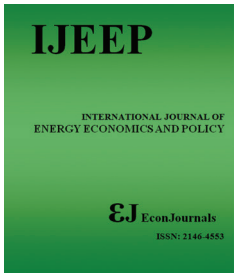


International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2025, 15(2), 600-608.

The Impact of Corruption on Green Growth: Theory and Empirical Evidence of Green Economy as a Source of Growth

Azwardi[1]*, Rabin Ibnu Zainal[2], Alghifari Mahdi Igamo[1]

[1]Faculty of Economics, Universitas Sriwijaya, Indonesia, [2]Faculty of Economics, Universitas Sumatera Selatan, Indonesia.
*Email: azwardi@fe.unsri.ac.id

Received: 22 October 2024 **Accepted:** 03 February 2025 **DOI:** https://doi.org/10.32479/ijeep.18343

ABSTRACT

The potential for economic growth through green growth can be driven by good governance. The purpose of this study is to further clarify the scientific concept, and proof of concept between the quality of governance in the form of controlling the level of corruption on green growth in high-income and lower-middle-income countries. The research objects are divided into 26 countries included in developed countries and 8 countries included in developing countries in Asia using panel data for the period 2019-2023. The results of the study show that controlling corruption has a significant negative impact on green growth, especially in countries with high income levels. This shows that the level of corruption control in these countries has not been effective during the observation period. Corruption hinders the implementation of effective environmental policies, weakens regulations, and causes inefficient resource allocation, especially in the energy and industrial sectors. This worsens environmental conditions and reduces green innovation which is essential for sustainable growth. However, the results of this study indicate that spending on environmental protection has a positive impact on green growth in the model of lower-middle income and high-income countries. In addition, the results of the study indicate that economic development and growth also have a negative effect on green growth, there is resource depletion due to economic activities. Thus, to achieve green growth and advance the 2030 Agenda for Sustainable Development Goals, anti-corruption policies must be implemented actively to strengthen environmental regulations and support green growth.

Keywords: Green Growth, Green Economy, Good Governance, Corruption, Environmental Protection, Economic Development, Sustainable Development
JEL Classifications: O44, Q56, Q58, K42

1. INTRODUCTION

The background of the research to be studied explains the influence between good governance in controlling the level of corruption and the potential for green growth based on the principles of the green economy and the sustainable development goals framework. The problem with previous research is that it does not emphasize the aspects of governance and green growth where previous research only focuses on environmentally friendly green investment (Qin et al., 2024; Qing et al., 2024). In addition, there are several studies that focus on pollution and only a few consider resource efficiency as reflected in green economic growth (Pei et al., 2021; Song et al., 2021; Wu et al., 2021). Therefore, the formulation of the problem to be studied is to see the impact of the level of corruption on green growth both from a theoretical approach and empirical evidence.

Latest study from Gu et al., (2021) conclude that economic policy uncertainty on green growth is multidimensional, but there is a research gap for improving methodology and determining variables in testing and identifying green growth. The first novelty in this study identifies and analyzes the green economy in detail with the main focus of research on green growth. The second novelty includes aspects of governance and institutional quality as measured by the level of corruption. Controlling the level of corruption can reduce disaggregation in budget allocations that contribute to green growth. The third novelty in this study uses developed and developing countries as objects. The research

This Journal is licensed under a Creative Commons Attribution 4.0 International License

objects are divided into 26 countries included in developed countries and 8 countries included in developing countries. So the urgency of the problem in this study examines how good governance influences the control of corruption levels and the potential for green growth based on the principles of the green economy and the sustainable development goals framework in both developed and developing countries.

The problem-solving approach to answering the existing problems is achieved by the following stages. First, exploring and identifying potential and problems and validating the main concepts/pillars to drive green growth. Increasing the understanding of the basic principles of green economy theory is further narrowed down to green growth. Second, conducting testing and developing concepts in accordance with the problems of green growth activities in developing and developed countries. Therefore, these objectives and benefits are important novelties in this article and have a feasibility study to develop further research.

The concept of green growth shows whether economic growth is becoming greener, more efficient, environmentally friendly and promotes a sustainable economy. Green economic growth in some countries is faced with two challenges, namely rapid economic development and environmental sustainability. (Shang et al., 2023) explores the implications of green growth strategies and emphasizes the need for policies to decouple economic growth from environmental degradation. (Barbier, 2022; Gu et al., 2023) investigates the specific challenges and opportunities faced by countries in adopting green growth practices. In economic theory, it has been explained that the quality and good governance of governance can affect economic growth. In the state of the art, there are factors that influence green growth as a component of the green economy and sustainable development. The main factors focus on good governance and its relationship to green growth.

Novelty in this study tries to contribute a comprehensive analysis on corruption and green growth. Effective governance is reflected by inclusive decision-making processes, decreasing corruption, and boosting economic growth (Aziz and Sarwar, 2023; Njangang et al., 2022; Qamruzzaman, 2023). (Ahmed et al., 2022; Degbedji et al., 2024; Li and Tong, 2024; Qiu et al., 2022) argues that economic growth as the main objective can be achieved with low levels of corruption and good quality of governance. Emphasized by (Karim et al., 2022) to achieve green economic growth requires good institutions, (Akhbari & Nejati, 2019) low levels of corruption lead to the formation of institutions that support sustainable development, because corruption can weaken environmental protection policies. (Sinha et al., 2019; K. Wang et al., 2019; Yang et al., 2018; Zhou & Li, 2021) In addition to weakening environmental regulations, corruption can also indirectly affect a country's ability to act pro-environmentally through other factors such as reduced revenues and misuse of funds for the environmental sector.

