Lyeonov, S., Toušek, Z., Bozhenko, V., & Kérmárki-Gally, S. E. (2023). The impact of corruption in climate finance on achieving net zero emissions. *Journal of International Studies, 16*(1), 142-159. doi:10.14254/2071-8330.2023/16-1/10

Journal of International Studies

Centre of Sociological Research

Scientific Papers

The impact of corruption in climate finance on achieving net zero emissions

Serhiy Lyeonov
Sumy State University,
Sumy, Ukraine
s.lieonov@uabs.sumdu.edu.ua
ORCID 0000-0001-5639-3008

Zdeněk Toušek
Czech University of Life Sciences Prague,
Prague, Czech
Republic
tousekz@pef.czu.cz
ORCID 0000-0003-3855-8811

Victoria Bozhenko
Department of Economic Cybernetics, Sumy State University,
Ukraine
Tubingen University, Germany
v.bozhenko@biem.sumdu.edu.ua
ORCID 0000-0002-9435-0065

Szilvia Erdeiné Kérmárki-Gally*
Faculty of Communication, Business and Tourism,
Budapest Metropolitan University, Hungary
ORCID 0000-0003-3118-9427
** Corresponding author*

Abstract. The study's primary purpose is to assess the probabilistic impact of corruption in climate finance on achieving zero emissions. This scientific problem is highly relevant since the largest recipients of international climate assistance are countries with significant corruption in the public sector. Thus, it is necessary to increase the transparency in the use of international assistance funds and strengthen accountability. The study used the methods of survival analysis, namely the Kaplan-Meier approach and the Cox proportional hazards regression model, to investigate 114 countries that received international climate assistance during 2005-2021. The empirical analysis showed that the most probable time frame for achieving 5% reduction in greenhouse gas emissions is five years. Moreover, the response of climate finance to reducing greenhouse emissions is

Received: May, 2022
1st Revision: January, 2023
Accepted: March, 2023

DOI: 10.14254/2071-8330.2023/16-1/10

faster in countries with medium levels of corruption than in countries with high and very high levels of corruption. Two covariates (the level of corruption and the volume of climate finance) likely to affect the achievement of net zero emissions were chosen to build the Cox proportional hazards model. The study empirically confirms that with a 1-point increase in the Corruption Perceptions Index, the probability of reducing emissions increases by 2.4581%, while the volume of climate finance does not have a statistically significant impact on the performance indicator. It suggests that current climate investment in underdeveloped countries is incapable of mitigating the negative impact of climate change.

Keywords: climate finance, emissions, corruption, climate investment, survival analysis

JEL Classification: C31, D73, Q54

1. INTRODUCTION

Climate change is the biggest environmental challenge that now affects sectors from agriculture and infrastructure to health and biosecurity (Hálová et al., 2021; Streimikiene, 2021; Tambovceva et al., 2020; Bako et al., 2022; Vakulenko & Lieonov, 2022). The global threat of climate change requires consolidated efforts from the international community and systematic financial support from developed countries to reduce greenhouse gas emissions and / or adapt natural and human systems to the effects of climate change. The IMF (2022) estimates that government spending on climate change adaptation over the coming decades will average 0.25 percent of the global gross domestic product annually. At the same time, the annual needs of low-income countries over the next ten years will exceed 1 percent of GDP. As of 2020, developed countries have invested over $600 billion in zero and low-carbon infrastructure projects in underdeveloped countries (Climate Policy Initiative, 2021). At the same time, to achieve the internationally agreed climate goals, annual climate funding must increase by at least 590% by 2030. It indicates that developed countries will increase their investment in the future to counteract climate change following the Paris Agreement.

International assistance is provided within the framework of bilateral and multilateral climate financing mechanisms (Khalatur & Dubovych, 2022) aimed at preserving biodiversity, switching to renewable energy, improving the energy efficiency of existing facilities, developing means for sustainable development of the transport system, protecting forests, etc. (Adepoju, 2021; Lyulyov et al., 2021; Skvarciany et al., 2019). In particular, from 2019 to 2020, 50% of total climate funding (i.e., $336 billion) was directed to modernizing energy infrastructure facilities, while 25.8% aimed to improve the transport sector (Climate Police Initiative, 2022). Renewable energy is critically important for decarbonizing electricity systems and mitigating the consequences of anthropogenic climate change (Kurbatova et al., 2020; Šubová, 2022; Matvieieva & Hamida, 2022; Stankevičienė & Borisova, 2022).

Climate finance can be implemented as concessional financing, carbon credits, climate-related debt instruments (green, blue, and sustainability/social bonds, debt swaps), international carbon credit schemes, climate-related insurance schemes (Versal & Sholoiko, 2022; IMF, 2022; Endri et al., 2022; Chishti et al., 2022; Boros et al., 2023). In addition, environmental taxes and payments may be introduced to encourage sustainable development (Vysochyna et al., 2020; Vostrykov & Jura, 2022; Piluso & Le Heron, 2022).

However, the desire to spend vast amounts of money in a relatively short period to achieve critical goals creates another threat called corruption. Corruption in the field of climate change can take various forms and types, namely the provision of illegal financial benefits to third parties for obtaining and granting permits and concessions in extractive industries and renewable natural resources sectors (fishing, forests, and wildlife), the non-transparent selection procedure for counterparties in climate projects implementation, irrational use of international assistance to finance climate projects, etc. Transparency International (2006) experts have found that 90% of government officials in Bangladesh's Ministries of Forestry and Environment of are involved in corruption offences.

The world's underdeveloped countries, especially small island states, are the most vulnerable to the adverse effects of climate change. Cantelmo et al. (2019) found that more frequent and severe weather disasters in these countries caused an average loss of well-being equivalent to a steady 1.6 percent reduction in consumption. Based on the analysis of systematic reviews and meta-analyses (PRISMA), Rajkoomar et al. (2022) and Supriyanto et al. (2022) substantiate that economic growth has a negative and significant effect on carbon emissions in Africa. At the same time, the most vulnerable countries to the impacts of climate change have a high level of corruption, which defines the relevance of research and the increased attention of the international community to the effective use of financial support aimed at climate goals. Many African countries have a low absorption capacity for effective use climate funds, which requires improving the regulatory framework and institutional environment to counter corruption schemes (Yu, 2014).

After analyzing the recipients of international climate assistance, it is worth noting that the countries that receive the most funding have high corruption in the public sector. In particular, the Corruption Perception Index of the top ten countries (India, Indonesia, China, Bangladesh, Brazil, Vietnam, Turkey, Egypt, Kenya, and Morocco) that receive the largest amount of climate funding averages 33.36%. At the same time, these ten countries account for 44.77% of global climate funding.

Consequently, investing significant funds in infrastructure projects in underdeveloped and sufficiently corrupt countries requires increased transparency in the use of international aid funds and increased accountability. Firstly, corruption can negate the efforts of the international community to ensure carbon-neutral economies, namely, reducing greenhouse gas emissions and neutralizing the negative consequences of climate change in the world. Secondly, corruption hinders economic growth (Simovic, 2021), transforms business operations destructively (Metzker et al., 2021; Aliyeva, 2022), discourages employment and investment (Nguyen et al., 2021; Al-Faryan, 2022; Lestari et al., 2022), as well as stimulates the illegal financial activities (Brychko et al., 2021; Sedmíková et al., 2021; Tiutiunyk et al., 2022). Based on survival analysis, this study proposes a scientific and methodological approach to assess the impact of corruption in the climate finance field on climate change dynamics.

2. LITERATURE REVIEW

The dynamic development of modern science is largely determined by the link between research centers around the world, the dissemination and exchange of scientific knowledge through modern digital and information technologies, ensuring open access to the results of scientific research, etc. These changes open up new opportunities for qualitative analysis of scientific achievements on specific issues and expansion of the field of scientific research.

