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## **Green Waves and Investment Currents: Unraveling the Dynamic Linkage between Environmental Regulations and FDI Inflows<sup>1</sup>**

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Incoming foreign direct investments (FDI) are considered as a crucial driver of economic development, innovation, and infrastructure improvement. Creating favorable conditions and eliminating obstacles to FDI remain top priorities for governments worldwide. Critical FDI determinants incorporate cost competitiveness, market size, institutional quality, and proximity metrics – alongside emerging environmental considerations. In today's context, climate change and states' intentions to mitigate its adverse effects have the potential to shape the dynamics and composition of FDI streams. The research investigates the impact of environmental regulations on FDI inflow on a global scale. This study constructs databases with a panel structure containing statistics on developed and developing nations during the period of 2000–2020. The empirical investigation employs the dynamic common correlated effects (DCCE) and Driscoll – Kraay fixed effects standard error (D-K FE) approaches, enabling to control for cross-sectional dependency, heteroscedasticity, autocorrelation, and endogeneity problems. The empirical findings indicate that environmental regulation, when considered in isolation, may constrain FDI inflow. On the other hand, in economically advanced settings, regulation can signal institutional quality and market maturity, thereby enhancing investment appeal despite higher compliance costs. This evidence suggests that emerging countries trying to align foreign investment flows with environmental conservation efforts are at

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heightened risk. These nations must direct their efforts toward enhancing economic capacity and designing environmental regulations that can further boost it.

**Key words:** foreign direct investments (FDI); environmental regulation; environmental policy; pollution haven hypothesis (PHV); pollution halo hypothesis (PHL); Porter hypothesis, developed countries; developing countries.

**JEL Classification:** F21, O44, Q52.

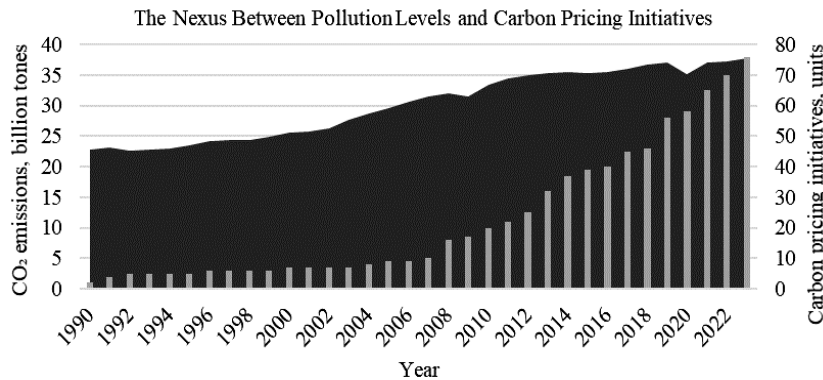
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## 1. Introduction

Foreign direct investment's (FDI's) spectacular growth is tightly associated with economic prosperity, innovation boost, and infrastructural upgrading of a host market. The manifestation of such positive externalities is driven by technology and knowledge transfer, as well as forward and backward linkages spillover effects [Silajdzic, Mehic, 2015; Haq, 2022; Sahoo, Dash, 2022]. Notwithstanding the negative consequences of intensive foreign investor penetration into the economy, the development of a supportive environment and the removal of FDI barriers are high on the agenda of many governments. The major determinants of foreign direct investment inflows encompass the cost of production inputs, size of the host market, and institutional framework of receiving economies [Osabuohien-Irabor, Drapkin, 2022; Lee et al., 2024]. In present-day world, environmental change and climate agenda turn into crucial factors influencing inward FDI.

The world has entered an era of high climate risks and unprecedented levels of pollution (fig. 1). The response of the world community to the current situation was the development of environmental policy and the unfolding of the global energy transition process. The pivotal process in environmental policy execution is the establishment of environmental regulation framework. The formation of global environmental policy initially involved the adoption of command-and-control measures. The 1980s saw market-based regulation instruments come into the spotlight [Xie et al., 2017; Li, Ramanathan, 2018]. Currently, the application of economic instruments is considered the most advanced practice.

Key turning points in the evolution of global environmental regulation include 1972, with the formulation of initial environmental policy principles at the UN Environment Conference; 1992, marked by the Earth Summit's introduction of sustainable development concept; and 1997 and 2015, which saw the Kyoto and Paris Accords stress the importance of worldwide environmental participation. As of 2023, 195 nations had become parties to the Paris Climate Agreement and almost 30% of the total CO<sub>2</sub> are covered by crucial economic instruments of environmental regulation (fig. 2). Initially the center of environmental policy buildup was developed world. Only during the 1980s developing nations became involved in devising their own environmental strategies – this phenomenon is connected with the environmental turmoil that countries are experiencing.



Notes: carbon pricing initiatives include emissions trading system, carbon tax, crediting mechanism.

**Fig. 1.** The dynamics of CO<sub>2</sub> emissions and the number of carbon pricing initiatives worldwide in 1990–2023

Source: compiled by the authors based on Global Carbon Budget (<https://globalcarbonbudget.org/gcb-2024/>) and Carbon Pricing Dashboard (<https://carbonpricingdashboard.worldbank.org/>).

On the one hand, the advancement of environmental policy and regulations is associated with switching to a low-carbon development track, spurring innovation activity, and positive reputational effects. On the other hand, this process involves a significant increase in costs, loss of competitiveness, slowing economic growth, and a red tape [Ahmed, 2020; Tian et al., 2020; Yirong, 2022]. The consequences of environmental policies on the economic and social dimensions of developed and developing nations differ significantly. Developed countries are more prone to experience positive effects from stricter environmental policies, owing to their ample resources, robust legislative system, and public willingness to accept extra environmental expenses. Meanwhile, developing countries are compelled to strike a balance between socio-economic efficiency and environmental conservation. In the context of assessing regulation's impact on FDI, the results can be diverse.