(Lu and Li, 2023) existence in the environmental sector so that (Hao et al., 2021) there is a need for transparency and decentralization in the environmental sector Wen et al., (2023) green growth is essential for humanity to drive economic growth and mitigate climate change. Tawiah et al., (2023) test for a negative and significant relationship between corruption and green economic growth (Liu and Zhang, 2024; Tacconi and AledWilliams, 2020; Troisi et al., 2023) The results show that corruption can hinder economic activities that are based on a sustainable concept. (Carlos, 2021; Kotlán et al., 2021; Quan et al., 2023; Tacconi and AledWilliams, 2020) explains that corruption reflects a series of illegal activities that endanger the smooth functioning of the economy. Environmental quality is significantly affected by corruption and the shadow economy separately (Cozma et al., 2021; Wang et al., 2019). There are several previous studies that raise the topic of corruption and green growth, but the next novelty in this study is the corruption perception index as an aspect of governance and institutional quality, and green growth is seen from environmental and resource productivity that reflects growth becoming more pro-environmental in both developed and developing countries. Environmental policies may fail in corrupt countries because they are used as a means to support profit-seeking activities rather than protecting the environment.

In terms of state of the art research, there is increasing attention to identifying problems in the issues of corruption and green growth, especially in relation to policies. (Bazie et al., 2024) highlighting the need to eradicate corruption in developing countries. (Sulistyani and Nurlinda, 2019; Zhao et al., 2022) anti-corruption systems must be improved to promote greener economic activities. (Farinha and López-de-Foronda, 2024) build a model to show the relationship between economic growth and environmental quality depending on the form of government control over the level of corruption. (Bilgili et al., 2024) analyze the dynamics of corruption control and political stability from an environmental perspective. This study also supports the application of the Kuznets curve hypothesis related to the environment and green growth.

The theoretical basis suggests several approaches to measuring governance, green growth and sustainable development. Cheba et al., (2022) a green growth indicator framework model that includes several categories of elements, including ecological and resource efficiency of economic activities, as well as policy responses. Kararach et al., (2018) taken from the green growth indicator framework to build a green growth indicator system that is more appropriate to the situation in developing countries and influenced by governance. (Kandpal and Okitasari, 2023; Kousar et al., 2023; Osabohien et al., 2023; Yin et al., 2022) emphasizing that good governance is an integral part of achieving sustainable development goals (SDGs).

2. METHODS

This methodology aims to improve good test results and the validity of the relationship between research indicators in answering problems in green growth. In the research flow diagram, the research procedure of research activities is carried out through theoretical measurement dimensions through secondary data and literature studies and measurements with a quantitative approach. The aim is for the research results to be objective and systematic and literature studies will strengthen the research results.

In line with the research objectives, the design of the fundamental research method uses a quantitative approach with panel data analysis techniques, namely a combination of time series and cross sections. The purpose of using this method is to find out how the relationship between variables with more variance in types and forms of data so as to provide more informative data, so that the data obtained is more valid and the research results are more objective and systematic. The sample used in this study is Developed and Developing Countries. Based on the main data reference, namely green growth issued by OECD Statistics, the focus of the study is divided into 26 countries included in Developed Countries and 8 countries included in Developing Countries. The data used is secondary data from several agencies, such as OECD Statistics, Transparency International, International Monetary Fund (IMF), Worldwide Governance Indicator, and World Development Indicator.

The dependent variables in this study use environmental and resource productivity indicators recently developed by the OECD to measure green economic growth. The independent variables used in this study are the Corruption Perception Index (CPI) and Expenditure on environmental protection. The corruption perception index issued by Transparency International. The corruption perception index ranges between 0 and 100, with higher values indicating low corruption. Expenditure on environmental protection or spending on environmental protection is issued by the International Monetary Fund (IMF), which refers to funds allocated by governments for various activities aimed at protecting and improving the environment. Given the multidimensional nature of environmental problems, green growth is likely to be influenced by various factors, including economic, institutional and energy factors. The first control variable is factors related to the economy, which include economic development and economic growth. We proxy economic development with GDP per capita and economic growth with the annual GDP growth rate. The second control variable is good governance, which is an integral part of achieving the sustainable development goals (SDGs), to ensure that policies are pro-environment. The third control variable is energy consumption. Energy consumption level measured by the use of primary energy to control energy-related factors in green economic growth. Based on the explanation above, the equation model that uses panel data in this study;

$$\text{Green Growth}_{it} = \alpha+\beta_1\text{Corruption}_{it}+\beta_2\text{EP}_{it}+\beta_3\text{ED}_{it}+\beta_4\text{EG}_{it}+\beta_5\text{GG}_{it}+\beta_6\text{EC}_{it}$$

$$\text{Green Growth High-income Countries}_{it} = \alpha+\beta_1\text{Corruption}_{it}+\beta_2\text{EP}_{it}+\beta_3\text{ED}_{it}+\beta_4\text{EG}_{it}+\beta_5\text{GG}_{it}+\beta_6\text{EC}_{it}$$

The regression stages using panel data are common effect, fixed effect model, random effect model. Furthermore, to select the best model, the Chow Test, Hausman Test and Lagrange Multiplier are used. The results of the cross-section probability F are the basis for whether the Chow Test hypothesis is accepted or rejected. If the Prob F value is less than 0.05 then Ho is rejected and H1 is accepted, so it can be concluded from the results of the Chow test that the best regression model is estimation with Fixed Effect. The Hausman test can be interpreted as a statistical test to choose whether the Fixed Effect or Random Effect model is most appropriate to use. The basis for assessing the Hausman test hypothesis is by looking at the Random Cross-Section Probability (Prob.) Value, if the value is <0.05 then H0 is rejected and H1 is accepted so that the best model based on the Hausman Test is the estimation with Fixed Effect. Lagrange Multiplier (LM) is a test to determine whether the Random Effect model or the Common Effect (OLS) model is the most appropriate to use. This Random Effect significance test was developed by Breusch Pagan.

3. RESULTS AND DISCUSSION

Environmental issues are multidimensional, green economic growth is likely to be influenced by various factors including economic, institutional, and energy factors, such as economic development, economic growth, government quality, and energy consumption. In these descriptive statistics also presents two types of data models based on country classification, namely lower-middle income countries and high-income countries in the ASIA Continent. The following are the results of the comparison of descriptive statistics of variables which are explained in detail in the Table 1 below.