This study analyzes scientific publications containing the keywords "corruption" and "climate" in journals included in the scientometric database Scopus. Based on the results of search queries, it was found that 847 publications on this issue were published in the scientometric database Scopus during 1991-2022. In 2022, scientists worldwide published 103 papers on the study of corruption in climate change, which is two times more than in 2019. As for geographical distribution, 60% of scientific publications on this topic were published during 1991-2022 by scientists from countries such as the United States, Great Britain, Australia, Germany, and Canada. At the same time, scientists from the United States published 259 publications, or 30.6% of the total volume, on this topic.

Analyzing the level of interest of the scientific community in the publications studying corruption and climate challenges, we note the following: they are among the 10% of the most cited publications in the world and make up on average 13.3%; in 2021, 35.8% of published scientific papers are among the top 25 cited papers in the world, which is a third more than in the previous year (in 2020 – 27.1% in the top 25); only 1.6% of papers during 2012-2021, was included in the top 1 most cited publications. 68% of publications on the issues under research were published in highly rated scientific journals during 2012-2021, including 48.6% of papers in journals with a Q1 rating and 19.4% in Q2.

Systematic empirical studies show that corruption exacerbates the problem of climate change and has a destructive impact on environmental protection. The imperfect functioning of democratic institutions (Lyulyov et al., 2021), low level of economic freedom (Linhartová & Halásková, 2022; Vyas-Doorgapersad et al., 2022; Remeikienė et al., 2022), unbalanced government fiscal policies (Tiganasu et al., 2022), acceptance of bribery within society (Korjonen-Kuusipuro & Wojciechowski, 2022), a lack of business integrity (Bednárová et al., 2021; Nastisin et al., 2021; Erwin et al., 2022) and inefficient work of judicial and regulatory authorities (Piplica, 2021; Salman et al., 2022; Ogunshola et al., 2022) in the country lead to the penetration of corruption schemes into economic life.

2.1. Corruption and the environment

Corruption is associated with the unfair behavior of officials of public and private structures to obtain illegal financial benefits. Saha & Gounder (2013) proved that civil servants might use illegal tools to influence the environment and access natural resources for their financial benefit. The Rahman (2018) survey showed that 77 out of 108 respondents (71.3%) are forced to pay bribes to run their businesses. The victims of these acts of corruption are beekeepers, forestry workers, fishermen, and palm leaf collectors.

Corruption in the forestry sector can occur starting with access to raw materials and ending with the transportation of timber to places of sale. Specific types of corruption in forestry may include changing product information, falsifying sales and transportation certificates, replacing tree identification codes, and intentionally updating trees by foresters with stems in operational diameters (Hatibovic et al., 2022).

Crate and Nuttall (2016) determined that high levels of resource concentration, social inequality, lack of political voice and representation, social exclusion of women from public life, and systemic corruption cause destructive climate change in the country. Based on data on pollution levels in 94 countries from 1987 to 2000, it was found that corruption led to an increase in emissions from sulfur oxide and carbon dioxide per capita (Cole, 2007). Welsch (2004) proved that corruption could delay the turning point of the environmental Kuznets curve (EKC). The environmental Kuznets curve is a hypothetical correlation between different indicators of environmental degradation and income levels per capita (Saraç & Yağlikara, 2017).

Haseeb & Azam (2021) estimated the relationship between tourism, corruption, democracy, and carbon dioxide emissions by constructing a regression model based on panel data from 1995-2015 in the context of countries with different income levels. First, the results of using the Granger causality test proved that there is a two-way relationship between the level of corruption and carbon dioxide emissions. Second, the long-term link assessment found that a 1% increase in corruption would lead to a 0.09% increase in CO2 emissions. Third, corruption significantly impacts increased CO2 emissions in all countries, regardless of their income per capita. Leitão (2021), based on panel data for European countries (Portugal, Spain, Italy, Ireland, and Greece) in 1995-2015, proved the existence of a unidirectional causal relationship between carbon dioxide emissions and corruption, i.e., the corruption index has a statistically significant positive impact on carbon dioxide emissions. Analyzing the work of Haseeb & Azam (2021) and Leitão (2021), we note that the relationship between corruption and carbon dioxide emissions can be diverse depending on the selected sample of countries for the study.

The paper of Ahmad et al. (2021) analyzed data from 72 middle-income countries for the period from 2010 to 2017 using a dynamic panel assessment by the generalized method of moments. It was found that combating corruption in environmental management could minimize the harmful effects of $PM_{2.5}$ microparticles on the population's life expectancy in these countries.

2.2. Corruption and climate finance

Case studies confirm the existence of numerous cases of corrupt interference in the use of international assistance to combat climate change. Examples of corruption offences in the field of international climate finance are: about 7-15% ($1-2 billion) of multilateral climate funds allocated to the water sector are lost annually due to corruption (GIZ, 2019); about 35 percent of the budget for climate projects in Bangladesh has been stolen or misappropriated; more than a quarter of solar energy projects in India are forced to pay bribes during the contract or construction phase; bribery in the design of an infrastructure facility in Indonesia for $148,000, which caused the project to be shut down in 2016 due to environmental, social and corruption issues (Sovacool, 2021). The director of the enterprise was jailed for three years and the city council deputy – for ten years.

Analyzing the activities of climate funds in Bangladesh, the authors of the article (Kabir et al., 2021) focus on the following main issues: limited access to information, political considerations when approving the fund, lack of transparent accountability, unknown applicants' basic criteria for selecting projects, as well as political influence and conflicts of interest in the distribution of climate resources.

The paper of Devine et al. (2022) justified the expediency of using green building certification to combat corruption and attract climate investment to achieve carbon neutrality goals.

2.3. Transparency and climate finance

Citizens' involvement in monitoring climate funds' use makes it possible to improve the quality of project implementation and national farms' resilience to climate change's effects. In particular, the experience of non-governmental organizations in Tunisia that receive funds for implementing climate action programs shows that they are focused exclusively on this task. Hence, the efficiency of using climate funds is relatively high. In addition, representatives of public organizations are actively involved in discussing climate issues at international forums, symposia, and the development of regulations in this area, etc. (Youssef et al., 2021).

The paper substantiates the expediency of involving the public to control the targeted use of climate project funds by the example of Bangladesh (Khan et al., 2022). Dual-use investments bring immediate benefits to local community residents and minimize the adverse effects of climate change. However, ensuring that the local community is involved in climate change management is quite a complex process. However, it can bring greater benefits to local communities and create stronger barriers to corruption or misappropriation of financial or natural resources. Ratmono & Darsono (2022) empirically substantiate that fiscal decentralization allows to reduce levels of corruption at country level. In addition to fiscal decentralization, it is advisable to implement a reliable system of internal control to fight corruption (Ratmono et al., 2021; Chand et al., 2022).

Abidin et al. (2015) note that countries with a high level of governance have a higher potential for effective environmental management compared to states with a low level of public administration and a low quality of democratic institutions. The fundamental mechanisms for ensuring transparency and minimizing corruption is the process simplification and transactions reduction through automation (Kharabsheh &

Gharaibeh, 2022; Popescu et al., 2022), blockchain (Pisár et al., 2022; Mynenko & Lyulyov, 2022) and supervisory artificial intelligence (Gladden et al., 2022).

Mačiulytė-Šniukienė & Sekhniashvili (2021) and Szczepańczyk (2022) prove that innovation in public and ecological spheres influences not only economic growth but also has a positive effect on environmental performance.

Thus, the issue of corruption in climate change is the focus of many scientific studies. However, assessing the impact of climate finance and corruption on reducing greenhouse gas emissions still needs to be studied.

