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On the Asymmetry of the Nexus between Governance and Environmental Pollution

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ABSTRACT

Governance has attracted the attention of researchers as a multifaceted and effective variable in the economic performance of countries during last three decades. On the other hand, with the intensification of environmental concerns of governments, the analysis of the relationship between governance and the worsening of environmental sustainability indicators, such as the volume of pollutant emissions, has also become one of the study primacies of environmental economists. The present study aimed to investigate the aforesaid relationship for a group of developing and developed countries for the period 1990 to 2020. To this end, the Nonlinear Autoregressive Distributed Lag model based on panel data was used, which permits examination of the existence of non-linear relationships between variables. Main results show asymmetry in the magnitude of the effects of governance indicators on carbon dioxide emissions in developed and developing countries as the coefficient of the positive shock to economic governance for developed countries (0.52) is almost twice that of developing nations (0.27). We found that economic governance enhancement has a stronger impact on reducing environmental pollution and thus protecting the environment.

Keywords: Governance, Environment, Nonlinear Autoregressive Distributed Lag, Emission, Developing Countries, Developed Countries
JEL Classifications: C13, Q53

1. INTRODUCTION

Throughout recent decades, industrial development has brought about serious damages to the environment. These can commonly be considered a result of a mixture of factors such as population growth, economic growth, energy consumption, and industrial and agricultural activities. Using numerous chemical fertilizers and pesticides in agricultural fields has caused the environment to become a victim of society's need to provide food for the growing population. Chemical gases such as various nitrogen oxides, carbon monoxide, fine suspended particles, and sulfur dioxide caused by industrial activities have had significant destructive effects on the environment (Aryabod et al., 2020).

In recent years, most of the world's countries have faced serious environmental problems such as soil erosion, air pollution, and biodiversity loss, so that a vast part of the world's natural resources, particularly in the second half of the last century, has devastated in favor of economic growth and development. Over the past few decades, good governance has become a significant issue in planning and policymaking. One of the key reasons for this fact is the important role of governments in promoting sustainable development and environmental protection. Consequently, assessing the effect of governance on environment seems to be interesting for both economists and policymakers (Payaesteh et al., 2019).

Regarding the lack of a market for environmental goods (air, green space, etc.), the price mechanism has become an impracticable tool to adjust and make these markets efficient. Consequently, it is not surprising that the pursuit of personal interests leads to the destruction of the environment. So, governments can reduce

pollution by pricing resources, estimating the environmental costs of economic activities, and using legal tools (Hall, 2017).

Environment destruction, whether in the form of pollution or extreme use of natural resources, is a phenomenon that is not limited to some countries and geographical borders. It exists throughout the world, although with different degrees. It has led (will lead) to significant impacts on the health and quality of life of current (future generations) (Aryabod et al., 2020). To face this unpleasant phenomenon, every country needs to design and implement suitable environmental policies not only for the protection of its citizens but also for the neighboring nations. Accordingly, one of the inevitable duties of governments is environmental quality management (Esty and Porter, 2002, Apostoaie and Maxim, 2017).

By adopting numerous economic, political, cultural, etc. policies and in the form of an index called governance, governments affect the environment and cause its protection or deterioration and destruction. So, recognizing how governance affects environmental pollution can help to revise destructive policies and eventually lay the context for preserving these resources.

Formerly, some studies have been done on the relationship between governance and the environment. Aryabod et al. (2020) comparatively studied the influence of governance indicators including the rule of law, corruption control, efficiency and effectiveness of the government, quality of laws, accountability and political stability on production and total factors productivity in the agricultural sector in a group of developing and developed countries during the period 2000–2013 using panel econometric models. The results revealed that governance indicators have a negative effect on the value of agricultural products and the total factors productivity in developing countries, and this effect is positive in the group of OECD countries. Among the six indicators of good governance, corruption control with an elasticity value of -0.079 in the group of developing countries and the rule of law with an elasticity value of 0.075 in the group of OECD countries have the highest impact on the value of agricultural production.

Payesteh et al. (2019) stated that in recent decades, the topic of "good governance" has attracted the attention of many scientific societies. Each researcher has defined good governance with diverse dimensions and goals. The diversity of viewpoints regarding good governance has caused the complexity of explaining the relevant criteria and indicators. Misperception regarding the selection of good governance criteria, particularly in the field of natural resources, has become a major problem for researchers. The main reason for creating this challenge is the possession of natural resources from two natural and social dimensions. The opposition of these two dimensions increases the lack of integration, lack of stakeholder participation, and lack of management perspectives in the field of natural resources.