Table 1 shows that the green growth with the highest value is China in 2023 with a value of 63.61. The lowest green growth value in the lower-middle income is Iraq in 2019. Over a period of 5 years, Iraq's green growth value was very low compared to other countries. One of the factors that makes the green growth value very low is dependence on oil, Iraq is very dependent on the oil sector as the main source of state revenue. More than 90% of state revenue comes from oil exports. This creates a high dependence on fossil fuels, which are not environmentally friendly and hinder investment in renewable energy and green technology. In addition to dependence on the oil sector, war and armed conflict have caused significant environmental damage in Iraq. Environmental infrastructure such as irrigation networks, agricultural land, and large resources, most of which are directed to rebuilding other sectors.

In addition to the low green growth rate, China is a country that has a very high green economic growth value because of several key factors that support their economic transformation towards

Table 1: Descriptive statistics on lower middle-income countries

Descriptive	GG	Corrupt	EP	ED	EG	GG	EC
Mean	44.74	−0.6538	3.17E+12	3418.49	2.94843	−0.3807	9,417,065
Median	46.49	−0.5585	1.50E+10	2672.46	4.12249	−0.4226	860,925.5
Maximum	63.61	0.0804	5.66E+13	12662.6	9.68959	0.80933	96,995,294
Minimum	17.20	−1.4342	5,200,000	852.33	−12.016	−1.684	106,733

Source: Data processed, 2024

Table 2: Descriptive Statistics on High-Income Countries

Descriptive	GG	Corrupt	EP	ED	EG	GG	EC
Mean	47.58	0.793818	4.97E+10	40317.74	1.490604	0.954058	3266325
Median	46.52	0.72142	8.68E+08	33121.37	1.381464	0.955951	911328
Maximum	65.03	2.139808	4.79E+11	93948.2	9.911312	2.284573	12240844
Minimum	26.40	-0.15943	500000	16707.62	-5.27402	-0.19505	55644

Source: Data processed, 2024

more sustainable and environmentally friendly development. This can be seen from the government's commitment, namely from government policies that support the green economy as part of their long-term strategy. In its latest 5-Years-Plans, China set ambitious targets for reducing carbon emissions, increasing renewable energy, and increasing energy efficiency. One of the most important initiatives is the target of achieving carbon neutrality by 2060.

The highest corruption control score among lower-middle income countries is Jordan in 2019 with a score of 0.08 from a range of −2.5 to 2.5. This shows that although the corruption control score in Jordan is high, the data interpretation has not yet reached 1. Meanwhile, the country with the lowest corruption control score is −1.4342 in Tajikistan in 2023. Overall, it can be said that lower-middle income countries in Asia have poor levels of corruption control, as reflected in all data showing an average score of −0.6538.

Some factors of very low corruption control are weak government institutions. Lower-middle-income countries often have weak or immature institutions. Weaknesses in the judicial, legislative, and executive systems result in weak law enforcement against corruption. Lack of transparency, accountability, and internal control create space for corrupt practices to continue to grow. This is what can spur very low levels of corruption control in lower-middle-income countries in Asia. Countries that rely heavily on natural resources, such as oil or mining, tend to experience higher levels of corruption. Income from this sector is usually concentrated in a few people and the management of natural resources is often non-transparent, increasing the opportunity for abuse of power.

Based on the data collected, information on high corruption control in high-income countries is Singapore. It is one of the countries with the lowest corruption rates in the world (Table 2). The country has very strict anti-corruption laws, with severe penalties for violators. In addition, high public employee salaries and strict supervision prevent them from committing corruption. In high-income countries, corruption is generally considered a serious offense.

The results of the panel data estimation are used to analyze how corruption impacts green growth in lower middle-income countries and high-income countries in Asia. The analysis models on panel data include, Common effect model (CEM), Fixed effect model (FEM), Random effect model (REM).

Based on Table 3 above, it shows that in comparison the best statistical model is the Fixed Effect Model (FEM). The model statistically contains three variables that have a significant relationship, namely spending on environmental protection (EP), economic growth (EG), and energy consumption (EC), while the

Table 3: Green growth model with lower middle income countries

Variable	Common	Fixed	Random
C	44.0114	−938.3239	40.0165
Corrupt	10.5914** (5.2080)	−2.4414 (10.9660)	2.4070 (7.9989)
EP	0.0009 (1.2700)	0.0005** (2.2400)	0.0003*** (1.7900)
ED	0.0004 (0.0006)	−0.0001 (0.0017)	0.0015 (0.0010)
EG	0.2842 (0.2859)	0.3746** (0.1660)	0.3235** (0.1593)
GG	−0.9389 (4.0231)	10.7375 (7.3056)	4.7903 (5.6824)
EC	0.3199 (0.8166)	70.2204* (12.7588)	0.0607 (1.7816)

*Level 1% significant, ** Level of 5% significant, ***Level of 10% significant
Corrupt is Control of Corruption, EP: Expenditure on environmental protection, ED is GDP Percapita, EG: Economic growth, GG: Good government, EC: Energy consumption

Table 4: Green growth model with high income countries

Variable	Common	Fixed	Random
C	52.6910	53.6167	51.3684
Corrupt	−8.8800** (4.3417)	−8.5033*** (4.1985)	−6.7722 (0.1825)
EP	0.0004* (8.9300)	0.0002* (8.5200)	0.0041* (0.0009)
ED	−0.0001** (5.300)	−0.0001* (5.1200)	−9.1700 (6.1500)
EG	0.5405** (0.2330)	0.3670 (0.3234)	0.4896* (0.2008)
GG	10.9958* (2.9742)	12.4924* (3.5561)	7.8261*** (4.2304)
EC	−1.0822** (0.5176)	−1.0798** (0.4918)	−1.0150 (0.1482)

*Level 1% significant, ** Level of 5% significant, ***Level of 10% significant
Corrupt is Control of Corruption, EP: Expenditure on environmental protection, ED: GDP Percapita, EG: Economic growth, GG: Good government, EC: Energy consumption