3. METHODOLOGY

Many econometric tools and methods can be used in studying and quantifying the relationships between socio-economic processes linear and nonlinear regression models (Melnyk et al., 2016; Rajnoha et al., 2021; Kolosok et al., 2022; Tiutiunyk & Kozhushko, 2022; Tahat, 2022; Fadel et al., 2021); panel regression (Georgescu et al., 2021; Pimonenko et al., 2021; Marinescu et al., 2022); correlation analysis (Kuzior et al., 2022); intellectual analysis (Kuzmenko et al., 2023); neural networks (Buturache & Stancu, 2021); composite approach (Mentel et al., 2020; (Khvostina et al., 2021; Hrushka et al., 2022)); granger causality (Naomi & Akbar, 2021). Unlike the above methods, survival analysis allows applying a probabilistic approach to assess the relationship between climate finance, considering corruption and greenhouse gas emissions. The first use of survival analysis and life expectancy models was carried out in medical studies. However, over time, the scope of the practical application of survival analysis techniques has significantly expanded, and now scientists call this type of analysis "time to event analysis." This statistical analysis method allows estimating the cumulative probability of occurrence of a certain event and simulating the influence of individual factors on this probability. We use two survival models in this study:

1. The Kaplan-Meier method (KM) is a nonparametric method used to estimate the probability of survival ($S(t_i)$) from the observed survival time

$$S(t_i) = S(t_{i-1})(1 - {}^{d_i}/_{n_i}) \tag{1}$$

$S(t_{i-1})$ – probability of reducing emissions by 5 % in the period t_i compared to t_{i-1}
n_i – the number of countries that achieved a 5% reduction in emissions immediately before t_i
d_i - number of events as of t_{i-1}

The Kaplan-Meier survival function is used to study general patterns of climate finance efficiency. The survival function estimates the probability of climate finance efficiency in a given time t.

2. The Cox proportional hazards regression model is a nonparametric method used to estimate the hazard function h(t)– the risk of an event occurring at time t

$$h(t) = h_0(t)e^{b_1x_1+b_2x_2+\cdots+b_px_p} \tag{2}$$

t – survival time
$h(t)$ – risk function defined by the set of p covariates (x_1, x_2, ….x_p)
b_1, b_2, ….b_p–coefficients that measure the effect of covariates
h_0 – basic danger.

The Cox proportional hazards regression model is based on two assumptions: first, the survival function is exponential; second, the risk ratio for the two groups compared is constant throughout the study period. Within the framework of this study, the Cox proportional hazards regression model is used to assess the degree of impact of independent variables (amount of climate funding, level of corruption) on greenhouse gas emissions.

Empirical verification of the proposed scientific and methodological approach for assessing the impact of corruption in the field of climate finance on the dynamics of climate change will allow testing of the following main working hypotheses of this study:

Hypothesis 1: the probability of reducing carbon emissions increases due to climate finance.

Hypothesis 2: corruption plays a vital role in the relationship between climate finance and carbon reduction.

The scientific and methodological approach to assessing the impact of corruption in the field of climate finance on the dynamics of climate change involves the implementation of the following steps:1) collection and processing of statistical information on the volume of climate finance in the context of developing countries; 2) determination of trigger dates as criteria for the effectiveness of climate finance programs in the context of the studied countries; 3) censorship of countries that failed to achieve a reduction in greenhouse emissions; 4) determination of the specification of the form of distribution of the survival function; 5) construction of survival tables that reflect the allocation of time before the occurrence of a particular analyzed event – reduction of greenhouse emissions; 6) calculation of the probability of occurrence of an event (carbon dioxide emissions reduction) for a certain period of time by plotting a Kaplan-Meier curve; 7) defining the determinants of the impact on the period of greenhouse gas emissions reduction based on the construction of the Cox proportional hazards model; 8) interpreting findings and model adequacy checking.

4. EMPIRICAL RESULTS AND DISCUSSION

The scientific and methodological approach to assessing the impact of corruption in climate finance on the dynamics of climate change provides for the implementation of the following steps:

1. Collection and processing of statistical information on the amount of climate finance in developing countries. 114 countries received international climate assistance were selected for the study. The countries mentioned above received international climate assistance for $281 billion in the context of 48,703 projects (Table 1) during 2005-2021. Regionally, Sub-Saharan Africa received 17,112 projects worth $62.4 billion, or 22.2% of global funding from 2005 to 2021. East and South Asian countries have accumulated $113.8 billion, or 40.5% of total financing.

Table 1

Distribution of international climate assistance by region during 2005-2021

Region	Amount of climate funding		Number of climate finance projects	
	billion US dollars	% of the total volume	units	% of the total volume
East Asia and the Pacific	57.2	20.4	11,483	23.6
Europe and Central Asia	36.2	12.9	3,422	7.0
Latin America and the Caribbean	40.4	14.4	9,124	18.7
Middle East and North Africa	28.2	10.0	2,499	5.1
South Asia	56.6	20.1	5,063	10.4
Sub-Saharan Africa	62.4	22.2	17,112	35.1
TOTAL	281.0	100.0	48,703	100.00

Source: Calculated by the authors.

The leading intermediaries in providing this assistance to underdeveloped countries are Green Climate Fund, Clean Technology Fund, IKI, Adaptation Fund, Global Environment Facility, Asian Development Bank, BMZ, EBRD, European Commission French Development Agency, Japanese International Co-operation Agency, Japan Bank for International Co-operation, European Development Fund, European Investment Bank, Export-Import Bank of Korea, etc.

2. The trigger dates determination as criteria for the effectiveness of climate finance programs in countries under consideration.

Survival analysis involves analyzing the length of time before a particular event occurs. As part of this study, a specific event is the reduction of greenhouse gas emissions.

The first date is the year of entry into force of the Kyoto Protocol (February 16, 2005). It is the first addition to the UN Framework Convention on climate change

The second date is the year when a particular country achieved an average 5 percent reduction in emissions compared to the previous year.

3. Censoring countries that have failed to achieve a reduction in greenhouse emissions.

An important advantage of the Kaplan-Meier curve is that the method can consider "censored" observations, i.e., identify countries that could reduce emissions during the study period. This censorship is called right-hand censorship because there have been no changes in environmental improvement over a fixed period. A fragment of the definition of "censored" data is shown in Figure 1.

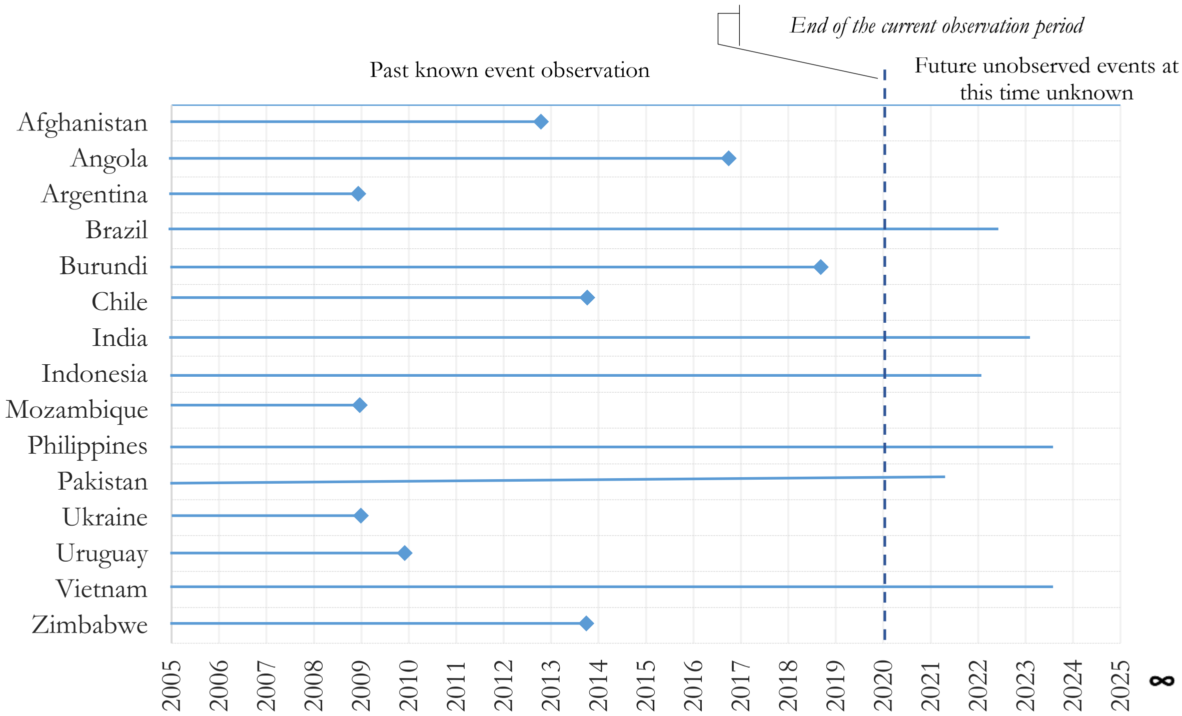

Figure 1. Survival analysis graph (fragment)