Arab Asadi (2020) stated that climate change as one of the major environmental crises has, directly and indirectly, threatened and damaged human life all over the planet. Stating increasing concern about the consequences and risks caused by such crises has caused international environmental law to emphasize the need for coordinated action, participation, and consensus of all international actors to overcome such problems. New legal concepts and doctrines have each tried to play a role in the global protection of the environment. In this study, via a new approach to the basic principles of international environmental law and how they interact under the concept of "common human concerns"; the tasks of the international community in terms of obligations as well as the role and obligations of governments and other international actors to face common environmental concerns are considered.

Khani and Houshmand (2018) indicated that financial development can reduce environmental pollutants. Though some others believe that financial development increases greenhouse gas emissions through industrial growth. This study considered the effect of financial development and good governance on environmental pollution in 16 selected oil-exporting countries during the period 1996–2014 using the panel data econometrics method. Main results reveal that financial development and good governance have a negative effect on environmental pollution in the sample countries.

Simionescu et al. (2018) considered the role of governance quality in reducing pollution in Romania. In this study, the Autoregressive Distributed Lag model (ARDL) and nonparametric Bayesian estimates were used. The authors indicate that attaining the goals of global sustainability and green growth creates a challenge for all countries, particularly developing ones. The quality of the institutional framework and laws of a country and their effectiveness determine the level of environmental control and sustainability. Since reducing pollution is a goal for European environmental policies, Romania must attain this goal by considering the quality of governance. In this study, the impact of governance indicators on greenhouse gas emissions in Romania during the years 1996–2019 has also been evaluated. The results reveal that corruption control and political stability will reduce pollution in the long term. Likewise, the consumption of renewable energy during the years 1996–2019 has not reduced pollution, while the analysis conducted for the years 2007–2019 confirmed the effect of renewable energy consumption in reducing pollution.

Ronaghi et al. (2020) via time series data, disclosed that governance reduced greenhouse gas emissions in OPEC countries during the period 2006–2015. On the other hand, the quality of governance increased carbon emissions in Saudi Arabia from 1996 to 2016.

Omri et al. (2021) recognized a non-linear relationship between carbon dioxide emissions and corruption control. This study was conducted in 125 countries during the period 1991–2011. Other results revealed that there was no significant relationship between other dimensions of governance (rule of law, regulatory quality, and government effectiveness) and environmental pollution.

Baloch and Wang (2019) also examined the effect of governance on carbon dioxide emissions in BRICS member countries (Brazil, Russia, India, China, and South Africa) in the period 1996 to 2017. Panel data and cointegration tests were used in this study. The most significant findings of this study designate the effect of governments' attitudes towards the design and implementation of correct and effective regulations and policies to control environmental degradation.

2. MATERIALS AND METHODS

Since in this study, the Nonlinear Autoregressive Distributed Lags (NARDL) model was used to investigate the relationship between governance and the emission of carbon dioxide, as the main pollutant of the environment, so in this section the above model is explained and then the research variables and relevant information collection sources are introduced.

The NARDL model presented by Shin and Greenwood-Nimmo (2014) is an asymmetric mode of the Autoregressive Distributive lags (ARDL) model, which is used to investigate non-linear and asymmetric relationships between economic variables in the short-term and long-term. They disclosed that the NARDL model, like the ARDL method, has advantages over other methods of testing long-term and short-term relationships between variables. First, these tests can be applied irrespective of whether the variables of the model are nonstationary or stationary or mutually cointegrated. Similarly, this method does not include short-term dynamics in the error correction component. Moreover, this method can be used with a small number of observations. Another benefit of this model is its applicability even in the presence of endogenous explanatory variables.