Table 5: Model testing results

Testing	Lower-middle		High	
	Statistic	P	Statistic	P
Chow test	115.027	0.0000	9.8359	0.0433
Hausman test	37.4207	0.0000	19.7443	0.0061
Lagrange multiplier test	54.1769	0.0000	2.4291	0.1191

Source: Data Processed, 2024

corruption control variable (Corrupt) and other control variables do not have a significant effect on green growth (Green Growth). Statistically, the Random Effect Model (REM) has two variables that show a significant relationship with a probability value smaller than the significance level, namely spending on environmental protection (EP) and economic growth, while other variables such as corruption control and other control variables from economic factors, institutions, and energy do not have a significant effect on green growth (Green Growth). While statistically the Common Effect Model (CEM) shows that only the corruption control variable (Corrupt) has an effect on green growth. Next, a detailed comparison of the Green Growth estimation model in high-income countries can be seen in Table 4.

Table 4 shows that statistically the best models are the Common Effect Model (FEM) and the Fixed Effect Model (FEM) which in the results show that all variables are significant to green growth. Meanwhile, based on the Random Effect Model (REM) there

are only three variables that have a significant effect on green growth. Furthermore, to determine which model is the best, three tests are carried out, namely the Chow test, the Hausman test, and the Lagrange multiplier test. The selection of the model is based on several tests. The following are the results of the model tests which can be seen in Table 5.

The first focus, the results of the Chow Test on the Green Growth models in lower-middle-income countries in Asia have a probability value of 0.0000, meaning that the best model chosen is the Fixed Effect Model (FEM) because the chi-square probability value is smaller than the real level of 5 percent or with a confidence level of 95 percent. The next test was conducted using the Hausman test and the results showed a chi-square probability value for the model of 0.0000, meaning that the best model is to use the Fixed Effect Model. Based on the chow and hausman tests, there is no need to conduct the Lagrange multiplier (LM) test, the LM test value is carried out only if the chow test shows that the model used is a common effect and the hausman test shows that the model used is a random effect, so a final stage test is needed to determine the common effect or random effect. If the results of the previous test with the chow and hausman tests show the correct model, namely fixed effect, then there is no need to conduct the LM test.

In line with this, the results of the chow test on the Green Growth model in high-income countries show a probability value smaller than the significance level (0.05), thus the best model is to use the Fixed Effect Model (FEM) approach. The same results are also shown in the Hausman test which shows a probability value smaller than the significance level (0.05), thus the best model is to use the Fixed Effect Model (FEM). Overall, by selecting a model based on model testing, it is analyzed in detail based on the classification of countries based on per capita income levels which are broken out into model equations which can be seen in Table 6.

Before carrying out further analysis stages, there are statistical tests including; F test, t test, and coefficient of determination. The results of the F statistical test show that the probability value of F statistics is smaller than the real level of 5% (0.0000 < 0.05), so that simultaneously Corrupt, EP, ED, EG, GG, EC have a significant effect on Green Growth in all of the analysis models.

Table 6: Model estimation results

Variable	Lower-middle (FEM)		High (FEM)	
	Coefficient	P	Coefficient	P
C	−938.3239	0.0000	53.6167	0.0000
Corrupt	−2.4414	0.8247	−8.5033	0.0501
EP	0.0005	0.0288	0.0002	0.0000
ED	−0.0001	0.9420	−0.0001	0.0076
EG	0.3746	0.0285	0.3670	0.2646
GG	10.7375	0.1479	12.4924	0.0013
EC	70.2204	0.0000	−1.0798	0.0353
Adjusted R^2	0.7960		0.7924	
P (F-statistic)	0.0000		0.0000	
Obs	70		45	

Source: Data processed, 2024
Corrupt is control of corruption, EP: Expenditure on environmental protection, ED: GDP percapita, EG: Economic growth, GG: Good government, EC: Energy consumption, FEM: Fixed effect model

Based on partial analysis, it shows that in the Green Growth model with lower-middle income countries, there are only three variables that have a significant effect including the control variable, while in the Green Growth model with high-income countries, almost all variables have a significant effect, except for the economic growth variable which does not have a significant effect as indicated by a probability value greater than alpha 5%.

For further discussion, each variable's influence on Green Growth in the ASIA Region will be analyzed by classifying lower-middle and high-income countries, as follows.

$$\text{Green Growth Low-middle Countries}_{it} = -938.323 - 2.4414\text{Corrup}t_{it} + 0.0005EP_{it} - 0.0001ED_{it} + 0.3746EG_{it} + 10.7375GG_{it} + 70.2204EC_{it}$$

$$\text{Green Growth High-income Countries}_{it} = 53.6167 - 8.5033\text{Corrup}t_{it} + 0.0002EP_{it} - 0.0001ED_{it} + 0.3670EG_{it} + 12.4924GG_{it} - 1.0798EC_{it}$$