Source: Built by the authors

According to the analysis of greenhouse gas emissions, it was found 57.89% (66 out of 114 countries) of the analyzed countries failed to reduce emissions by at least 5% during 2005-2020. After analyzing the countries that could not achieve a reduction in greenhouse gas emissions, we note that during 2005-2020, these countries attracted $218.193 billion or 80.18% of the total amount of climate funding. Based on this, due to the failure to achieve a 5% reduction in greenhouse gas emissions by the end of 2020, 66 countries fell under right-wing censorship, i.e., they were not used for further analysis.

4. Definition of the distribution form of the survival function

The parametric model $S(t)$ is constructed by selecting the theoretical distribution of a random variable T. We used specialized STATISTICA software, which provides for the calculation of four types of distribution: exponential, linear, Weibull, and log-normal, to perform the survival analysis. Estimates of distribution parameters are calculated using the maximum likelihood estimation (Weight 1), the method of moments (Weight 2), or the least squares method (Weight 3). The adequacy of the model is evaluated based on the values of the significance level of the p criterion. If the criterion is significant ($p<0.05$), the chosen form of distribution significantly differs from the analyzed data. The results of determining parameters for various forms of distribution are presented in Table 2.

Table 2

Results of parameter estimation for various distribution forms

Estimation method	**Parameter Estimates, Model: Linear Hazard (Spreadsheet1) Note: Weights: 1=1., 2=1./V, 3=N(I)*H(I)**									
	Lambda	**Variance Lambda**	**Std.Err. Lambda**	**Gamma**	**Variance Gamma**	**Std.Err. Gamma**	**Log-Likelhd.**	**Chi-Sqr.**	**df**	**p**
Linear Hazard										
Weight 1	0.063440	0.002569	0.050687	0.020676	0.000128	0.011300	-67.1967	9.264659	2	0.009739
Weight 2	-0.013144	0.000600	0.024485	0.035755	0.000051	0.007163	-63.8233	2.517780	2	0.283983
Weight 3	0.007794	0.000879	0.029640	0.033080	0.000059	0.007651	-64.1794	3.230052	2	0.198902
Gompertz										
Weight 1	-2.90282	0.143994	0.379465	0.158588	0.003113	0.055793	-67.9587	10.78855	2	0.004547
Weight 2	-2.75280	0.118248	0.343872	0.180178	0.002340	0.048374	-66.7289	8.32904	2	0.015546
Weight 3	-3.29938	0.167914	0.409774	0.250459	0.003294	0.057395	-67.2267	9.32449	2	0.009452
Weibull										
Weight 1	0.015624	0.000094	0.009710	1.977525	0.078290	0.279803	-64.7687	4.408488	2	0.110351
Weight 2	0.014443	0.000069	0.008325	2.092044	0.062487	0.249973	-63.7703	2.411708	2	0.299450
Weight 3	0.010953	0.000047	0.006846	2.209008	0.076586	0.276741	-63.7999	2.471042	2	0.290697
Exponential										
Weight 1	0.208175	0.001473	0.038381	x	x	x	-79.1263	33.12370	3	0.000000
Weight 2	0.082603	0.000232	0.015218	x	x	x	-82.9435	40.75819	3	0.000000
Weight 3	0.161997	0.000459	0.021427	x	x	x	-76.5156	27.90236	3	0.000004

Source: Calculated by the authors

As a result of the calculations, the Gompertz distribution and exponential distribution are not adequately applied in modeling the effects of climate finance. The best level of adequacy is inherent in the Weibull distribution and the linear distribution is the closest to the actual distribution of the studied parameters among all distributions. At the same time, the Weibull distribution shows the adequacy of the model simultaneously in the context of three methods for calculating parameters (Weight 1-3) since the p-value is greater than 0.05. The smaller the obtained chi-square value, the more accurate the parameter estimate is.

5. Construction of survival tables that reflect the time distribution before a particular analyzed event – reduction of greenhouse emissions. Considering the subject of this study – climate financing, it is advisable to rename the "survival" tables to "performance" tables instead of "survival".

The performance table summarizes the length of the period required to reduce greenhouse emissions for a particular set of observations. The construction of performance tables involves dividing the observation period of the sample into smaller time intervals. As part of this study, it is proposed to divide the follow-up period of 14 years into eight periods with a break of 2 years. The results of constructing performance tables that reflect the probability of reducing greenhouse emissions are presented in Table 3.

Table 3

Climate finance performance chart for 2005-2020

Interval	Interval Start	Mid Point	Interval Width	Number Entering	Number Withdrwn	Number Exposed	Number Dying	Proportn Dead	Proportn Survivng
A	1	2	3	4	5	6	7	8	9
Intno.1	0.00	1.00	2.000	48	0	48.00	1	0.021	0.979
Intno.2	2.00	3.00	2.000	47	0	47.00	6	0.128	0.872
Intno.3	4.00	5.00	2.000	41	0	41.00	20	0.488	0.512
Intno.4	6.00	7.00	2.000	21	0	21.00	7	0.333	0.667
Intno.5	8.00	9.00	2.000	14	0	14.00	8	0.571	0.429
Intno.6	10.00	11.00	2.000	6	0	6.00	1	0.167	0.833
Intno.7	12.00	13.00	2.000	5	0	5.00	3	0.600	0.400
Intno.8	14.00			2	0	2.00	2	0.750	0.250

Interval	Cum.Prop Survivng	Problty Density	Hazard Rate	Std.Err. Cum.Surv	Std.Err. Prob.Den	Std.Err. Haz.Rate	Median Life Exp	Std.Err. Life Exp
A	10	11	12	13	14	15	16	17
Intno.1	1.000	0.010	0.011	0.000	0.010	0.011	5.700	0.346
Intno.2	0.979	0.063	0.068	0.021	0.024	0.028	3.750	0.343
Intno.3	0.854	0.208	0.323	0.051	0.036	0.068	2.143	0.915
Intno.4	0.438	0.073	0.200	0.072	0.025	0.074	2.875	0.573
Intno.5	0.292	0.083	0.400	0.066	0.027	0.130	1.750	0.468
Intno.6	0.125	0.010	0.091	0.048	0.010	0.091	3.333	0.816
Intno.7	0.104	0.031	0.429	0.044	0.017	0.224	1.667	0.745
Intno.8	0.042			0.029				

Source: Calculated by the authors

Table 3 shows that among 48 developing countries (column "Number Entering") only one country (column "Number Dying") was able to reduce greenhouse gas emissions through the climate finance programs implementation from the beginning of the observation (2005) to 2007. Significant changes in the effectiveness of climate finance programs are recorded from 2009 to 2010 (interval 3). In particular, the share of countries that recorded a reduction in greenhouse gas emissions during this period by at least 5% for the first time was 0.488. Accordingly, the probability of reducing carbon dioxide emissions into the atmosphere within 4-5 years from the beginning of the transition of the world community to a carbon-neutral economy was 0.323 (Hazard rate). , Only 0,146 developing countries have been able to reduce their carbon dioxide emissions in the first five years since the entry into force of the Kyoto Protocol.

6. Determining the probability of an event occurring over a certain period – reducing carbon dioxide emissions.

The nonparametric Kaplan–Meier method was used to visualize the survival function (or effectiveness of climate finance), which reflects the probability of reducing carbon emissions over the appropriate time interval. The horizontal axis (x) represents time in years. In contrast, the vertical axis (y) shows the probability of climate finance effectiveness or the share of countries that have reduced greenhouse gas emissions by at least 5%. The vertical step in the Figure indicates the event.