The basis of the NARDL model with two variables can be seen in the following relationship:

$$y_t = \beta^+ x_t^+ + \beta^- x_t^- + u_t \tag{1}$$

where xt and yt are vector of variables integrated of first order or I(1) and the changes of xt are divided into two positive (increase) and negative (decrease) parts according to Equation 2.

$$\begin{aligned} x_t &= x_0 + x_t^+ + x_t^- \\ x_t^+ &= \sum_{j=1}^{t} \Delta x_j^+ = Max(\Delta x_j, 0) \\ x_t^- &= \sum_{j=1}^{t} \Delta x_j^- = Min(\Delta x_j, 0) \end{aligned} \tag{2}$$

Now, the cointegrated linear combination of positive and negative cumulative components of the variables can be defined as follows:

$$z_t = \beta_0^+ y_t^+ + \beta_0^- y_t^- + \beta_1^+ x_t^+ + \beta_1^- x_t^- \tag{3}$$

If zt is integrated of order zero (stationary), then it is said that xt and yt are asymmetrically cointegrated. If $\beta_0^+ = \beta_0^-$ and $\beta_1^+ = \beta_1^-$, then the cointegration will be symmetric (Im et al. 2003).

Now, considering how to separate the positive and negative impulses of the variable x in the form of the relation $x_t = x_0 + x_t^+ + x_t^-$ and entering it into an ARDL (p,q) model, the NARDL (p,q) can be written in the following form:

$$y_t = \sum_{j=1}^{p} \varphi_j y_{t-j} + \sum_{j=1}^{q} \left(\theta_j^+ x_{t-j}^+ + \theta_j^- x_{t-j}^- \right) + \varepsilon_t \tag{4}$$

where p and q are the optimum lag lengths, ϕj is the coefficient of the lagged dependent variable, θ_j^+ and θ_j^- are the asymmetric coefficients of the lagged positive and negative impulses of the explanatory variable, and ε_t is the disturbance term with zero mean and constant variance.

A short-term error correction pattern can be attributed to each long-term relationship in the ARDL (p,q) model, which shows how to correct short-term disequilibriums. Accordingly, in the NARDL model, the error correction pattern is clarified as follows:

$$\begin{aligned} \Delta y_t &= \rho y_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + \\ &\sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=0}^{q-1} (\upsilon_j^+ \Delta x_{t-j}^+ + \upsilon_j^- \Delta x_{t-j}^-) + \varepsilon_t \\ &= \rho \xi_{t-1} + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=0}^{q-1} \left(\upsilon_j^+ \Delta x_{t-j}^+ + \upsilon_j^- \Delta x_{t-j}^- \right) + \varepsilon_t \end{aligned} \tag{5}$$

where

$$\rho = \sum_{j=1}^{p} \varphi_j - 1, \gamma_j = -\sum_{t=j+1}^{p} \varphi_i \ for\ j = 1, \ldots p-1$$

$$\theta^+ = \sum_{j=0}^{q} \theta_j^+, \theta^- = \sum_{j=0}^{q} \theta_j^-, \tag{6}$$

$$\upsilon_0^+ = \theta_0^+, \upsilon_j^+ = -\sum_{i=j+1}^{q} \theta_i^+ \quad for\ j =, \ldots, q$$

Likewise, $y_{t-1} - \beta^+ x_t^+ - \beta^- x_t^- = \xi_t$ is the asymmetric error correction component and $\beta^+ = -\theta^+ / \rho, \beta^- = -\theta^- / \rho$ are asymmetric long-term coefficients.

To examine the effect of governance on environmental pollution and based on literature review, theoretical foundations, and study objectives, the following variables were considered. Two governance indicators include government effectiveness (as a representative of economic governance) and political stability (as a proxy for political governance), financial development, foreign direct investment, human development index, the degree of trade openness (the ratio of trade to GDP), real per capita gross domestic product, per capita energy consumption, and finally the amount of per capita carbon dioxide emission (as the dependent variable of the study) constitute research variables. Relevant data for two groups of countries (developing and developed) are gathered. Table 1 depicts comprehensive information about research variables.

3. RESULTS AND DISCUSSION

In Table 2, some descriptive statistics of the variables are reported, including the mean, maximum and minimum values, skewness and kurtosis, and finally the Jarque-Bera statistic (to test the normality

of the statistical distribution of the variables). As can be seen, the average governance indicators for the developed countries (Canada, Denmark, Germany, Greece, France, Italy, Japan, the Netherlands, Norway, Spain, and Sweden) are positive, while for the selected developing nations (Brazil, Egypt, Indonesia, India, Iran, Iraq, Kazakhstan, Malaysia, Pakistan, Mexico, Saudi Arabia, Thailand, and Turkey[1]) are negative. This clearly indicates a significant difference in the quality of governance in the two groups of countries.