This research aims to empirically investigate the complex interrelations between environmental regulation and FDI inflow worldwide. Particular emphasis is placed on how a country's economic development shapes the impact of environmental regulation on incoming FDI.

The role of environmental regulation stringency for economies is scrutinized with the means of advanced econometrics modeling. What sets this study apart is, first, our modeling approach captures the effect of environmental regulation from multiple perspectives. Second, we utilize special methods that solve the problem of cross-sectional dependence affecting groups of countries, an issue that has been overlooked in previous literature. Finally, the study implements several approaches to reveal the role of economic development level in shaping the effects of environmental regulation. In particular, it estimates models on separate samples for developed and developing countries and introduces interaction terms.

The article is organized as follows: Section 2 discusses the existing literature on environmental regulation-inward FDI nexus and summarizes the possible pathways of interrelations; Section 3 formulates the empirical model and discusses econometric estimation processes; Section 4 provides empirical results; Section 5 debates key findings, policy implications, and limitations of the study.

## 2. Literature Review

The multidimensional relationships between environmental regulations and FDI flows can be scrutinized through the prism of three reputed theoretical concepts: the Pollution Haven Hypothesis (PHV), Porter's Hypothesis (PH), and Pollution Halo Hypothesis (PHL).

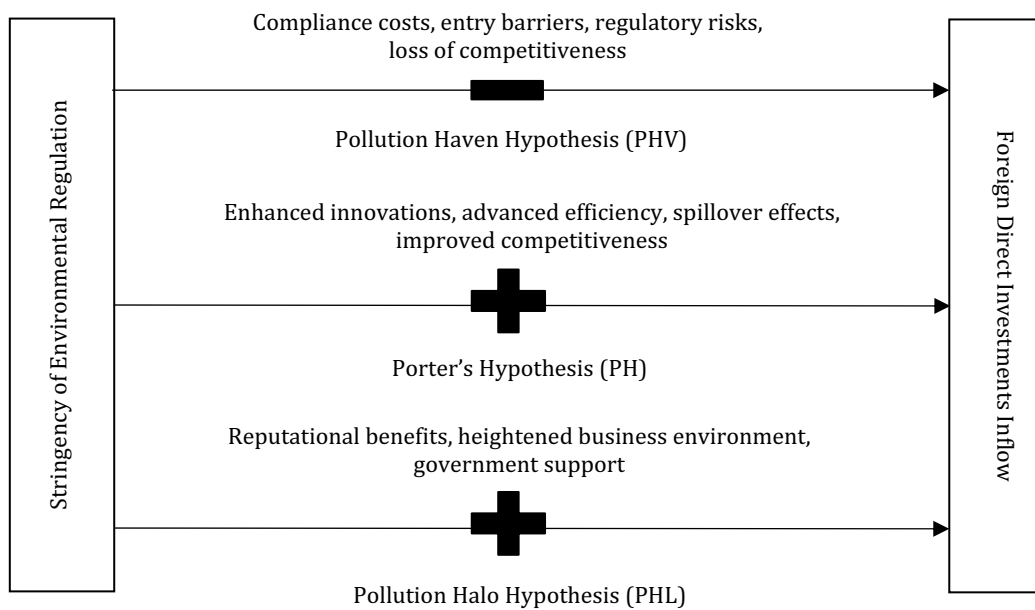
The Pollution Haven Hypothesis (PHV) implies that strict environmental policy negatively affects the competitiveness of enterprises inasmuch as they encounter additional compliance costs. Incremental environmental expenses prompt the production process transfer to countries or regions with less draconian ecological standards. Accordingly, areas with lax environmental regulations turn into the centers of FDI attraction, while active environmental policies in other regions are perceived by investors as an institutional barrier and important pre-entry condition [Doytch et al., 2025; Obani et al., 2025]. Copeland and Taylor (1994), Zhang and Fu (2008), Cai et al. (2016), Xu et al. (2016), Mulatu (2017), Cheng et al. (2018), Eldin and Elsayy (2018) and Hu et al. (2020) elicited that the difference in environmental standards between areas is a crucial factor for production redistribution. The studies by Xing and Kolsad (2002), Mihci et al. (2005), Dean et al. (2009) and Condliffe and Morgan (2008) demonstrated that the hypothesis is supported in the case of heavy polluting industries. Cole and Elliott (2005) uncovered that in order to effectively relocate production processes, a country should have not only more relaxed environmental regulations, but also extensive capital. In the modern literature there is a bundle of studies detecting no significant association between environmental policy stringency and FDI. For instance, Manderson and Kneller (2012) and Yoon and Heshmati (2021) concluded that environmental standards are not a crucial factor in FDI decision-making process. Dong et al. (2020) emphasized that government intentions to loosen environmental regulations with an eye on attracting FDI become less motivated in the context of transboundary pollution.

The Porter's Hypothesis (PH), as compared to PHV's static worldview, puts forward an idea that properly designed environmental regulations promote long-term companies' competitiveness. Porter and Linde (1995) have evinced that the introduction of environmental standards can act as a trigger for technological innovation and efficiency improvement. In a related context, there are "innovation offsets" enabling not merely to cover the compliance costs, but also to gain competitive advantages over firms that are not subject to environmental regulations. The innovations adoptions, driven by the environmental intentions of the state, in one sector are able to boost the productivity of other sectors owing to the spillover effects – this fact emerges an economy as the leading contender for attracting FDI [Zhang et al., 2019; Luo et al., 2023; Dou and Lee, 2024; Chen et al., 2025]. Fahad et al. (2022) and Guo et al. (2024) discerned a pronounced synergetic effect of environmental regulations on inward FDI. Qui et al. (2022) and Liu et al. (2024) also underscored that industrial upgrade animated by environmental policy stringency serves as a significant catalysis for FDI influx. Wang and Zhang (2022) defined that the most pronounced positive effect is observed for strategic emerging sectors. Jiang et al. (2025) uncovered a strong positive association, but income level and innovation potential play a crucial role in this case. Wang et al. (2022) reached the similar conclusion about the critical role of economic development.