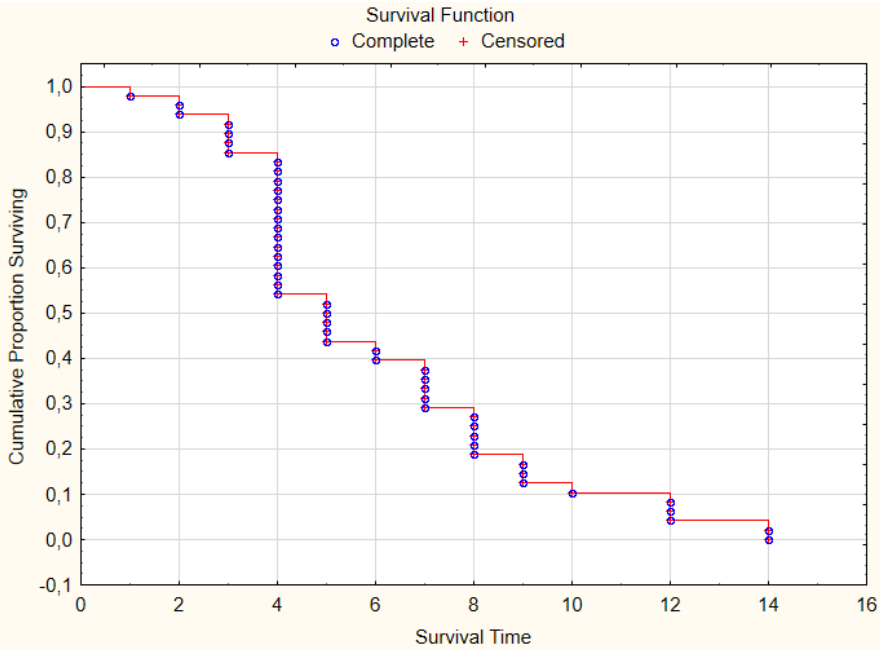

Figure 2. Visualization of the dependence of climate finance performance based on the Kaplan-Mayer curve

Source: Calculated by the authors

The probability of climate finance being effective is 1.0 (or 100% of countries have not reduced their carbon emissions) at zero point in time. Figure 2 shows that the average time to reduction is 5 years, indicating that 50% of countries have achieved emission reductions in the 5th year after adopting the Kyoto Protocol. The probability of non-reduction of carbon emissions in the fourth year was 0.86; starting from the fifth year (2009), the probability of obtaining an impact from climate finance projects increased.

Since numerous scientific papers and reports of international organizations have proved the existence of corruption schemes in the implementation of climate finance programs, therefore, it was decided to group countries according to a homogeneous level of corruption in them and review the effectiveness of climate finance in the context of selected groups. The Corruption Perception Index (Cor) was selected to characterize the level of corruption and the following levels of corruption were identified:

$0 < COR \leq 25$ – very high level of corruption (extreme);

$25 < COR \leq 50$ – high level of corruption (high);

$50 < COR \leq 75$ – average level of corruption (medium);

$75 < COR \leq 100$ – low level of corruption (low).

The average value was determined for 114 countries based on data on the Corruption Perception Index for 2005-2020. In particular, 76 countries were included in the group with a high level of corruption (or

66.6% of the total). In comparison, a quarter of the analyzed countries (29 countries) had a very high level of corruption. Visualization of the effectiveness of climate finance by countries with different levels of corruption is shown in Figure 3.

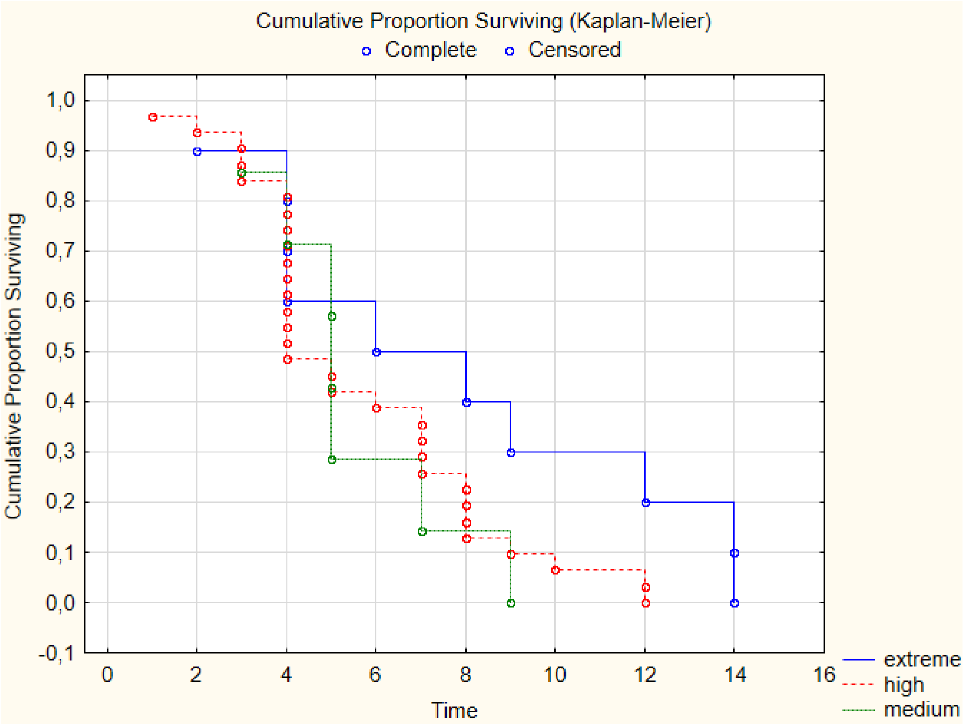

Figure 3. Visualization of the dependency of climate finance effectiveness in countries with different levels of corruption based on the Kaplan-Meier curve construction

Source: Calculated by the authors

Figure 3 shows that the response of climate finance to reducing greenhouse emissions in countries with medium levels of corruption is faster compared to countries with high and very high levels of corruption. In particular, countries with moderate levels of corruption could reduce their greenhouse gas emissions by receiving climate funding from the developed world during the first nine years, while countries with high levels of corruption during 12 years, and countries with very high levels of corruption during 14 years.

7. Determinants of the impact on the period of greenhouse gas emissions reduction based on the construction of the Cox proportional hazards model.

The Cox proportional hazards model was used to define the relationship between the period of obtaining the effect of climate finance and individual impact factors. This econometric model allows including all countries initially selected for the study (114 countries), despite censorship, because the basic assumption of the Cox proportional hazards model is that the reduction in carbon dioxide emissions occurs randomly. The basic assumptions of Cox regression are: all explanatory variables are independent and linearly affect the probability of occurrence of an event. The results of calculating the Cox regression parameters are presented in Table 4.

We note that the constructed model is statistically significant, confirmed by the chi-square test value (p-value 0.00875 < 0.05), based on the data in Table 4. In addition, the Wald test shows that all covariates are significant. If the Corruption Perception Index increases by 1 point, the probability of reducing emissions increases by 2.4581% (1.024581*100-100). Thus the annual probability of reducing emissions is possible from 0.3591% to 4.6011% if the Corruption Perception Index increases by 1 point. This variable is statistically significant when constructing the Cox regression model since the significance of the Wald test (0.0215) is less than 0.05.