The average financial development index also gives a similar picture because the figure calculated for developed countries (0.63) is far higher than the similar figure for developing countries (0.12). This difference approves the significant gap in the development of the financial system (credit supply, number of bank branches, number of ATMs, and development of electronic banking) between the two groups. The net flow of foreign direct investment for developed countries is negative (USD -110 billion), which shows that capital outflow from these countries is more than inflow. An inverse finding for developing countries can be seen in the table (USD 335 billion). As estimated, selected developing countries are net recipients of foreign direct investment. On the other hand, the share of trade in the gross domestic product (TO) for developed countries is at a level beyond that of developing countries, which confirms more trade connections with the world in these countries.

The last three variables, including per capita real GDP, per capita energy consumption, and per capita carbon dioxide emission, also indicate a significant difference between the two groups, while also being consistent with theoretical expectations. This reveals the high share of rich countries' residents in energy consumption (including fossil energy) and production of carbon dioxide compared to residents of developing countries.

Before estimation of the model, stationarity of the variables is examined. Tables 3 and 4 present the result of three common unit root tests for our panel data set, which confirm non-stationarity (existence of common unit root) for all variables.

On the other hand, to investigate the presence of non-linear unit root in the data, Ucar-Omay (UO) and Emirmahmutoglu-

1 The selection of countries is based on access to the required information.

Table 1: Research variables

Variable	Symbol	Type	UOM*	Source
Economic governance	EG	Independent	-	World Bank
Political governance	PG	Independent	-	World Bank
Financial development	FD	Independent	-	International Monetary Fund
Foreign direct investment	FDI	Independent	Million USD	World Bank
Human development index	HDI	Independent	-	World Bank
Degree of trade openness	TO	Independent	-	World Bank
Real GDP	GDP	Independent		World Bank
Energy consumption	EC	Independent	Million BOE**	World Bank
Environmental pollution (CO2 emission)	EP	Dependent	Thousand ton	World Bank

*Unit of Measurement, **Barrel of Oil Equivalent

Table 2: Descriptive statistics of variables (1990–2020)

Statistic	EG		PG		FD		FDIa		HDI		TO		GDPb		ECc		EPd	
	Dd	Dg	Dd	Dg	Dd	Dg	Dd	Dg	Dd	Dg	Dd	Dg	Dd	Dg	Dd	Dg	Dd	Dg
Average	1.23	−0.65	1.42	−0.76	0.63	0.12	−110	335	0.87	0.45	63%	24%	34000	4700	4100	1150	9.8	3.3
Maximum	1.8	−1.4	1.83	−0.3	0.85	0.55	−65	825	0.91	0.61	89%	53%	43000	5350	5630	1210	12.3	5.1
Minimum	0.9	−2.8	1.12	−1.94	0.42	0.05	−215	112	0.78	0.42	42%	12%	27500	1225	2650	350	6.5	1.7
Kurtosis	1.25	2.54	1.11	1.95	1.23	1.65	1.94	2.12	1.11	1.24	2.21	2.65	1.73	2.32	1.25	1.83	1.69	2.71
Skewness	0.54	0.32	0.34	0.22	0.13	0.21	−0.11	0.17	0.61	0.85	0.36	0.25	0.42	0.32	0.51	0.63	0.43	0.36
JB	1.12	1.23	0.78	0.36	0.67	0.59	1.14	1.32	0.62	0.95	0.75	0.69	0.91	1.11	0.64	0.86	1.73	1.23

Dg and Dd stand for developing and developed countries, respectively, a: USD billion, b: USD per capita at constant 2015 prices, c: Kilograms of crude oil equivalent per capita, d: Tons per capita

Table 3: Results of the unit root tests (developed countries)