In contrast to the Pollution Haven Hypothesis (PHV) denoting the degradation of the environment encouraged by weak environmental standards and subsequent FDI inflows, the Pollution Halo Hypothesis (PHL) suggests that the environmental quality improves with the advent of new investors [Tamazian et al., 2009; Hille et al., 2019; Ahmad et al., 2020; Kisswani, Zaitouni, 2023]. FDI is usually conducted by large and efficient companies that can transfer their advanced

and cleaner technologies to the host market. Besides, such companies are typically concerned about their reputation, including environmental matters. From this perspective, the strictness of environmental regulation falls by the wayside. And even the more sophisticated the regulation, the greater the reputational benefits a company can gain. Zhou and (2022), Gao et al. (2021), Luo et al. (2021), and Zheng et al. (2023) utilizing the example of Chinese economy, checked the relevance of PHL. Their analysis revealed that both inward FDI and environmental regulation have a beneficial effect on the environment. As regulation becomes stricter, the positive influence of FDI becomes more evident. The authors stressed the critical importance of focusing on the positive interplay between FDI and environmental regulation.

Based on the analyzed theoretical frameworks and empirical studies, channels connecting the stringency of environmental regulations and FDI inflow can be identified as follows (fig. 2).



**Fig. 2.** Pathways of environmental regulation severity's impact on FDI inflows under theoretical concepts

Source: compiled by the authors.

### 3. Methodology and data

The comprehensive interrelation between environmental regulation and FDI inflow is examined by applying econometrics modeling approach. The research question is addressed by building several panel databases for the period of 2000–2020 incorporating statistics on advanced and emerging economies. The analysis of the first empirical model incorporates both the aggregate sample and disaggregated samples for developed versus developing countries (eq. 1). The evaluation of the second model is carried out on the general country sample and involves the

use of interaction term variables signifying the synergistic impact of economic advancement and the stringency of environmental policies (eq. 2).

$$\begin{aligned}
 (1) \quad IIFDI_{it} &= \beta_0 + \beta_1 IGDP_{it} + \beta_2 UE_{it} + \beta_3 TO_{it} + \beta_4 LAW_{it} + \\
 &\quad + \beta_5 INT_{it} + \beta_6 LAIR_{it} + \beta_7 VI_{it} + \varepsilon_{it} \\
 (2) \quad IIFDI_{it} &= \beta_0 + \beta_1 UE_{it} + \beta_2 TO_{it} + \beta_3 LAW_{it} + \\
 &\quad + \beta_4 INT_{it} + \beta_5 LAIR_{it} + \beta_6 IT_{it} + \varepsilon_{it},
 \end{aligned}$$

where  $IIFDI_{it}$  indicates foreign direct investments inflow,  $IGDP_{it}$  stands for gross domestic product,  $UE_{it}$  signifies unemployment rate,  $TRADE_{it}$  is trade openness indicator,  $LAW_{it}$  designates the rule of law indicator,  $INT_{it}$  expresses the Internet use,  $LAIR_{it}$  is air transport infrastructure.  $VI_{it}$  represents the variable of interest, presupposing the incorporation of  $IETAX_{it}$  (environmental tax revenues),  $CPI_{it}$  (carbon price initiative),  $EPSI_{it}$  (environmental policy stringency index).  $IT_{it}$  is the interaction term including variables  $IGDP_{it} \times IETAX_{it}$  (the joint influence of economic development and environmental tax revenues),  $IGDP_{it} \times CPI_{it}$  (the joint influence of economic development and carbon pricing initiative),  $IGDP_{it} \times EPSI_{it}$  (the joint influence of economic development and environmental policy stringency index).  $\varepsilon_{it}$  refers to error term,  $i$  is individual observations and  $t$  is time period.

The variables of the empirical models and the data sources are presented in detail in table 1. The inflow of FDI per capita ( $IFDI_{it}$ ) is designated as the dependent variable of the empirical models. The indicator presented by the UNCTADstat reflects the amount of fresh investment entering the country's economy from foreign capital owners over a specific time period.

The set of control variables in the models is comprised of several groups: macroeconomic, institutional, and infrastructure factors. The macroeconomic situation in the country is depicted by GDP per capita ( $GDP_{it}$ ) and the level of unemployment ( $UE_{it}$ ). The income profile is seen as a pivotal factor in attracting international investors. High GDP often represents strong market potential, favorable institutional arrangements, and a developed business environment. The prevailing view is that there is an inverse association between unemployment rate and inward FDI. Low unemployment rates are indicative of an efficient labor market, a sizable skilled workforce, and social stability, while galloping unemployment levels signal serious structural challenges. Trade openness indicator ( $TO_{it}$ ) and the rule of law index ( $LAW_{it}$ ) constitute the institutional factors of the model.  $TO_{it}$  is computed as the total of exports and imports relative to GDP, serving as a gauge of a nation's involvement in the world economy and the intensity of foreign trade regulation. Liberalization of the host market's trade environment can be an indicator for investors of export possibilities and added value chain integration.  $LAW_{it}$ , in its turn, measures the public's trust in the domestic legal framework of the recipient economy. With this index rising, foreign investors experience reduced regulatory risks. Ultimately, the model incorporates the infrastructural element through the proportion of citizens using the Internet ( $INT_{it}$ ) and the volume of air travel ( $AIR_{it}$ ).  $INT_{it}$  serves as an indirect measure of the development of information and telecommunication technologies (ICT) in the country. A mature ICT infrastructure signifies automa-

tion capabilities, innovation capacity, robust information exchange, and transparent business operations. High air traffic volumes reflect the presence of solid logistics chains, export readiness, and the capacity to break down the production process.

