



Governance, Democracy, and the Effectiveness of Economic Policies in Green Finance

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Highlights

- Governance quality is a core driver of the effectiveness of green finance policies.
- Democracy Strengthens Policy Impact on Renewable-Energy Expansion.
- Institutional–Policy Synergies Enhance Green Financial Growth.
- Income-Level Differences Shape the Governance–Green Finance Relationship.

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Abstract

Governance quality and democracy are important pillars of sustainable green finance. The establishment of transparent legal frameworks, effective anti-corruption controls, and improved regulatory quality are essential to increase investor confidence in green financial markets. This study seeks to evaluate the role of institutional quality and democracy in the effectiveness of economic policies related to green finance from 2006 to 2023. Using Driscoll–Kraay standard error regressions, Westerlund and Kao cointegration tests, the GMM estimator, and the JKS Granger non-causality test, the results show that democracy and governance quality have positive and significant effects on green investment development across high-, middle-, and low-income countries. The presence of democratic institutions and transparent governance enhances the efficiency of macroeconomic policies in promoting renewable-energy expansion. The effect of fiscal policies is positive and significant in high-income countries, while in lower-income countries, institutional weakness and corruption weaken this effect. In addition, combining monetary and fiscal policies with high-quality institutions generates a synergistic effect on green financial growth. Our findings reveal that the success of economic policies in advancing environmental goals depends on the institutional and democratic structure of countries. The study recommends aligning macroeconomic policies with environmental objectives and integrating sustainability criteria into fiscal and monetary policy frameworks, particularly within central banks and finance ministries.

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1. Introduction

Over the past decade, climate change, the shift to renewable energy, and the Sustainable Development Goals have become top priorities around the world. Governments and international groups have tried all sorts of approaches—green bonds, loans, tax breaks, stricter environmental rules—to push public and private money into green projects (Singh, 2024). However, empirical studies have indicated large variations among countries with regard to the efficacy of such economic policies (Shabir et al., 2022). The first influential factor among those causing such variations is the nature of governance and democracy (Shah et al., 2024; Dokuzoğlu & Güzel, 2024; Sun et al., 2025).

Green finance is a prime mover in shifting toward a low-carbon economic structure (Hu et al., 2023), and this heavily depends on the contextual setting of governance and politics (Sethi et al., 2024) in any given country. Current scholarly writings suggest that the pursuit of economic policy in support of the initiatives, through subsidies, tax benefits, or investment, is totally untethered from the possibility of the transition toward green finance. Even such policies can be rendered successful or unsuccessful depending on governance standards and democracy.

Good governance is crucial for the proper distribution of green finance funds (Yuan et al., 2024) and ensures that green objectives are achieved. In the absence of such institutional support, policies to support green finance can fall short or even experience greenwashing (Huo et al., 2025).

The economic policies associated with green finance have led to high investments in renewably generated energy only in countries with high governance quality (Akhtaruzzaman, 2022). This is because, in high governance quality countries, the legal framework is supportive in regard to contracts and intellectual property, and the effectiveness of the government promotes the efficient distribution of public funds and incentives to environmentally sustainable initiatives (Montes et al., 2019; Sadeghi Amroabadi & Kazemi, 2022). On the contrary, in countries with low governance quality and high levels of corruption and instability, policies that seem valid may not work (Fagbadebo, 2007). Funds can be diverted to non-green or less productive investments because of administrative corruption, and there can be a lack of transparency with regard to green credit disbursements, which is a critical deterrent to private investments (Dung, 2024).

Nonetheless, empirical evidence indicates that green finance and the effectiveness of governance have mitigating effects on CO₂ emissions with respect to investments in green energy (Yadav et al., 2024). Furthermore, democracy and egalitarian forms of governance have implications for the formulation and implementation of policies related to green finance. Egalitarian societies have increased demands for the preservation of the environment; therefore, they facilitate transition towards green energy (de Soysa et al., 2025). Stability in policies is the essential ingredient for leading sustainable growth through green finance (Nguyen et al., 2024).

Democracy strengthens the efficacy of green economic policies with forms of accountability politics, public engagement, and expression (Uzar, 2024; Fu & Geng, 2019). In democratic regimes, governments can be held accountable directly by the public for their engagement with environmental goals. This not only ensures that governments carry out green finance initiatives effectively but also provides a strong motivation to work in this manner (Arsawan et al., 2024; Pucheta-Martínez & Gallego-Alvarez, 2024). There is a direct and significantly positive relationship between democracy measures and the growth of green bond markets and clean technology investments. Citizens' influence and free media in such societies force governments to take actions openly and work towards their environmental goals with seriousness (Shah et al., 2025; Zecca & Nicolli, 2021).

Additionally, the open nature of the politics in democratic nations makes it easy for non-governmental agencies (NGOs) to scrutinise the implementation of policies and report cases of mismanagement. This serves as another mechanism that can prevent "greenwashing" (Besley & Burgess, 2002). Besides the quality of governance and the extent of democracy, the development and execution of government policies on the economy appear to significantly contribute to the path of growth of green finance (Zhang et al., 2021; Muganyi et al., 2021). Governments shape the behavior of green financial markets with various instruments that form a broad palette of schemes that go from carbon pricing and green subsidies and tax credits to partnerships between governments and the financial community through cooperation on schemes of public-private partnerships, disclosure requirements that make the sector more transparent, and green taxonomies at the national levels (Heine et al., 2019; Koval et al., 2022).