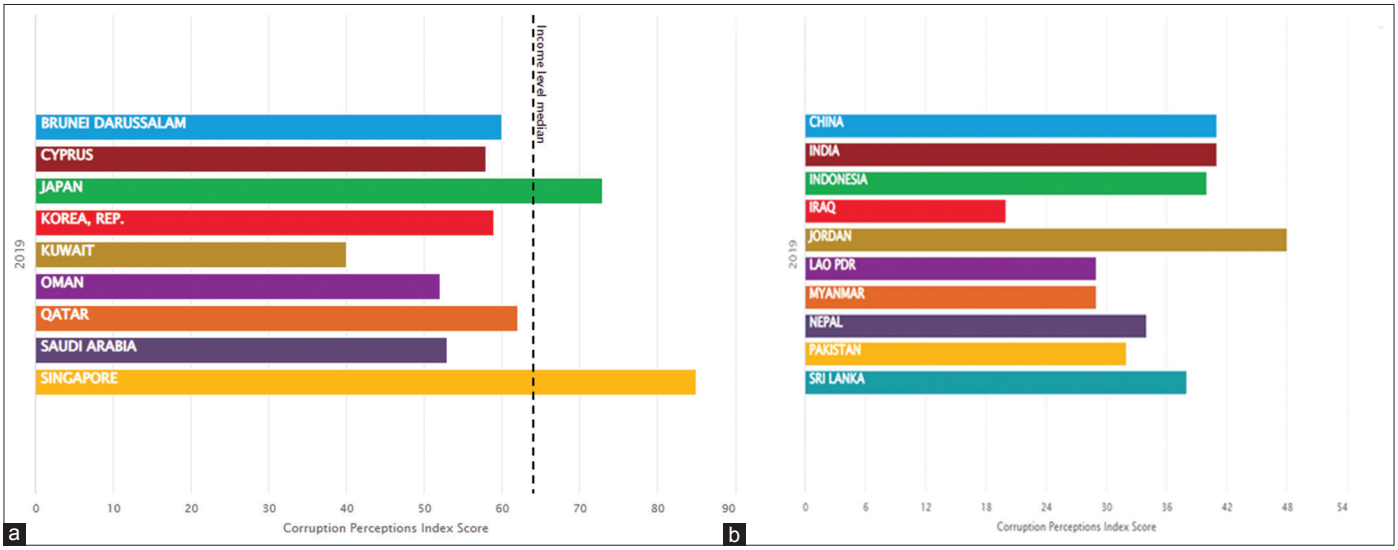
The coefficient results can be interpreted as follows:

Statistically, the results can be interpreted that in the green growth model with low-middle income countries, there are only three variables that have a significant effect including the control variable. Spending on environmental protection has a positive correlation with green growth, if there is an increase in the value of spending on environmental protection by 1 percent then green growth will increase by 0.0005 percent, cateris paribus. Economic growth has a positive correlation with green growth. If there is an increase in economic growth of 1 percent, green growth will increase by 0.3746 percent assuming cateris paribus. Energy consumption has a positive correlation with green growth. If there is an increase in energy consumption of 1 percent, green growth will increase by 70.2204 percent assuming cateris paribus.

Green growth model with high-income countries, almost all variables have a significant effect, except for the economic growth variable which has no significant effect as indicated by a probability value greater than alpha 5 percent. In this model, corruption control has a negative correlation with green growth, if corruption increases by 1 percent, it will reduce green growth by 8.50 percent assuming cateris paribus. Spending on environmental protection has a positive correlation with green growth, if there is an increase in the value of spending on environmental protection by 1 percent then green growth will increase by 0.0002 percent, cateris paribus. Economic development has a negative correlation with green growth. If there is an increase in the value of economic development by 1 percent, green growth will decrease by 0.0001 percent, cateris paribus. Good governance has a positive correlation with green growth. If there is an increase in the quality of government by 1 percent, green growth will increase by 12.49 percent assuming cateris paribus. Energy consumption has a negative correlation with green growth. If there is an increase in energy consumption of 1 percent, green growth will decrease by 1.07 percent assuming cateris paribus.

From the results of the two models, corruption has a significant impact only on the high-income countries model and has a negative impact on green growth. In some cases, the presence of corruption

Figure 1: Corruption levels in high-income countries (a) and lower-middle-income countries (b). Source: World Bank, 2024



may spur countries or international organizations to introduce stronger anti-corruption policies and mechanisms. Liu & Zhang (2024) shows that awareness of corruption in the public sector can trigger more transparent governance reforms, which also support green growth efforts. For example, tighter monitoring programs often improve the efficiency of environmental policy implementation and support the sustainability of green projects. Wen et al., (2023) noted that corruption can raise public awareness of the need for greener and fairer policies. Public pressure to reduce corruption can accelerate greener policy changes, leading to greener, fairer and more inclusive growth.

Control corruption has a significant negative impact on green growth and environmental sustainability. Corruption hinders the implementation of effective environmental policies, weakens regulation, and leads to inefficient resource allocation, especially in the energy and industrial sectors. This worsens environmental conditions and reduces green innovation that is essential for sustainable growth (Tawiah et al., 2024). It can be seen that in several cases in various countries with different income levels, the value of corruption perception has significant differences (in figure 1). The difference in corruption levels between high and lower middle countries is the result of a combination of institutional, economic, social, and cultural factors. High-income countries generally have more mature and effective systems in preventing corruption, while lower middle-income countries often face structural challenges that make it more difficult to eradicate.

Recent research also shows that corruption affects green innovation by inhibiting the technological progress needed to achieve sustainability goals. Corruption reduced the positive impact of innovation on sustainability (Troisi et al., 2023). This underscores the need for strong anti-corruption policies to support the development of environmentally friendly technologies and to ensure that incentives for corporate executives are not distorted (Wang et al., 2023). On the other hand, research conducted by Wen et al., (2023) highlights the impact of corruption on how corruption affects environmental policy across countries and finds that corruption does hinder the development of effective environmental policies, but its effects are not uniform across countries. Countries with low levels of democracy and lower middle income tend to have weak environmental policy frameworks, so the impact of corruption on green growth is often masked by other structural problems. Weak or unstable governments also have fewer incentives to implement strong environmental policies, despite the presence of corruption (Dincer & Fredriksson, 2018). Thus, to achieve green growth and advance the 2030 Agenda for Sustainable Development Goals, anti-corruption policies must be implemented firmly to strengthen environmental regulations and support sustainable innovation.

Government spending, especially for environmental protection, is an important factor in determining the green economy. Zhang et al. (2021) showed that fiscal spending in the green sector and human resources lead to a green economy. Hossain (2024) the approach of using targeted government spending for the environment can effectively achieve green growth. Green growth focuses on countries becoming greener without sacrificing development and economic growth. Liu and Dong (2021) report that corruption afects haze pollution via economic development. Large development and growth require resources and create rapid depletion of natural assets, this confirms that economic development and economic growth have a negative impact on green growth (Shahbaz et al., 2015). The results of this study also confirm that quality good governance can encourage green growth, in line with research by (Karim et al., 2022).