In the models the rigor of environmental regulation in the host market is indicated by environmental tax revenues ( $ETAX_{it}$ ), the presence of carbon pricing schemes ( $CPI_{it}$ ), and environmental policy stringency index ( $EPSI_{it}$ ). The statistics on the tax revenues related to environmental protection is collected by OECDstat, and it incorporates energy, transportation, resource, and pollution taxes.  $CPI_{it}$  is a binary measure, with data provided by the World Bank. It indicates whether a country has implemented one of the following carbon regulation mechanisms in a certain period of time: carbon tax, emission trading systems (ETS), crediting mechanisms. The level of environmental tax revenues, coupled with the establishment of carbon pricing frameworks, demonstrates the degree of sophistication in a country's environmental governance and its commitment to market oriented regulatory approaches, which are regarded as hallmarks of mature environmental policy. A principal benefit of employing these variables lies in the capacity to substantially broaden the study's sample size and incorporate a greater number of developing nations. Moreover, these variables can be viewed as an effective way to address the problem of endogeneity. As a robustness check for the results obtained with the use of  $ETAX_{it}$  and  $CPI_{it}$  variables, the research additionally integrates the Environmental Policy Stringency Index ( $EPSI_{it}$ ), which is composed based on surveys of business leaders in OECD countries and some non-OECD nations. Empirical studies commonly employ this indicator since it captures multiple environmental regulatory mechanisms, delivering a holistic view of a country's environmental policy advancement.

**Table 1.****Data description and sources**

Variable	Description	Data source
<i>Dependent variable</i>		
$IFDI_{it}$	Foreign direct investments (FDI) inflow into country $i$ at time $t$ , current US dollars per capita	UNCTADstat
<i>Independent variables: control variables</i>		
$GDP_{it}$	Gross domestic product of country $i$ at time $t$ , current US dollars per capita	The World Bank
$UE_{it}$	Unemployment rate of country $i$ at time $t$ , % of the total workforce	The World Bank
$TO_{it}$	Trade openness indicator of country $i$ at time $t$ , % GDP	The World Bank
$LAW_{it}$	The rule of law indicator of country $i$ at time $t$ , -2,5-2,5	The World Bank
$INT_{it}$	People using the Internet in country $i$ at time $t$ , % of the total population	The World Bank
$AIR_{it}$	International and domestic flights operated by air carriers in country $i$ at time $t$ , number of flights per 1 million of population	The World Bank

Continuation

Variable	Description	Data source
<i>Independent variables: variables of interest</i>		
$ETAX_{it}$	Tax revenues related to environmental protection in country $i$ at time $t$ , current US dollars per capita	OECDstat
$CPI_{it}$	Carbon price initiative in country $i$ at time $t$ , 0–1 0 – country $i$ at time $t$ has no carbon price mechanism 1 – country $i$ at time $t$ has carbon price mechanism	The World Bank
$EPSI_{it}$	Environmental policy stringency index in country $i$ at time $t$ , 0–7	OECDstat

$i$  stands for individual countries,  $i = 1, 2, 3, \dots, 31$  (developed countries dataset) and  $i = 1, 2, 3, \dots, 73$  (developing countries dataset),  $i = 1, 2, 3, \dots, 546$  (developed countries dataset with  $EPSI_{it}$ ) and  $i = 1, 2, 3, \dots, 672$  (general dataset with  $EPSI_{it}$ )

$t$  denotes time period,  $t = 2000, 2001, 2002, \dots, 2020$

Source: compiled by the authors.

The empirical procedure of the research entails the following stages. The investigation starts with the representation of descriptive statistics and pre-estimation tests to check the unit root problem and the existence of cross-sectional dependence [Pesaran, 2004; Barbieri, 2009]. The second stage of the analysis involves estimation of empirical models employing dynamic common correlated effects (DCCE) and Driscoll – Kraay fixed effects standard errors (D-K FE) techniques.

Dynamic Common Correlated Effects (DCCE) approach proposed by Chudik and Pesaran (2015) emerges as one of the state-of-the-art methods to efficiently estimate the panel models. The method has a number of distinct advantages: the approach addresses cross-sectional dependence issue arising in most of the panel data due to common shocks, unobserved components, tight economic and financial integration across countries [Pesaran, 2006]; it provides robust estimations in the presence of structural breaks and solves heterogeneity problem [Kapetanios et al., 2006]; the approach is applicable for unbalanced datasets; it includes lagged values of the variables, which makes it suitable for analyzing dynamic processes [Ditzen, 2018].

To verify the robustness of the DCCE results, we estimate the empirical models with Driscoll – Kraay fixed effects standard errors (D-K FE). This approach address cross-sectional dependence, heteroscedasticity, and endogeneity issues in panel datasets [Driscoll, Kraay, 1998].

#### 4. Results and discussion

Descriptive statistics of the data is presented in table 2. It underpins several important conclusions: there is a vast heterogeneity across states; cross-sectional dependence issue is common for our dataset; model variables are integrated of different order (I(0) or I(1)). The pre-evaluation results highlight the necessity of employing specialized econometric methods that address cross-sectional dependence, diverse time series integration orders, heterogeneity, and data imbalance.

Table 2.