Table 4

Results of estimation of the Cox regression model parameters

	Status Chi = 9,47963 df = 2 p = ,00875									
N=114	**Beta**	**Standard Error**	**Beta 95% lower**	**Beta 95% upper**	**t-value**	**Wald Statist.**	**p**	**Risk ratio**	**Risk ratio 95% lower**	**Risk ratio 95% upper**
Funding	-0.000	0.000	-0.000	0.000	-1.59	2.520	0.112	1.000	1.000	1.000
Corruption	0.024	0.011	0.004	0.045	2.30	5.287	0.021	1.025	1.004	1.046

Source: Calculated by the authors

The second covariant – the amount of climate funding – not statistically significant for the constructed model. Given the current level of climate funding (according to experts, current funding is insufficient to minimize the negative impact) from the consequences of climate change, natural results were obtained. Funding of climate programs in the actual amount does not affect the period of the beginning of reducing greenhouse emissions in the world.

The Cox proportional hazards model confirms the hypothesis of the importance of overcoming corruption in reducing carbon emissions and increasing transparency in climate finance. At the same time, another hypothesis about the probability of reducing carbon emissions increases due to climate finance should be rejected, explaining that there is no effect between the existing investment in climate projects in developing countries and the reduction of greenhouse gases in the environment of these countries.

5. CONCLUSION

The main corruption risks in financing programs aimed at countering climate change are financing with significant amounts of money; low level of efficiency in monitoring the implementation of the project; low level of transparency on the results of the work received; systemic corruption in the recipient countries of international assistance in such sectors of the economy as building, energy, and forestry; the urgency of financing measures to combat climate change in the world, etc. have a problem of corruption. For over a decade, developed countries have committed to mobilize significant funds to support developing countries in adapting to the effects of climate change and emissions reduction. A significant part of climate funding is paid in high-risk environments, so it is advisable to strengthen monitoring of the use of climate funds. Multilateral funds can maximize the effectiveness of mitigation and adaptation programs through the active introduction of integrity, transparency, accountability, inclusivity, and zero tolerance of corruption in climate finance and measures. The highest standards in these areas strengthen anti-corruption contributions such as policy dialogue and participatory training, improved lobbying practices, better laws and policies, open data, monitoring and reporting mechanisms, and whistleblower protection.

ACKNOWLEDGEMENT

This research was funded by the grant from the Ministry of Education and Science of Ukraine (No. s/r 0121U100467, 0121U109559, 0120U100473).

REFERENCES

Abidin, I. S. Z., Haseeb, M., Azam, M., & Islam, R. (2015). Foreign direct investment, financial development, international trade and energy consumption: Panel data evidence from selected ASEAN countries. *International Journal of Energy Economics and Policy*, *5*(3).

Adepoju, O. O. (2021). Analysis of road transportation infrastructure construction and maintenance for sustainable development in South-Western Nigeria. *Journal of Sustainable Development of Transport and Logistics*, *6*(1), 49–58. https://doi.org/10.14254/jsdtl.2021.6-1.4

Ahmad, N. A., Ismail, N. W., Tilde, A. Y., & Aliyu, A. J. (2021). Effects of Air Pollution and Corruption Control on Life Expectancy in Middle-Income Countries. *International Journal of Economics and Management*, *15*(2).

Al-Faryan, M. A. S. (2022). Nexus between corruption, market capitalization, exports, FDI, and country's wealth: A pre-global financial crisis study. *Problems and Perspectives in Management*, *20*(4), 224-237. doi:10.21511/ppm.20(4).2022.17

Aliyeva, A. (2022). Post-Oil Period in Azerbaijan: Economic Transformations, Anti-Inflation Policy and Innovations Management. *Marketing and Management of Innovations*, 2, 268-283. https://doi.org/10.21272/mmi.2022.2-24

Bako E. D., Rus A. V., Rovinaru M. D., Varvari S. A. D., Rovinaru F.I., Negrut L. Climate Change Approach in EU Countries VS Economic Development. *Transformations in Business & Economics*. 21(2A), 707-726

Bednárová, L., Michalková, S., & Vandžura, S. (2021). Public procurement in the conditions of the Slovak Republic with regard to the participants in the procurement. *International Journal of Entrepreneurial Knowledge*, *9*(1). https://doi.org/10.37335/ijek.v9i1.124

Boros, A., Lentner, C., Nagy, V. & Tőzsér, D. (2023). Perspectives by green financial instruments – a case study in the Hungarian banking sector during COVID-19. *Banks and Bank Systems*, *18*(1), 116-126. doi:10.21511/bbs.18(1).2023.10

Brychko, M., Savchenko, T., Vasylieva, T., & Piotrowski, P. (2021). Illegal activities of financial intermediaries: A burden of trust crisis. *Journal of International Studies*, *14*(1). https://doi.org/10.14254/2071-8330.2021/14-1/12

Buturache, A. N., & Stancu, S. (2021). Solar energy production forecast using standard recurrent neural networks, long short-term memory, and gated recurrent unit. *Engineering Economics*, *32*(4). https://doi.org/10.5755/J01.EE.32.4.28459

Cantelmo, A., Melina, G., & Papageorgiou, C. (2019). Macroeconomic Outcomes in Disaster-Prone Countries. *IMF Working Papers*, *19*(217). https://doi.org/10.5089/9781513515380.001

Chand, A., Kumar, N., Kumar, R., Prasad, S., Patel, A., & Stauvermann, P.J. (2022). Determinants of social and environmental accounting information disclosure: an analysis of top 50 firms in New Zealand. *Engineering Economics*, *33*(2), 118-131.

Chishti M. F., Sultan S., Ahmed A., Haq I. (2022). Spiritual finance a way forward for sustainable finance: a conceptual approach. *Business, Management and Economics Engineering, 20*(2), 1308-1327.

Climate Policy Initiative (2021). Global Landscape of Climate Finance 2021. URL: https://www.climatepolicyinitiative.org/wp-content/uploads/2021/10/Full-report-Global-Landscape-of-Climate-Finance-2021.pdf

Cole, M. A. (2007). Corruption, income and the environment: An empirical analysis. *Ecological Economics*, *62*(3–4). https://doi.org/10.1016/j.ecolecon.2006.08.003

Crate, S.A, & Nuttall, M. (2016) Anthropology and climate change: from actions to transformations. Routledge, New York, and London

Devine, A., McCollum M., & Orlova S. (2022). Cleaning up corruption and the climate: The role of green building certifications. *Finance Research Letters*. Vol. 47. URL: https://www.sciencedirect.com/science/article/abs/pii/S1544612322001829 DOI:10.1016/j.frl.2022.102929

Endri, B., Hania, T., & Ma'ruf, A. (2022). Corporate green Sukuk issuance for sustainable financing in Indonesia. *Environmental Economics*, *13*(1), 38-49. doi:10.21511/ee.13(1).2022.04

Erwin H., Sarjon, D., Zefriyenni, Z., & Nanik, I. (2022). Local government performance model through innovation: leadership, organizational culture and competency in Padang Lawas Utara Regency Indonesia. *Administratie si Management Public*, 38, 90-103. DOI: 10.24818/amp/2022.38-05

Fadel, S., Rouaski, K., Zakane, A., & Djerboua, A. (2021). Estimating climate influence of the potential covid-19 pandemic spreading in Algeria. *SocioEconomic Challenges, 6*(1), 24-40. https://doi.org/10.21272/sec.6(1).24-40.2022

Georgescu, I., Kinnunen, J., & Androniceanu, A. M. (2021). Empirical evidence on circular economy and economic development in Europe: a panel approach. *Journal of Business Economics and Management*, *23*(1). https://doi.org/10.3846/jbem.2022.16050

Gladden, M., Fortuna, P., & Modliński, A. (2022). The Empowerment of Artificial Intelligence in Post-Digital Organizations: Exploring Human Interactions with Supervisory AI. *Human Technology*, *18*(2), 98–121. https://doi.org/10.14254/1795-6889.2022.18-2.2

Hálová, P., Mach, J., Čechura, L., & Slaboch, J. (2021). Climate change and sustainability in Czech wheat production. *Agris On-Line Papers in Economics and Informatics*, *13*(4). https://doi.org/10.7160/AOL.2021.130402

Haseeb, M., & Azam, M. (2021). Dynamic nexus among tourism, corruption, democracy and environmental degradation: a panel data investigation. *Environment, Development and Sustainability*, *23*(4). https://doi.org/10.1007/s10668-020-00832-9

Hatibovic, F. J.; Pinto I., Páez, D. (2022). National identification and control of corruption mediated by socioemotional climate, collective efficacy, and trust in Chilean students: an experimental study. *Revista de Psicología*, *41*(1), 2223-3733.