3.1. Lower Middle-Income Countries

Constant value ($\beta 0$) = −938.323 It can be interpreted that if corruption control, spending on environmental protection, control variables in the economic, institutional and energy dimensions, namely economic development, economic growth, quality of government, energy consumption are considered constant or zero, then green growth is reduced by 938%.

Constant value ($\beta 1$) = −2.4413 it can be interpreted that controlling corruption has a negative correlation with green growth, if

corruption increases by 1%, it will reduce green growth by 2.4%, cateris paribus.

Constant value (β2) = 0.0005 it can be interpreted that spending on environmental protection has a positive correlation with green growth, if there is an increase in the value of spending on environmental protection by 1% then green growth will increase by 0.0005%, cateris paribus.

Constant value (β3) = −0,0001 it can be interpreted that the economic control variable, namely economic development, has a negative correlation with green growth. If there is an increase in the value of economic development by 1%, green growth will decrease by 0.0001%, cateris paribus.

Constant value (β4) = 0.3746 it can be interpreted that the economic control variable, namely economic growth, has a positive correlation with green growth. If there is an increase in economic growth of 1%, green growth will increase by 0.3746% assuming cateris paribus.

Constant value (β5) = 10.7375 it can be interpreted that the control variable of the institutional dimension, namely the quality of government, has a positive correlation with green growth. If there is an increase in the quality of government by 1%, then green growth will increase by 10.7375% assuming cateris paribus.

Constant value (β6) = 70.2204 it can be interpreted that the control variable of the energy dimension, namely energy consumption, has a positive correlation with green growth. If there is an increase in energy consumption of 1%, green growth will increase by 70.2204% assuming cateris paribus.

3.2. High Income Countries

Constant value (β0) = 53.6167 can be interpreted if corruption control, spending on environmental protection, control variables in the economic, institutional, and energy dimensions, namely economic development, economic growth, quality of government, energy consumption are considered constant or zero, then green growth increases by 53.61%. This means that green growth without corruption control, spending on environmental protection, control variables in the economic, institutional, and energy dimensions, namely economic development, economic growth, quality of government, energy consumption is 53.61%.

Constant value (β1) = −8.5033 it can be interpreted that corruption control has a negative correlation with green growth, if corruption increases by 1%, it will reduce green growth by 8.50% assuming cateris paribus.

Constant value (β2) = 0.0002 it can be interpreted that spending on environmental protection has a positive correlation with green growth, if there is an increase in the value of spending on environmental protection by 1% then green growth will increase by 0.0002%, cateris paribus.

Constant value (β3) = −0.0001 It can be interpreted that the economic control variable, namely economic development, has a negative correlation with green growth. If there is an increase in the value of economic development by 1%, green growth will decrease by 0.0001%, cateris paribus.

Constant value (β4) = 0.3670 It can be interpreted that the economic control variable, namely economic growth, has a positive correlation with green growth. If there is an increase in economic growth of 1%, green growth will increase by 0.3670% assuming cateris paribus.

Constant Value (β5) = 12.4924 It can be interpreted that the control variable of the institutional dimension, namely the quality of government, has a positive correlation with green growth. If there is an increase in the quality of government by 1%, green growth will increase by 12.49% assuming cateris paribus.

Constant Value (β6) = 1.0798 It can be interpreted that the control variable of the energy dimension, namely energy consumption, has a negative correlation with green growth. If there is an increase in energy consumption of 1%, green growth will decrease by 1.07% assuming cateris paribus.

The results of panel data estimation are used to analyze the impact of corruption on green growth in low-middle income countries and high-income countries in Asia. This shows that in the Green Growth model with low-middle income countries, there are only three variables that have a significant effect including the control variable, while in the Green Growth model with high-income countries, almost all variables have a significant effect, except for the economic growth variable which has no significant effect as indicated by a probability value greater than alpha 5%. The results in the Low-Middle Income Countries model show that spending on environmental protection has a positive correlation with green growth, economic growth has a positive correlation with green growth, energy consumption has a positive correlation with green growth. Corruption control has not influenced green growth in the Low-Middle Income Countries model. While in the High-Income Countries model, corruption control has a negative correlation with green growth, spending on environmental protection has a positive correlation with green growth, economic development has a negative correlation with green growth, quality of government has a positive correlation with green growth, energy consumption has a negative correlation with green growth. Corruption hinders the implementation of effective environmental policies, weakens regulation, and causes inefficient resource allocation.

In some cases, the presence of corruption may spur countries or international organizations to introduce stronger anti-corruption policies and mechanisms. Liu and Zhang (2024) shows that awareness of corruption in the public sector can trigger more transparent governance reforms, which also support green growth efforts. For example, tighter monitoring programs often improve the efficiency of environmental policy implementation and support the sustainability of green projects. Wen et al., (2023) noted that corruption can raise public awareness of the need for greener and fairer policies. Public pressure to reduce corruption can accelerate greener policy changes, leading to greener, fairer and more inclusive growth.

Corruption has a significant negative impact on green growth and environmental sustainability. Corruption hinders the implementation of effective environmental policies, weakens regulation, and leads to inefficient resource allocation, especially in the energy and industrial sectors. This worsens environmental conditions and reduces green innovation that is essential for sustainable growth (Tawiah et al., 2024).

Recent research also shows that corruption affects green innovation by inhibiting the technological progress needed to achieve sustainability goals. A study of Italian companies, for example, found that corruption reduced the positive impact of innovation on sustainability (Troisi et al., 2023). This underscores the need for strong anti-corruption policies to support the development of environmentally friendly technologies and to ensure that incentives for corporate executives are not distorted (Wang et al., 2023). On the other hand, research conducted by Wen et al., (2023) highlights the impact of corruption on how corruption affects environmental policy across countries and finds that corruption does hinder the development of effective environmental policies, but its effects are not uniform across countries. Countries with low levels of democracy and lower middle income tend to have weak environmental policy frameworks, so the impact of corruption on green growth is often masked by other structural problems.