**Descriptive statistics, cross-sectional dependence  
and unit root test, correlation matrix**

Variable	$IIFDI_{it}$	$IGDP_{it}$	$UE_{it}$	$TO_{it}$	$LAW_{it}$	$INT_{it}$	$IAIR_{it}$	$IETAX_{it}$	$CPI_{it}$	$EPSI_{it}$
<i>Descriptive statistics</i>										
Mean	5.043	8.660	8.007	86.198	0.611	38.416	8.043	4.562	0.244	2.188
S.D.	2.319	1.461	2.231	54.153	0.308	30.668	2.253	4.658	0.430	1.131
Min	-11.288	4.952	0.172	10.969	0.010	0.000	-6.812	-82.694	0.000	0.000
Max	13.030	11.548	37.250	477.602	0.999	99.533	15.182	11.982	1.000	4.889
Skew.	-0.174	-0.159	1.636	2.693	-1.354	-1.303	0.212	-0.328	1.190	-0.196
Kurt.	2.182	-0.877	1.636	2.693	-0.230	0.307	0.883	1.913	-0.584	1.930
CD	73.240 <sup>b</sup>	205.260 <sup>b</sup>	15.020 <sup>b</sup>	21.130 <sup>b</sup>	0.850	215.690 <sup>b</sup>	39.090 <sup>b</sup>	62.670 <sup>b</sup>	-	78.610 <sup>b</sup>
UR	-3.111 <sup>b</sup>	-2.390 <sup>b</sup>	-1.363	-1.323	-1.425	-1.190	-1.690	-2.081 <sup>b</sup>	1.325	-2.110 <sup>b</sup>
<i>Correlation matrix</i>										
$IIFDI_{it}$	1.000									
$IGDP_{it}$	0.733 <sup>b</sup>	1.000								
$UE_{it}$	0.263 <sup>b</sup>	0.164 <sup>b</sup>	1.000							
$TO_{it}$	0.359 <sup>b</sup>	0.239 <sup>b</sup>	-0.002	1.000						
$LAW_{it}$	0.537 <sup>b</sup>	0.739 <sup>b</sup>	0.229 <sup>b</sup>	0.099 <sup>b</sup>	1.000					
$INT_{it}$	0.601 <sup>b</sup>	0.351 <sup>b</sup>	0.058 <sup>b</sup>	0.172 <sup>b</sup>	0.635 <sup>b</sup>	1.000				
$IAIR_{it}$	0.671 <sup>b</sup>	0.789 <sup>b</sup>	0.227 <sup>b</sup>	0.220 <sup>b</sup>	0.586 <sup>b</sup>	0.582 <sup>b</sup>	1.000			
$IETAX_{it}$	0.317 <sup>b</sup>	0.364 <sup>b</sup>	0.124 <sup>b</sup>	0.013	0.271 <sup>b</sup>	0.351 <sup>b</sup>	0.213 <sup>b</sup>	1.000		
$CPI_{it}$	0.419 <sup>b</sup>	0.632 <sup>b</sup>	0.063	0.072 <sup>b</sup>	0.506 <sup>b</sup>	0.674 <sup>b</sup>	0.416 <sup>b</sup>	0.287 <sup>b</sup>	1.000	
$EPSI_{it}$	0.190 <sup>b</sup>	0.536 <sup>b</sup>	-0.108 <sup>b</sup>	0.221 <sup>b</sup>	0.366 <sup>b</sup>	0.611 <sup>b</sup>	0.177 <sup>b</sup>	0.330 <sup>b</sup>	0.605 <sup>b</sup>	1.000

Notes: CD represents CD-statistics in cross-sectional dependency testing; UR signifies CIPS-statistics in unit root testing in the presence of cross-sectional dependency problem; b stands for the significance at 5% level.

Source: compiled by the authors.

This study examines the determinants of FDI inflows worldwide. Table 3 summarizes the results for developed and developing countries, highlighting the difference in the impact of environmental regulation across country groups.

The empirical findings display the positive significant association between economic welfare ( $GDP_{it}$ ), trade openness ( $TO_{it}$ ), transport infrastructure ( $AIR_{it}$ ) and incoming FDI ( $IIFDI_{it}$ ), irrespective of the country's level of development. Our study contributes to the existing growth-

led FDI literature and establishes a direct correlation between economic prosperity and the inflow of investments. The findings can be viewed through the prism of the electric paradigm. This means that FDI is more inclined to target large, fast-growing markets and those offering access to particular resources [Dunning, Zhang, 2008]. Our empirical evidence on the role of GDP aligns with the results obtained by Greenaway et al. (2007), Ullah and Khan (2017), and Ghazalian (2024). Furthermore, that the more a country is open to trade, the greater its ability to attract FDI. The vigorous engagement in export-import activities in a country may signal the market's appeal as an export platform or a node in the value-added chain. The low quotas and tariffs on international trade operations imply reduced operational expenses for firms investing in the country through FDI. Such trade liberalization facilitates the avoidance of sanctions and restrictions applied to the FDI-sending nation. The empirical evidence concerning the effect of trade openness on FDI inflows corresponds with the findings of other researchers, namely Ho and Rashid (2011) and Albahouth and Tahir (2024). Finally, the role of air transport is tightly associated with the international trade development and advanced business environment. The investigation by Bassem (2025) demonstrated the similar outcome.

**Table 3.**  
**Impact of environmental tax revenues on FDI inflow: general sample, developed and developing countries**

