.016*** (0.004)	0.015*** (0.004)
<b>Ref. Other Services</b>								
Manufacturing	0.078*** (0.010)	0.089*** (0.011)	0.057*** (0.010)	0.067*** (0.010)	0.049*** (0.009)	0.050*** (0.009)	0.090*** (0.010)	0.100*** (0.011)
Retail Services	-0.033* (0.013)	-0.029* (0.013)	0.040*** (0.012)	0.049*** (0.012)	-0.035*** (0.012)	-0.018 (0.012)	0.012 (0.013)	0.015 (0.013)
<b>Ref. Small Firms</b>								
Medium Firms	0.038*** (0.010)	0.040*** (0.013)	0.043*** (0.010)	0.048*** (0.010)	0.037*** (0.009)	0.042*** (0.009)	0.045*** (0.010)	0.045*** (0.010)
Large Firms	0.074*** (0.012)	0.029*** (0.013)	0.063*** (0.012)	0.075*** (0.012)	0.084*** (0.010)	0.091*** (0.009)	0.101*** (0.012)	0.107*** (0.012)
Board of Directors	0.089*** (0.010)	0.085*** (0.010)	0.091*** (0.010)	0.088*** (0.010)	0.074*** (0.009)	0.071*** (0.009)	0.072*** (0.010)	0.070*** (0.010)
Female Manager	-0.044*** (0.011)	-0.037*** (0.011)	-0.016 (0.010)	-0.007 (0.010)	-0.048*** (0.010)	-0.034*** (0.009)	-0.007 (0.010)	-0.004 (0.010)
Firm's Age	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	0.001* (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Affiliation	0.052*** (0.014)	0.054*** (0.014)	0.043*** (0.014)	0.046*** (0.014)	0.001 (0.012)	0.008 (0.012)	0.039*** (0.014)	0.039*** (0.014)
<b>Ref. Firms sell only on national Market</b>								
Firms sell only on international market	0.081*** (0.025)	0.057** (0.025)	0.025 (0.024)	0.008 (0.024)	0.031 (0.021)	0.036* (0.021)	0.025 (0.024)	0.013 (0.024)
Firms sell on national and international market	0.083*** (0.010)	0.075*** (0.010)	0.043*** (0.010)	0.042*** (0.010)	0.045*** (0.009)	0.056*** (0.009)	0.063*** (0.010)	0.058*** (0.010)
Trade Globalization		0.002*** (0.000)		0.001** (0.000)		-0.001*** (0.000)		0.002* (0.000)
Environmental Performance		-0.005*** (0.001)		-0.009*** (0.001)		-0.008*** (0.001)		-0.005*** (0.001)
<b>Ref. European Countries</b>								
No EU Countries	-0.050*** (0.010)	-0.054*** (0.014)	-0.004 (0.009)	-0.072*** (0.014)	0.071*** (0.008)	-0.057*** (0.013)	-0.161*** (0.009)	-0.162*** (0.014)
Candidate EU Countries	-0.088*** (0.016)	-0.108*** (0.017)	-0.026* (0.015)	-0.082*** (0.016)	0.044*** (0.014)	-0.027* (0.015)	-0.126*** (0.015)	-0.147*** (0.017)

Standard errors in parentheses \*\*\*p<0.01, \*\*p<0.05, \*p<0.10