This study shows that in lower-middle-income countries, corruption can undermine environmental policy implementation, but this effect may be less pronounced because economic priorities are higher. Weak or unstable governments also have fewer incentives to implement strong environmental policies, despite the presence of corruption (Dincer and Fredriksson, 2018). Thus, to achieve green growth and advance the 2030 Agenda for Sustainable Development Goals, anti-corruption policies must be implemented firmly to strengthen environmental regulations and support sustainable innovation.

4. CONCLUSION

The uncertainty of economic policy towards green growth is multidimensional, but there is a research gap to improve the methodology and determine the variables in testing and identifying green growth. The results of the study indicate that the level of corruption control has not been effective against green growth so that it has a significant negative impact on green growth, especially in countries with high income levels. Corruption hinders the implementation of effective environmental policies, weakens regulations, and causes inefficient resource allocation, especially in the energy and industrial sectors. However, the results of this study indicate that spending on environmental protection has a positive impact on green growth in the model of lower-middle income and high-income countries. In addition, the results of the study indicate that development and growth activities also have a negative effect on green growth, there is resource depletion due to economic activities. The government must pay more attention to economic activities that are more pro-green growth.

ACKNOWLEDGMENT

The researcher expresses gratitude to the Directorate General of Higher Education DRTPM, which is part of the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia that provides research funds for Regular Fundamental Research Scheme for Fiscal Year 2024.

REFERENCES

Ahmed, F., Kousar, S., Pervaiz, A., Shabbir, A. (2022), Do institutional quality and financial development affect sustainable economic growth? Evidence from South Asian countries. Borsa Istanbul Review, 22(1), 189-196.

Akhbari, R., Nejati, M. (2019), The effect of corruption on carbon emissions in developed and developing countries: Empirical investigation of a claim. Heliyon, 5(9), e02516.

Aziz, G., Sarwar, S. (2023), Revisit the role of governance indicators to achieve sustainable economic growth of Saudi Arabia - pre and post implementation of 2030 Vision. Structural Change and Economic Dynamics, 66, 213-227.

Barbier, E.B. (2022), The policy challenges of green rural transformation for Asia-Pacific emerging and developing economies in a post-COVID world. Economic Analysis and Policy, 75, 689-704.

Bazie, P., Thiombiano, N., Maiga, E.W.H. (2024), Allocating budget in developing countries, the need to fight corruption: Evidence from Sub-Saharan African countries. Future Business Journal, 10(1), 2.

Bilgili, F., Alsanusi, M., Kabir, M.M., Awan, A. (2024), Quantile dynamics of control of corruption, political stability, and renewable energy on environmental quality in the MENA region. Environment, Development and Sustainability. https://doi.org/10.1007/s10668-024-04504-w

Carlos, N. (2021), The effects of corruption, renewable energy, trade and CO_2 Emissions. Economies, 9, 62.

Cheba, K., Bąk, I.D., Pietrzak, M.B. (2022), Conditions of the Green transformation. The Case of the European Union. Technological and Economic Development of Economy, 29, 1-30.

Cozma, A.C., Cotoc, C.N., Vaidean, V.L., Achim, M.V. (2021), Corruption, shadow economy and deforestation: Friends or strangers? Risks, 9(9), 153.

Degbedji, D.F., Akpa, A.F., Chabossou, A.F., Osabohien, R. (2024), Institutional quality and green economic growth in West African economic and monetary union. Innovation and Green Development, 3(1), 100108.

Dincer, O.C., Fredriksson, P.G. (2018), Corruption and environmental regulatory policy in the United States: Does trust matter? Resource and Energy Economics, 54, 212-225.

Farinha, J., López-de-Foronda, O. (2024), The impact of corruption on investment and financing in the European Union: New insights. European Journal of Finance, 30(4), 339-344.

Gu, K., Dong, F., Sun, H., Zhou, Y. (2021), How economic policy uncertainty processes impact on inclusive green growth in emerging industrialized countries: A case study of China. Journal of Cleaner Production, 322, 128963.

Gu, X., Shen, X., Zhong, X., Wu, T., Rahim, S. (2023), Natural resources and undesired productions of environmental outputs as green growth: EKC in the perspective of green finance and green growth in the G7 region. Resources Policy, 82, 103552.

Hao, Y., Gai, Z., Yan, G., Wu, H., Irfan, M. (2021), The spatial spillover effect and nonlinear relationship analysis between environmental decentralization, government corruption and air pollution: Evidence from China. Science of the Total Environment, 763, 144183.

Hossain, B. (2024), Do government spending on pollution abatement and targeted environmental policies promote green growth in Canada? Journal of Cleaner Production, 434, 140391.

Kandpal, R., Okitasari, M. (2023), Governance transformation towards localisation of sustainable development goal 11 in India. World Development Sustainability, 2, 100069.

Kararach, G., Nhamo, G., Mubila, M., Nhamo, S., Nhemachena, C., Babu, S. (2018), Reflections on the green growth index for developing countries: A focus of selected African countries. Development Policy Review, 36, 432-454.

Karim, S., Appiah, M., Naeem, M.A., Lucey, B.M., Li, M. (2022), Modelling the role of institutional quality on carbon emissions in Sub-Saharan African countries. Renewable Energy, 198, 213-221.

Kotlán, I., Němec, D., Kotlánová, E., Skalka, P., Macek, R., Machová, Z. (2021), European green deal: Environmental taxation and its sustainability in conditions of high levels of corruption. Sustainability, 13(4), 1981.

Kousar, S., Bhutta, A.I., Ullah, M.R., Shabbir, A. (2023), Impact of economic and green growth on poverty, income inequalities, and environmental degradation: A case of South Asian economies. Environmental Science and Pollution Research, 30(12), 35200-35213.

Li, X., Tong, X. (2024), Fostering green growth in Asian developing economies: The role of good governance in mitigating the resource curse. Resources Policy, 90, 104724.

Liu, Y., & Dong, F. (2021), Haze pollution and corruption: A perspective of mediating and moderating roles. Journal of Cleaner Production, 279, 123550.