Variable	Developed countries		Developing countries		General sample	
	DCCE	D-K FE	DCCE	D-K FE	DCCE	D-K FE
$lGDP_{it}$	2.114 <sup>a</sup> (0.816)	1.114 <sup>a</sup> (0.191)	1.723 <sup>a</sup> (0.337)	0.893 <sup>a</sup> (0.008)	1.953 <sup>a</sup> (0.315)	1.458 <sup>a</sup> (0.108)
$UE_{it}$	-0.221 (0.041)	-0.012 (0.011)	-0.092 (0.139)	0.037 <sup>b</sup> (0.011)	-0.070 (0.092)	0.011 (0.015)
$TO_{it}$	0.036 <sup>a</sup> (0.112)	0.002 <sup>c</sup> (0.003)	0.024 <sup>a</sup> (0.007)	0.006 <sup>a</sup> (0.000)	0.033 <sup>a</sup> (0.006)	0.001 <sup>a</sup> (0.000)
$LAW_{it}$	-6.806 (5.939)	-0.344 (0.488)	-1.899 (5.079)	0.076 (0.218)	-4.883 <sup>c</sup> (2.571)	0.265 (0.265)
$INT_{it}$	-0.011 (0.007)	-0.006 (0.004)	-0.027 <sup>b</sup> (0.011)	0.004 (0.003)	-0.025 <sup>a</sup> (0.008)	-0.011 <sup>b</sup> (0.002)
$LAIR_{it}$	0.613 (0.417)	0.112 (0.066)	0.029 (0.127)	0.168 <sup>a</sup> (0.051)	-0.022 (0.133)	0.070 <sup>c</sup> (0.034)
$lETAX_{it}$	-1.076 <sup>a</sup> (0.769)	-0.012 <sup>a</sup> (0.103)	0.228 (0.276)	0.011 (0.008)	-0.292 (0.426)	0.025 (0.070)
Const	-	-4.636 <sup>b</sup> (2.035)	-	-4.865 <sup>a</sup> (0.574)	-	-6.969 <sup>a</sup> (0.940)
R <sup>2</sup>	0.460	0.113	0.543	0.253	0.430	0.237
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
Obs	651	651	1134	1134	1764	1764

Notes: a – significance at 1%, 5%, 10% levels; b – significance at 5% and 10% levels; c – significance at 10%; standard errors are shown in parentheses.

Source: compiled by the authors.

The advancement of ICT infrastructure ( $INT_{it}$ ) and the rule of law ( $LAW_{it}$ ) have an inverse correlation with FDI inflows in both developed and developing nations. The obtained result regarding the role of the Internet and other telecommunication technologies contradicts the hypothesis proposed for this variable of the model. This relationship can be interpreted as follows: the more developed the market is in terms of digital technologies, the more competitive and independent local companies become, which acts as a barrier to FDI; a high level of digitalization in a country may indicate the degradation of the real economy sector; the advanced state of ICT infrastructure suggests a potentially more regulated environment in the host market. Based on other investigations, the positive impact of ICT on FDI is most frequently observed in the service sectors [Yin, Choi, 2021; Mensah, Traore, 2024]. The assumption of our research that a well-developed legal environment attracts FDI by enhancing business transparency has not been borne out. The data reveals that higher rule of law indices are associated with reduced FDI inflows, affecting both developed and developing states. A highly evolved regulatory framework may correlate with slower decision-making, bureaucratic red tape, extra costs, and political conservatism. In this particular context, countries with either low or moderate levels of rule of law might be more attractive to foreign investors. This finding has also been documented in modern literature [Kim, Ryu, 2023].

The baseline empirical model depicts the role of environmental regulation via environmental taxation ( $ETAX_{it}$ ). According to the results, the effect of environmental regulation is heterogeneous for developed and developing countries: for advanced states it is significant and negative, while for emerging economies it is insignificant.

The evaluation results of the model controlling for the role of environmental regulation using dummy variable for carbon pricing initiative ( $CPI_{it}$ ) are displayed in table 4. Using the derived coefficients and their significance, we validate the relevance of the results in table 3. Whereas in developing countries, the presence of a carbon pricing initiative has no significant impact, in developed countries, the implementation of at least one such economic regulatory tool substantially reduces FDI influx.

Table 4.

**Impact of carbon pricing initiative on FDI inflow:  
general sample, developed and developing countries**

Variable	Developed countries		Developing countries		General sample	
	DCCE	D-K FE	DCCE	D-K FE	DCCE	D-K FE
$IGDP_{it}$	1.036 <sup>b</sup> (0.444)	1.095 <sup>a</sup> (0.184)	1.967 <sup>a</sup> (0.275)	1.481 <sup>a</sup> (0.151)	1.661 <sup>a</sup> (0.240)	1.422 <sup>a</sup> (0.153)
$UE_{it}$	-0.054 (0.052)	-0.013 (0.013)	-0.022 (0.080)	0.025 (0.016)	-0.038 (0.056)	0.014 (0.015)
$TO_{it}$	0.036 <sup>a</sup> (0.107)	-0.003 (0.003)	0.017 <sup>a</sup> (0.006)	0.002 (0.001)	0.023 <sup>a</sup> (0.005)	0.001 (0.001)
$LAW_{it}$	-7.860 (5.245)	-0.409 (0.793)	-4.024 (4.982)	0.659 <sup>c</sup> (0.336)	-2.147 (1.573)	0.560 <sup>c</sup> (0.279)
$INT_{it}$	-0.010 (0.007)	-0.007 <sup>c</sup> (0.003)	-0.028 <sup>a</sup> (0.009)	-0.010 <sup>c</sup> (0.004)	-0.239 <sup>a</sup> (0.006)	-0.010 <sup>a</sup> (0.003)

Continuation

Variable	Developed countries		Developing countries		General sample	
	DCCE	D-K FE	DCCE	D-K FE	DCCE	D-K FE
$LAIR_{it}$	0.507 (0.758)	0.110 <sup>b</sup> (0.050)	0.848 (0.133)	-0.065 (0.043)	-0.025 (0.103)	-0.033 (0.037)
$CPI_{it}$	-0.217 <sup>c</sup> (0.136)	-0.079 <sup>a</sup> (0.119)	0.190 (0.185)	-0.182 (0.176)	0.199 (0.130)	-0.054 (0.124)
Const	-	-4.420 <sup>b</sup> (1.857)	-	-7.263 <sup>a</sup> (1.076)	-	-7.075 <sup>a</sup> (1.198)
R <sup>2</sup>	0.460	0.113	0.350	0.270	0.420	0.230
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
Obs	651	651	1134	1134	1764	1764

Notes: a – significance at 1%, 5%, 10% levels; b – significance at 5% and 10% levels, c – significance at 10%; standard errors are shown in parentheses.