Hrushka, R., Stehlikova, B., Mura, V., & Spirkova, D. (2022) Quantification of Economic, Ecological and Social Impacts of Climate Change in the EU. *European Journal of Interdisciplinary Studies*. Issue 02. P. 63-81.

IMF (2022). Aligishiev Z., Bellon M., Massetti E. Macro-Fiscal Implications of Adaptation to Climate Change. MF Staff Climate Note 2022/002.

Kabir, M. R., Khan, S., Chowdhury, S., Jahan, S., Islam, K. M. A., & Zayed, N. M. (2021). Corruption Possibilities in the Climate Financing Sector and Role of the Civil Societies in Bangladesh. *Journal of Southwest Jiaotong University*, *56*(2), 55–64. https://doi.org/10.35741/issn.0258-2724.56.2.6

Khalatur, S., & Dubovych, O. (2022). Financial Engineering of Green Finance as an Element of Environmental Innovation Management. *Marketing and Management of Innovations*, 1, 232-246. https://doi.org/10.21272/mmi.2022.1-17

Khan, M., Watkins, M., Aminuzzaman, S., Khair, S., & Khan, M. Z. H. (2022). Win-win: designing dual-use in climate projects for effective anti-corruption in Bangladesh. *Climate and Development*. https://doi.org/10.1080/17565529.2022.2027741

Kharabsheh, B., & Gharaibeh, O. K. (2022). Corruption, political instability and their impact on investment: An FMOLS approach. *Investment Management and Financial Innovations*, *19*(1). https://doi.org/10.21511/imfi.19(1).2022.06

Kolosok, S., Saher, L., Kovalenko, Y., & Delibasic, M. (2022). Renewable Energy and Energy Innovations: Examining Relationships Using Markov Switching Regression Model. *Marketing and Management of Innovations*, 2, 151-160. https://doi.org/10.21272/mmi.2022.2-14

Korjonen-Kuusipuro, K., & Wojciechowski, A. (2022). The value of superdiverse human-technology entanglements. *Human Technology*, *18*(1), 1–5. https://doi.org/10.14254/1795-6889.2022.18-1.1

Kurbatova, T., Sotnyk, I., Kubatko, O., Baranchenko, Y., Arakpogun, E. O., & Roubik, H. (2020). State support policy for renewable energy development in emerging economies: The case of Ukraine. *International Journal of Global Environmental Issues*, *19*(1–3). https://doi.org/10.1504/ijgenvi.2020.114864

Kuzior, A., Vasylieva, T., Kuzmenko, O., Koibichuk, V., & Brożek, P. (2022). Global digital convergence: Impact of cybersecurity, business transparency, economic transformation, and AML efficiency. *Journal of Open Innovation: Technology, Market, and Complexity, 8*(4) doi:10.3390/joitmc8040195

Kuzmenko, O., Bilan, Y., Bondarenko, E., Gavurova, B., & Yarovenko, H. (2023). Dynamic stability of the financial monitoring system: Intellectual analysis. *PLoS ONE*, 18. doi:10.1371/journal.pone.0276533

Leitão, N. C. (2021). The effects of corruption, renewable energy, trade and CO2 emissions. *Economies*, *9*(2). https://doi.org/10.3390/economies9020062

Lestari, D., Lesmana, D., Yudaruddin, Y. & Rizky, Y. (2022). The impact of financial development and corruption on foreign direct investment in developing countries. *Investment Management and Financial Innovations*, *19*(2), 211-220. doi:10.21511/imfi.19(2).2022.18

Linhartová, V., & Halásková, M. (2022). Determinants of corruption: a panel data analysis of Visegrad countries. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, *17*(1). https://doi.org/10.24136/eq.2022.003

Lyulyov, O., Paliienko, M., Prasol, L., Vasylieva, T., Kubatko, O., & Kubatko, V. (2021). Determinants of shadow economy in transition countries: Economic and environmental aspects. *International Journal of Global Energy Issues*, *43*(2–3). https://doi.org/10.1504/ijgei.2021.115142

Lyulyov, O., Pimonenko, T., Kwilinski, A., & Us, Y. (2021). The heterogeneous effect of democracy, economic and political globalisation on renewable energy. *E3S Web of Conferences*, *250*. https://doi.org/10.1051/e3sconf/202125003006

Mačiulytė-Šniukienė, A., & Sekhniashvili, D. (2021). The eco-innovation impact on economic and environmental performance of EU member states. *Business, Management and Economics Engineering*, *19*(2). https://doi.org/10.3846/bmee.2021.14497

Marinescu, Ș., Mahdavian, M.S., Rădulescu, M. (2022). Globalization, Energy Mix, Renewable Energy, and Emission: Romanian Case. *European Journal of Interdisciplinary Studies*, 2,175-192.

Matvieieva, Yu., & Hamida, H.B. (2022). Modelling and Forecasting Energy Efficiency Impact on the Human Health. *Health Economics and Management Review, 3*(2), 78-85. https://doi.org/10.21272/hem.2022.2-09

Melnyk, L. G., Kubatko, O. V., & Kubatko, O. V. (2016). Were Ukrainian regions too different to start interregional confrontation: Economic, social and ecological convergence aspects? *Economic Research-Ekonomska Istrazivanja*, *29*(1). https://doi.org/10.1080/1331677X.2016.1174387

Mentel, G., Vasilyeva, T., Samusevych, Y., Vysochyna, A., Karbach, R., & Streimikis, J. (2020). The evaluation of economic, environmental and energy security: Composite approach. *International Journal of Global Environmental Issues*, *19*(1–3). https://doi.org/10.1504/ijgenvi.2020.114872

Metzker, Z., Maroušek, J., Hlawiczka, R., Belás, J., & Khan, K. A. (2021). The Perception of the Market and Operational Area of Business by Service Sector and Tourism Companies in terms of CSR implementation. *Journal of Tourism and Services*, *12*(23). https://doi.org/10.29036/JOTS.V12I23.328

Mynenko, S., & Lyulyov, O. (2022). The Impact of Digitalization on the Transparency of Public Authorities. *Business Ethics and Leadership, 6*(2), 103- 115. http://doi.org/10.21272/bel.6(2).103-115.2022.

Naomi, P., & Akbar, I. (2021). Beyond sustainability: empirical evidence from OECD Countries on the connection among natiral resources, ESG performances, and economic development. *Economics and Sociology*, *14*(4). https://doi.org/10.14254/2071-789X.2021/14-4/5

Nastisin, L., Gavurova, B., Bacik, R., Svetozarovova, N., & Fedorko, R. (2021). Sustainable performance of players in the global aviation industrz in the light of multi-factor analysis of online reputation. *International Journal of Entrepreneurial Knowledge*, *9*(1). https://doi.org/10.37335/ijek.v9i1.130

Nguyen, M.L.T., Doan, T.T.T., & Bui, T.N. (2021). The impact of macroeconomic and control of corruption on foreign direct investment inflows. *Polish Journal of Management Studies*, *24*(1). https://doi.org/10.17512/pjms.2021.24.1.14

Ogunshola, I.B. & Kasztelnik, K. (2022). Observational Study of Tax Compliance and Tax Evasion in Nigeria. *Financial Markets, Institutions and Risks, 6*(4), 1-14. doi: https://doi.org/10.21272/fmir.6(4).1-14.2022

Piluso, N., & Le Heron, E. (2022). The macroeconomic effects of climate policy: A Keynesian point of view. *Environmental Economics*, *13*(1), 16-27. doi:10.21511/ee.13(1).2022.02

Pimonenko, T., Lyulyov, O., & Us, Y. (2021). Cointegration between Economic, Ecological and Tourism Development. *Journal of Tourism and Services*, *12*(23). https://doi.org/10.29036/JOTS.V12I23.293