Liu, S., Zhang, H. (2024), Governance quality and green growth: New empirical evidence from BRICS. Finance Research Letters, 65, 105566.

Lu, J., Li, H. (2023), The impact of environmental corruption on green consumption: A quantitative analysis based on China's Judicial Document Network and Baidu Index. Socio-Economic Planning Sciences, 86, 101451.

Njangang, H., Asongu, S.A., Tadadjeu, S., Nounamo, Y., Kamguia, B. (2022), Governance in mitigating the effect of oil wealth on wealth inequality: A cross-country analysis of policy thresholds. Resources Policy, 76, 102561.

Osabohien, R., Karakara, A.A.W., Ashraf, J., Al-Faryan, M.A.S. (2023), Green environment-social protection interaction and food security in Africa. Environmental Management, 71(4), 835-846.

Pei, Y., Zhu, Y., Wang, N. (2021), How do corruption and energy efficiency affect the carbon emission performance of China's industrial sectors? Environmental Science and Pollution Research, 28(24), 31403-31420.

Qamruzzaman, M. (2023), An asymmetric nexus between clean energy, good governance, education and inward FDI in China: Do environment and technology matter? Evidence for chines provincial data. Heliyon, 9(5), e15612.

Qin, L., Aziz, G., Hussan, M.W., Qadeer, A., Sarwar, S. (2024), Empirical evidence of fintech and green environment: Using the green finance as a mediating variable. International Review of Economics and Finance, 89, 33-49.

Qing, L., Abbas, J., Najam, H., Ma, X., Dagestani, A.A. (2024), Investment in renewable energy and green financing and their role in achieving carbon-neutrality and economic sustainability: Insights from Asian region. Renewable Energy, 221, 119830.

Qiu, W., Zhang, J., Wu, H., Irfan, M., Ahmad, M. (2022), The role of innovation investment and institutional quality on green total factor productivity: Evidence from 46 countries along the "Belt and Road". Environmental Science and Pollution Research, 29(11), 16597-16611.

Quan, X., Zhang, K., Zhong, R., Zhu, Y. (2023), Political corruption and green innovation. Pacific Basin Finance Journal, 82, 102169.

Shang, Y., Lian, Y., Chen, H., Qian, F. (2023), The impacts of energy resource and tourism on green growth: Evidence from Asian economies. Resources Policy, 81, 103359.

Shahbaz, M., Nasreen, S., Abbas, F., & Anis, O. (2015), Does foreign direct investment impede environmental quality in high-, middle-, and low-income countries? Energy Economics, 51, 275-287.

Sinha, A., Gupta, M., Shahbaz, M., Sengupta, T. (2019), Impact of corruption in public sector on environmental quality: Implications for sustainability in BRICS and next 11 countries. Journal of Cleaner Production, 232, 1379-1393.

Song, M., Xie, Q., Shen, Z. (2021), Impact of green credit on high-efficiency utilization of energy in China considering environmental constraints. Energy Policy, 153, 112267.

Sulistyani, W., Nurlinda, I. (2019), Green Growth Strategy in Natural Resources Management and Its Correlation to Prevention of Corruption: Practices in Indonesia. In: Proceedings of the 3rd International Conference on Globalization of Law and Local Wisdom (ICGLOW 2019). Vol. 358. p1-4.

Tacconi, L., Aled Williams, D. (2020), Corruption and anti-corruption in environmental and resource management. Annual Review of Environment and Resources, 45, 305-329.

Tawiah, V., Zakari, A., Alvarado, R. (2023), Effect of corruption on green growth. Environment, Development and Sustainability, 26, 10429-10459.

Tawiah, V., Zakari, A., Alvarado, R. (2024), Effect of corruption on green growth. Environment, Development and Sustainability, 26(4), 10429-10459.

Troisi, R., Nese, A., Blanco-Gregory, R., Giovanniello, M.A. (2023), The effects of corruption and innovation on sustainability: A firm-level analysis. Sustainability, 15(3), 848.

Wang, K., Yin, H., Chen, Y. (2019), The effect of environmental regulation on air quality: A study of new ambient air quality standards in China. Journal of Cleaner Production, 215, 268-279.

Wang, S., Yuan, Y., Wang, H. (2019), Corruption, hidden economy and environmental pollution: A spatial econometric analysis based on China's provincial panel data. International Journal of Environmental Research and Public Health, 16(16), 2871.

Wang, X., Chu, X., Lee, C.C. (2023), How does anti-corruption policy affect the sensitivity of green innovation to executive incentives? Economic Change and Restructuring, 56(1), 79-109.

Wen, J., Yin, H.T., Jang, C.L., Uchida, H., Chang, C.P. (2023), Does corruption hurt green innovation? Yes - Global evidence from cross-validation. Technological Forecasting and Social Change, 188, 122313.

Wu, H., Xia, Y., Yang, X., Hao, Y., Ren, S. (2021), Does environmental pollution promote China's crime rate? A new perspective through government official corruption. Structural Change and Economic Dynamics, 57, 292-307.

Yang, J., Guo, H., Liu, B., Shi, R., Zhang, B., Ye, W. (2018), Environmental regulation and the Pollution Haven Hypothesis: Do environmental regulation measures matter? Journal of Cleaner Production, 202, 993-1000.

Yin, Q., Anser, M.K., Abbas, S., Ashraf, J., Ahmad, M., Jamshid, J., Osabohien, R. (2022), Integrating the role of green fiscal policies with energy prices volatility and energy efficiency: Presenting a COVID-19 perspective. Frontiers in Energy Research, 9, 838307.

Zhao, J., Yan, J., Yang, X., Nie, C., Sun, H., Ran, Q. (2022), Government competition, corruption and green total factor energy efficiency: An empirical analysis from china. Frontiers in Environmental Science, 10,976451.

Zhou, A., Li, J. (2021), Impact of anti-corruption and environmental regulation on the green development of China's manufacturing industry. Sustainable Production and Consumption, 27, 1944-1960.