Source: compiled by the authors.

When representing the variable of interest via a comprehensive environmental policy stringency index ( $EPSI_{it}$ ), a significant negative effect is observed for the full sample as well as for the subsample of developed countries (table 5).

Table 5.

**Impact of environmental policy stringency on FDI inflow:  
general sample and developed countries**

	Developed countries		General sample	
	DCCE	D-K FE	DCCE	D-K FE
$IGDP_{it}$	1.018 <sup>c</sup> (0.595)	1.193 <sup>b</sup> (0.232)	0.954 <sup>c</sup> (0.507)	1.479 <sup>a</sup> (0.222)
$UE_{it}$	-0.092 (0.047)	0.001 (0.014)	-0.302 (0.632)	0.006 (0.015)
$TO_{it}$	0.038 <sup>a</sup> (0.012)	-0.002 (0.004)	0.035 <sup>a</sup> (0.009)	-0.004 (0.005)
$LAW_{it}$	-10.026 (7.653)	-0.432 (0.679)	-8.177 (6.873)	-0.372 (0.474)
$INT_{it}$	-0.001 (0.008)	-0.003 (0.004)	-0.013 <sup>c</sup> (0.007)	-0.005 (0.004)
$LAIR_{it}$	0.575 (0.877)	0.111 <sup>c</sup> (0.062)	-0.174 (0.346)	0.094 (0.063)
$EPSI_{it}$	-0.249 <sup>c</sup> (0.232)	-0.208 <sup>b</sup> (0.096)	-0.191 (0.023)	-0.263 <sup>b</sup> (0.099)
Const	-	-5.441 <sup>c</sup> (2.775)	-	-7.896 <sup>a</sup> (2.144)
R <sup>2</sup>	0.460	0.100	0.410	0.192
Prob > F	0.000	0.000	0.000	0.000
Obs	546	546	672	672

The authors further investigate how economic development influences the impact of environmental regulation on foreign direct investment (FDI) inflows through the inclusion of interaction terms ( $IGDP_{it} \times IETAX_{it}$ ,  $IGDP_{it} \times CPI_{it}$ ,  $IGDP_{it} \times EPSI_{it}$ ). Empirical findings show that interaction terms have a positive impact on FDI when considering the general sample (table 6). This suggests that both higher GDP per capita and improved environmental regulation contribute to increased FDI inflows, and their combined influence is especially pronounced.

Individual estimation results of the DCCE method reveal a strong positive effect of interaction terms in the case of Australia, Bulgaria, Croatia, Estonia, Spain, Sweden, United States, China, Chile, Turkiye, Indonesia, and Russia. These economies are major manufacturing hubs with large markets. In such economies, the costs of compliance with regulations are spread over a large volume of production, making them acceptable to foreign investors. The development of environmental regulation in such markets can signal positive reputational benefits for investors. Moreover, the development of environmental regulation is imposed on an already relatively advanced institutional environment. A negative impact of interaction terms is observed for Denmark, Finland, Slovakia, Iceland, Armenia, Bolivia, India, and Malaysia. Some of these countries represent fast-growing economies with substantial manufacturing capacity. Yet they suffer from poor infrastructure and weak institutional frameworks. The aforementioned countries – Denmark, Finland, Slovakia, and Iceland – exhibit a very high degree of environmental regulatory development. Furthermore, their foreign investment policies are not particularly democratic.

Table 6.

**Impact of environmental tax revenues, carbon pricing initiative,  
environmental policy stringency on FDI inflow:  
the joint effect of development level and environmental regulation**

Variable	Environmental tax revenues		Carbon pricing initiative		Environmental policy stringency	
	DCCE	D-K FE	DCCE	D-K FE	DCCE	D-K FE
$UE_{it}$	-0.096 (0.087)	0.025 (0.019)	0.086 <sup>c</sup> (0.049)	-0.030 (0.019)	-0.005 (0.069)	-0.029 <sup>b</sup> (0.055)
$TO_{it}$	0.027 <sup>a</sup> (0.006)	0.001 (0.001)	0.028 <sup>a</sup> (0.009)	-0.001 (0.006)	0.025 <sup>b</sup> (0.011)	-0.004 (0.006)
$LAW_{it}$	-2.402 (1.839)	0.979 <sup>c</sup> (0.550)	-4.198 (3.313)	1.625 <sup>c</sup> (0.566)	-4.387 (4.212)	0.556 (0.522)
$INT_{it}$	-0.025 <sup>a</sup> (0.009)	-0.010 <sup>b</sup> (0.004)	-0.021 <sup>b</sup> (0.007)	-0.007 <sup>b</sup> (0.001)	-0.017 <sup>a</sup> (0.006)	0.001 (0.004)
$LAIR_{it}$	-0.117 (0.109)	0.071 <sup>c</sup> (0.036)	-0.101 (0.146)	0.066 (0.081)	0.209 (0.236)	0.152 (0.101)
$IGDP_{it} \times IETAX_{it}$	0.749 <sup>a</sup> (0.209)	0.048 <sup>a</sup> (0.007)	-	-	-	-
$IGDP_{it} \times CPI_{it}$	-	-	1.156 <sup>b</sup> (0.482)	0.097 (0.073)	-	-
$IGDP_{it} \times EPSI_{it}$	-	-	-	-	0.377 <sup>c</sup> (0.219)	0.307 (0.055)

Continuation

Variable	Environmental tax revenues		Carbon pricing initiative		Environmental policy stringency	
	DCCE	D-K FE	DCCE	D-K FE	DCCE	D-K FE
Const	-	2.954 (1.352)	-	3.165 (1.976)	-	1.582 (1.422)
R <sup>2</sup>	0.410	0.100	0.310	0.100	0.450	0.110
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
Obs	1764	1764	1764	1764	672	672

## 5. Conclusion

FDI captures the interest of government officials owing to its positive influences on the host economy, including technology and knowledge transfer, increased demand for domestic products, infrastructure development, and broader tax base.