Piplica, D. (2021). The economic reverse of the corruption suppression in Croatia. *Montenegrin Journal of Economics*, *17*(2). https://doi.org/10.14254/1800-5845/2021.17-2.16

Pisár, P., Priščáková, S., Špaček, D., & Nemec, J. (2022). Digitization as a tool of e-government in selected public services of the state: international comparison of Slovakia and the Czech Republic. *Administratie si Management Public,* 39, 111-132. DOI: 10.24818/amp/2022.39-07

Popescu, M.-F., Constantin, M., & Chiripuci, B. C. (2022). Transition to a sustainable energy production and consumption model – mapping the patterns of success. *Journal of Business Economics and Management*, *23*(4), 915–936. https://doi.org/10.3846/jbem.2022.17022

Rahman, M. A. (2018). Governance matters: climate change, corruption, and livelihoods in Bangladesh. *Climatic Change*, *147*(1–2). https://doi.org/10.1007/s10584-018-2139-9

Rajkoomar, M., Marimuthu, F., Naicker, N., & Mvunabandi, J. D. (2022). A meta-analysis of the economic impact of carbon emissions in Africa. *Environmental Economics*, *13*(1), 89-100. doi:10.21511/ee.13(1).2022.08

Ratmono, D., & Darsono, D. (2022). New public management and corruption: Empirical evidence of local governments in Indonesia. *Public and Municipal Finance*, *11*(1), 54-62. doi:10.21511/pmf.11(1).2022.05

Ratmono, D., Cholbyah, A., Cahyonowati, N., & Darsono, D. (2021). The problem of corruption in government organizations: Empirical evidence from indonesia. *Problems and Perspectives in Management*, *19*(4). https://doi.org/10.21511/ppm.19(4).2021.03

Remeikienė, R., Ligita, G., Fedajev, A., Raistenskis, E., & Krivins, A. (2022). Links between crime and economic development: EU classification. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, *17*(4), 909–938. https://doi.org/10.24136/eq.2022.031

Saha, S., & Gounder, R. (2013). Corruption and economic development nexus: Variations across income levels in a non-linear framework. *Economic Modelling*, *31*(1). https://doi.org/10.1016/j.econmod.2012.11.012

Salman, R.T., Sanni, P., Olaniyi, T.A., & Yahaya, K.A. (2022). Governance Transparency of Tax Revenue Performance in West Africa. *Business Ethics and Leadership*, *6*(1), 14-24. doi: http://doi.org/10.21272/bel.6(1).14-24.2022

Saraç, Ş., & Yağlikara, A. (2017). Environmental Kuznets Curve: The Evidence from BSEC Countries. *Ege Akademik Bakış Dergisi*, *17*(2).

Simovic, M. (2021). The impact of corruption on economic growth in the countries of southeast Europe. *Transformations in Business and Economics*, *20*(1).

Skvarciany, V., Jurevičienė, D., & Morkunas, M. (2019). Determinants of bank profitability: Empirical research on Lithuanian market. *International Journal of Economic Policy in Emerging Economies*. https://doi.org/10.1504/IJEPEE.2019.104637

Sovacool, B. K. (2021). Clean, low-carbon but corrupt? Examining corruption risks and solutions for the renewable energy sector in Mexico, Malaysia, Kenya and South Africa. *Energy Strategy Reviews,* 38. https://doi.org/10.1016/j.esr.2021.100723

Stankevičienė, J., & Borisova, J. (2022). Conceptual approach to valuation of climate change in EU countries through the prism of economic activities. *Economics, Management and Sustainability*, *7*(1), 6–16. https://doi.org/10.14254/jems.2022.7-1.1

Streimikiene, D. (2021). Challenges of approaching climate neutral society in v4 countries. *Montenegrin Journal of Economics*, *17*(3). https://doi.org/10.14254/1800-5845/2021.17-3.15

Šubová, N. (2022) "The Contribution of Energy Use and Production to Greenhouse Gas Emissions: Evidence from the Agriculture of European Countries", *AGRIS on-line Papers in Economics and Informatics*, *3*(14), 111-123. DOI 10.7160/aol.2022.140309

Supriyanto, W. R. A., Arintoko, D. R., & Nunik, K. (2022). Economic growth and environmental degradation paradox in ASEAN: A simultaneous equation model with dynamic panel data approach. *Environmental Economics*, *13*(1), 171-184. doi:10.21511/ee.13(1).2022.14

Szczepańczyk, M. (2022). Transformation towards circular economy in comparison with eco-innovation development on the example of EU member states. *Polish Journal of Management Studies*, 26(1), 292-309. https://doi.org/10.17512/pjms.2022.26.1.18

Tahat, I.A.M. (2022). Association Between Factors Likely to Have an Influence on Foreign Direct Investment: The Case of Jordan. *SocioEconomic Challenges, 6*(4), 34-45. https://doi.org/10.21272/sec.6(4).34-45.2022

Tambovceva, T., Ivanov, I. H., Lyulyov, O., Pimonenko, T., Stoyanets, N., & Yanishevska, K. (2020). Food security and green economy: Impact of institutional drivers. *International Journal of Global Environmental Issues*, *19*(1–3). https://doi.org/10.1504/ijgenvi.2020.114871

Tiganasu, R., Pascariu, G., & Lupu, D. (2022). Competitiveness, fiscal policy and corruption: evidence from Central and Eastern European countries. *Oeconomia Copernicana*, *13*(3), 667–698. https://doi.org/10.24136/oc.2022.020

Tiutiunyk, I. & Kozhushko, I. (2022). Modeling the Impact of Shadow Financial Transactions on the Country's Financial Potential. *Financial Markets, Institutions and Risks, 6*(4), 134-143. https://doi.org/10.21272/fmir.6(4).134-143.2022

Tiutiunyk, I., Cieśliński, W., Zolkover, A., & Vasa, L. (2022). Foreign direct investment and shadow economy: One-way effect or multiple-way causality? *Journal of International Studies*, *15*(4), 196-212. doi:10.14254/2071-8330.2022/15-4/12

Transparency International Bangladesh (2006). Corruption database report 2005 (released on July 5, 2006). Transparency International Bangladesh, Dhaka.

Vakulenko, I., & Lieonov, H. (2022). Renewable Energy and Health: Bibliometric Review of Non-Medical Research. *Health Economics and Management Review*, 2, 44-53. http://doi.org/10.21272/hem.2022.2-05

Versal, N., & Sholoiko, A. (2022). Green bonds of supranational financial institutions: On the road to sustainable development. *Investment Management and Financial Innovations*, *19*(1). https://doi.org/10.21511/imfi.19(1).2022.07

Vostrykov, P., & Jura, A. (2022). Environmental Taxes Impact for the Population Health Protection: Cross-Country Analysis. *Health Economics and Management Review, 3*(4), 35-45. https://doi.org/10.21272/hem.2022.4-04

Vyas-Doorgapersad, S. (2022). Organisational Ethics Management to Combat Corruption in the South African Public Sector. *Business Ethics and Leadership, 6*(3) 14-22. doi: https://doi.org/10.21272/bel.63.14-22.2022

Vysochyna, A., Samusevych, Y., & Starchenko, L. (2020). Convergence trends of environmental taxation in European countries. *E3S Web of Conferences*, *202*. https://doi.org/10.1051/e3sconf/202020203031

Welsch, H. (2004). Corruption, growth, and the environment: A cross-country analysis. *Environment and Development Economics*, *9*(5). https://doi.org/10.1017/S1355770X04001500

Youssef, A.B. (2021). The role of NGOs in climate policies: the case of Tunisia. ERF Working Papers Series. Working Paper 1519. URL: https://erf.org.eg/app/uploads/2021/12/1640263511_866_1020388_1519.pdf

Yu, Y. (2014). Climate finance, Africa, and China's role. *African East-Asian Affairs*, 1, 36–57.