Variable	LLC		IPS		F-ADF		Result
	Level	First difference	Level	First difference	Level	First difference	
EG	0.82	−5.34*	−0.23	−4.40*	−1.43	−7.55*	I (1)
PG	0.62	−5.63*	−0.44	−3.36*	−1.63	−5.67*	I (1)
FD	−0.75	−6.21*	−0.63	−5.97*	−1.97	−5.32*	I (1)
FDI	−1.11	−5.42*	−1.29	−4.63*	−1.56	−6.99*	I (1)
HDI	−0.91	−5.27*	−0.98	−5.33*	−2.82	−5.18*	I (1)
TO	−0.65	−5.20*	−1.01	−3.19*	−0.89	−6.64*	I (1)
GDP	−1.21	−5.69*	−1.27	−5.73*	−0.97	−7.88*	I (1)
EC	0.39	−6.87*	0.65	−4.54*	−1.11	−5.19*	I (1)
EP	0.78	−5.46*	−0.69	−5.19*	−1.57	−6.67*	I (1)

Variables in natural logarithm. *Significant at one percent level

Table 4: Results of the unit root tests (Developing countries)

Variable	LLC		IPS		F-ADF		Result
	Level	First difference	Level	First difference	Level	First difference	
EG	0.52	−5.64*	−0.33	−4.86*	−1.14	−6.55*	I (1)
PG	0.46	−5.91*	−0.59	−3.66*	−1.72	−5.33*	I (1)
FD	−0.89	−6.59*	−0.73	−5.67*	−1.66	−5.42*	I (1)
FDI	−1.41	−5.36*	−1.43	−4.83*	−1.79	−6.74*	I (1)
HDI	−0.71	−6.14*	−0.75	−5.27*	−2.74	−5.28*	I (1)
TO	−0.68	−5.74*	−1.25	−3.49*	−0.70	−6.39*	I (1)
GDP	−1.44	−5.95*	−1.01	−5.61*	−0.86	−7.92*	I (1)
EC	0.82	−5.43*	0.94	−4.73*	−1.23	−5.44*	I (1)
EP	0.63	−5.72*	−0.72	−5.49*	−1.63	−6.36*	I (1)

Variables in natural logarithm. *significant at one percent level.

Table 5: Results of the non-linear unit root tests (Developed countries)

Variable	Non-linear unit root		Symmetric non-linear unit root
	UO	EO	EO
EG	−1.01**	4.25***	1.01
PG	−1.52***	5.32***	1.23
FD	−1.34***	4.94***	1.11
FDI	−2.12***	5.64***	1.19
HDI	−1.61***	5.39***	1.21
TO	−1.73***	4.75***	1.53
GDP	−2.56***	5.29***	0.98
EC	−1.79***	4.67***	1.07
EP	−1.84***	5.79***	1.87

** and *** denote significance at five and one percent levels, respectively.

Table 6: Results of the non-linear unit root tests (developing countries)

Variable	Non-linear unit root		Symmetric non-linear unit root
	UO	EO	EO
EG	−1.11**	4.66***	1.07
PG	−1.12**	5.45***	1.12
FD	−1.51***	4.34***	1.02
FDI	−2.33***	5.72***	1.07
HDI	−1.72***	5.44***	1.03
TO	−1.85***	4.93***	1.24
GDP	−2.69***	5.47***	0.63
EC	−1.29***	4.76***	1.08
EP	−1.77***	5.63***	1.14

** and *** denote significance at five and one percent levels, respectively.

Omay (EO) tests, were applied. These investigate the presence of unit root allowing for asymmetric non-linearity. According to the results presented in the Tables 5 and 6, the presence of non-linear unit root in all variables has been confirmed. Moreover, we could not reject the null hypothesis of symmetric non-linear unit root in our data, which suggests superiority of non-linear models in examining the association between variables.

Succeeding the preliminary investigations, the next step was to estimate the NARDL model. The results of the estimates are reported in Tables 7 and 8. The comparison of the coefficients of the variables for two groups of countries approves significant differences in the magnitude of the effects. For instance, the coefficient of the positive shock of economic governance for developed countries (−0.52) is almost twice that of developing countries (−0.27). More exactly, a one percent increase in the positive shock of economic governance in developed nations will cause a 0.52 percent reduction in carbon dioxide emissions, while the same coefficient for developing countries is estimated at 0.27. In other words, improving economic governance will have a stronger effect on reducing environmental pollution, considering other factors affecting environmental pollution, which are expected to be in a better condition in developed countries. This finding is consistent with the results reported by Aryabod et al. (2020), Payesteh et al. (2019), and Alexandra (2006).