The ongoing climate crisis and the subsequent activation of climate agenda have led to a revision of the list of key determinants of incoming FDI. As hypothesized by PHV, the level of environmental regulation sophistication in the recipient country emerges as a pivotal factor in FDI location choice. Because foreign investors are unwilling to bear extra costs related to environmental protection FDI is redirected to countries with lax environmental policies. The response to the PHV worldview involved the conceptual development of PH and PHL. From the perspective of PH, strict environmental regulation is seen as advantageous, capable of boosting the economy's efficiency and innovation. Meanwhile, from the standpoint of the PHL, a market with rigorous regulation can be attractive owing to reputation advantages and a more reliable regulatory setting.

Utilizing recent macroeconomic data and advanced econometrics approach, this research empirically assesses how environmental regulation impacts the inward FDI worldwide.

The application of DCCE and D-K FE techniques proves that environmental regulation affects inward FDI in a non-uniform manner. Incorporating environmental regulation as an independent variable in the empirical models, the research finds a statistically significant negative impact in developed countries, while the effect remains insignificant in developing economies and for general sample. Nevertheless, by analyzing environmental regulation effects in relation to economic development levels, via incorporating interaction variables in the models, the present work confirms a positive impact. Advancing environmental regulation within a country might be interpreted by investors as another obstacle to entering the market. Nevertheless, economic development in a country, which signifies greater production potential, sophisticated infrastructure, enhanced innovative potential, and reliable institutional framework, is capable of neutralizing the adverse impacts of introducing environmental regulations. The evidence suggests that adopting environmental regulations may present the most significant hurdle for emerging markets striving to balance FDI inflows with ecological safeguards.

In order to achieve a positive impact of environmental regulation on FDI, governments need to prioritize the design of policies and regulations that foster innovation, improve efficiency, and

facilitate collaboration with foreign investors. Initially, the environmental policy should be structured around explicit, detailed, realistic, but nonetheless ambitious environmental aims. The targets should be defined to enable the dynamic advancement of environmental policy. Today's world favors market-based tools as the primary mechanisms of environmental policy, as they are capable of delivering both flexibility and economic efficiency. The most productive performance of economic regulation tools is achieved in conjunction with information tools and a robust monitoring process. Environmental regulation must strike a balance between its costliness and the economic efficiency of enterprises. The high compliance costs and significant administrative risks of non-compliance are integral to a policy that will incentivize companies to innovate. It is noteworthy that costs should increase over time, making regulation stricter. Moreover, the emergence of the "innovation offset" effect is possible only in the presence of a competitive environment and a well-developed R&D infrastructure. Trade opening up and international environmental cooperation both can make substantial contributions.

In shaping environmental policy, a particular focus must be placed on its synergy with FDI to attain both economic growth and environmental objectives. A well-crafted environmental policy can inherently attract high-quality FDI, but this alone might not be adequate, but it may not be enough on its own. In parallel, measures should be taken to improve the investment climate through institutional restructuring, introduction of preferences and specialized industrial zones, as well as increasing the skill level of the workforce.

Future research could explore whether the link between environmental regulation stringency and FDI changes with the share of manufacturing or polluting industries in a nation's GDP. This would indirectly verify if economies heavily reliant on polluting sectors are more prone to the PHV effect. However, this analysis faces methodological hurdles in identifying a universal, comparable metric that fully captures a country's structural susceptibility to PHV across diverse economies. An alternative could be subsample analysis, grouping countries by their vulnerability to PHV. This structural-economy-type approach, rather than focusing on individual sectors, offers a promising direction for future studies, helping to account for sectoral nuances despite data constraints

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## Строгость экологического регулирования и потоки прямых иностранных инвестиций: эмпирический анализ динамической взаимосвязи

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Прямые иностранные инвестиции (ПИИ) выступают одним из ключевых двигателей экономического прогресса, инновационного развития и модернизации инфраструктуры. Формирование благоприятного инвестиционного климата и устранение барьеров для притока ПИИ – это приоритетные задачи правительств большинства стран. Среди важнейших факторов, определяющих приток ПИИ, выделяют стоимость производственных ресурсов, размер рынка, качество институтов и географическую близость – при этом все большее значение приобретают экологические факторы. В современном контексте климатические изменения и намерения стран по смягчению их негативных последствий могут определять характер и структуру инвестиционных потоков. Данное исследование посвящено изучению воздействия экологического регулирования на приток ПИИ. В рамках исследования формируются базы данных с панельной структурой за период 2000–2020 гг. Эмпирическое исследование использует методы динамических общих коррелированных эффектов (DCCE) и фиксированных эффектов Дрисколла – Края (D-K FE). Эмпирические результаты демонстрируют, что экологическое регулирование, рассматриваемое изолированно, может ограничивать приток ПИИ. Тем не менее в условиях высокого уровня экономического развития экологическое регулирование способно сигнализировать о качестве институтов и зрелости рынка, тем самым повышая инвестиционную привлекательность несмотря на более высокие издержки на соблюдение природоохранных норм. Полученные результаты свидетельствуют, что развивающиеся страны, балансирующие между привлечением ПИИ и защитой окружающей среды, подвергаются повышенному риску. Данным странам необходимо сосредоточить усилия на наращивании экономического потенциала и разработке экологической политики и регулирования, способной дополнительно стимулировать его рост.

**Ключевые слова:** прямые иностранные инвестиции (ПИИ); экологическое регулирование; экологическая политика; гипотеза «убежища для загрязнений»; гипотеза «ореола загрязнений»; гипотеза Портера; развитые страны; развивающиеся страны.