Table 7 depicts the effect of the negative impulse of economic governance on pollution directly. This means that any decline in the economic governance index leads to more pollution, while this effect is estimated to be stronger for developing countries. Hence, it is expected that this group of countries will be more sensitive to weakening of the economic governance index. This finding is in line with the results of Baloch and Wang (2019).

Similar results have been attained for the political governance index. While all the above coefficients are significant at the one percent level, so the main hypothesis of the research is confirmed about the influence of governance on environmental pollution in two groups of countries. Other findings designate a negative and significant effect of the positive shock of financial development on environmental pollution, although this effect is stronger in developing countries. The reason for this can be related to the weaker financial infrastructure (banking system, number of branches, penetration of the banking system in different regions, etc.) in these countries. The inverse and significant effect of the positive shock of foreign direct investment on the emission of carbon dioxide in developing countries is one of the other noteworthy findings of this study. This finding is consistent with theoretical expectations because, with the expansion of foreign direct investment, it will be probable to enter new and updated technologies for pollution control.

The positive impulse of the human development index in both groups of countries designates a negative effect on pollution. The expansion of foreign trade, the size of the economy, and energy consumption are among the factors that aggravate environmental pollution in the countries studied in this research.

Table 7: NARDL panel model estimation results (Developed countries)

Variable	Coefficient	Probability	Variable	Coefficient	Probability
EG^+	−0.52	0.01	HDI^+	−0.24	0.01
EG^-	0.05	0.15	HDI^-	0.03	0.04
PG^+	−0.48	0.01	TO^+	0.32	0.01
PG^-	0.07	0.14	TO^-	−0.11	0.01
FD^+	−0.14	0.01	GDP^+	0.27	0.01
FD^-	0.02	0.24	GDP^-	0.04	0.05
FDI^+	−0.01	0.22	EC^+	0.33	0.01
FDI^-	0.02	0.24	EC^-	−0.12	0.01
			ECT(-1)	−0.12	0.01

NARDL: Nonlinear Autoregressive Distributed Lags

Table 8: NARDL panel model estimation results (developing countries)

Variable	Coefficient	Probability	Variable	Coefficient	Probability
EG^+	−0.27	0.01	HDI^+	−0.08	0.06
EG^-	0.11	0.01	HDI^-	0.02	0.05
PG^+	−0.32	0.01	TO^+	0.26	0.01
PG^-	0.14	0.04	TO^-	−0.15	0.01
FD^+	−0.31	0.01	GDP^+	0.22	0.01
FD^-	0.05	0.05	GDP^-	−0.03	0.07
FDI^+	−0.16	0.01	EC^+	0.18	0.01
FDI^-	0.04	0.05	EC^-	−0.09	0.01
			ECT(-1)	−0.07	0.01

NARDL: Nonlinear Autoregressive Distributed Lags

4. CONCLUSION

The current study aimed to identify the relationship between governance and environmental pollution in two groups of selected developing and developed countries. To this end, the Non-linear Autoregressive Distributed lags (NARDL) model and panel data for the period 1990-2020 were used. Main findings showed the existence of non-linear relationship between the variables. This implies that there is a threshold association between governance and carbon dioxide emissions. Furthermore, the above-mentioned relationship is asymmetric. This asymmetry designates the difference in the effect of positive and negative impulses on the governance of carbon dioxide emissions.

On the other hand, the strength of the relationship between the two variables under investigation in two categories of developed and developing countries shows a significant difference. For instance, in both groups of countries, the negative effect of the positive impulse of economic governance on environmental pollution was established, and the severity of this effect was projected to be much higher in developed countries than in developing countries. This result is not far from anticipated because the improvement of economic governance in developed countries due to the existing efficient institutional infrastructure and the wider spread of the culture of environmental protection in these societies can reduce the emission of the pollutant more effectively and strongly.

The stated relationship regarding the negative shock of economic governance was observed directly. Put differently, this impact is stronger in developing countries than in developed countries. Furthermore, this effect is direct in both groups, that is, the weakening of economic governance leads to more pollution.

Financial growth, which means increasing the supply of banking credit and increasing the banking infrastructure, has a negative and significant effect on pollution. Consequently, the effort to provide access to banking loans for economic actors has led to investment in pollution control technologies and can naturally be effective in reducing the amount of carbon dioxide emissions.

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