However, the efficiency of these instruments depends not only on their technical aspects but on the dimension of the government's engagement with them that should shape the higher levels of the institutional context of their development and implementation (Bhandary et al., 2021; Çitil et al., 2023). On the other hand, when governments come up with policy consistency that could emanate through predictable markets of carbon pricing schemes that offer predictable markets and schemes that come with clearly visible forms of transparent conditions on their development and implementation, the ambitious targets of green financial instruments could appear more attractive even to the financial markets of the countries because of the specific conditions affiliated with their execution (Olasehinde-Williams et al., 2023). On the other hand, policy volatility, inconsistent environmental regulations, and politicised resource allocation may well succeed in weakening investor confidence and complete the mission of the transformative elements of green financing (Ozili, 2022). Thus, the political will and strategic

coherence of government policies become a critical transmission mechanism by which governance and democracy shape the real-world effectiveness of green finance initiatives (Shawoo et al., 2023).

In summary, there is a close link between governance quality and democracy. While democracy promotes competition and accountability with the help of governance quality, it ensures the proper functioning of democracy (Wang et al., 2019). It is evident that the effectiveness of green finance policies is sustainable and successful in those countries with high democratic governance and high governance quality (Sethi et al., 2024). For example, Norway and other similar countries with high governance quality have led the world in green finance innovation and implementation (Andersen, 2020). At the same time, authoritarian countries with high economic status, like those with economies driven by oil, continue to face daunting tasks in creating enduring green finance markets with their high economic expenditure. This is because their lack of democracy prevents the sustainable nature of their green finance policies.

The quality of governance is, therefore, closely related to democracy. It follows, therefore, that the effectiveness of economic policy to promote green finance heavily relies on the institutional and political environment. On one hand, good governance provides the necessary foundation for effective policy implementation by promoting order and stability, as well as transparency and efficiency (Mahmoudinia & Amroabadi, 2023). Democracy also allows accountability, participation, and social control to keep policies in line with the will of the people and environmental aims (Abhayawansa et al., 2021; Sadeghi Amroabadi, 2021; Sari, 2023). Thus, improving democratic governance and governance quality is a critical preliminary requirement for the effectiveness of any ambitious economic strategy in the realm of green finance.

Although there is a burgeoning amount of literature addressing green finance, there is still a lack of systematic studies on the interrelation between regime type and democratic indicators and the effectiveness of economic measures mobilising green funds directly (Xu & Zhu, 2022). The mediating effect of institutional factors such as corruption control measures, legal stability, and the enforcement capacity of policies on the effectiveness of green finance tools is still unclear in cross-country studies (Shi et al., 2024). The majority of current studies focus on the technological-financial component of green finance tools without paying attention to the role of the political-institutional mechanism influencing capital flows (Bracking & Leffel, 2021).

Moreover, there is a lack of empirical information and modelling tools to accurately identify the role of different forms of democracy in green investing and

related environmental results (Dokuzoğlu & Güzel, 2024). Notable researchers have also brought to attention the demand to comparatively evaluate the effectiveness of green monetary and finance policies in varied forms of institutional and governance structures (Bracking & Leffel, 2021).

In conclusion, governance, institutional quality, and regime type can be identified as essential factors influencing the success of green finance policies. The lack of rigorous cross-country studies and the inadequate investigation of the mediating role of institutional quality imply that there is a pressing need to focus research on the relationship between governance and democracy to influence green finance policy success.

2. Literature Review

2.1 Institutional Foundations of Green Policy Effectiveness

The institutional theory differentiates between formal institutions, which include laws, rules, or regimes of supervision, and informal institutions, which include social norms or values. The two aspects contribute to the effectiveness of the implementation of the green financial policy. A green finance system that operates in an environment that values aspects of transparency and accountability is able to promote environmental values (Fu et al., 2023; Yadav et al., 2024).

Institutional quality weakens policy risks, hence creating conducive environmental investments by increasing the confidence of the investors' community (Hunjra et al., 2023). Institutions with good supervision over financial markets, hence good social profits, improve the environmental profits from green investments. According to Degbedji et al. (2024), the interaction effect between the quality of the institution and green investment has a strong positive impact on the SDG index. The implication is that the more efficient the institutional system, the more successful the green economic policies will be.

Theory of Sustainable Finance emphasises that sound institution-building and regulatory developments are dispersed prerequisites for the stability and credibility of green financial markets. Investor confidence rises, and the risk of greenwashing declines while regulatory standards are clear and transparent. The systematic review confirms that there is integration between the world of governance and financial markets necessary for the advancement of sustainable development, categorised by green finance (Fu et al., 2023).

Bai (2025) highlights the effectiveness of green bonds in raising the standard of financial and environmental outcomes, mostly in corporations that focus on quantitative environmental objectives.

Creti & Ftiti (2024) also highlight the importance of having institutions around the world, on the regional and national levels, to ensure the realisation of the "just transition" process from fossil fuels to the production of low-carbon energy sources. The importance of the "just transition" process focuses on the need for

there to be governance structures that promote fairness, which supports the thesis that civil rights are one of the important foundations of the just transition process. Theoretical foundations linked to institutionalism, environmental political economy, and policy governance help develop the arguments about the manner in which the effectiveness of green financial practices is shaped by the channels between the practices of governance, democracy, and the result of green financial practices (Xu & Zhu, 2022). In particular, the influencing channels are the reduction of policy risks, greater attention to transparency, and the enforcement of financial environment policies (Çitil et al., 2023).

Good quality governance practices are key to instilling confidence in investors, policy consistency, and the success of green financial instruments (Bracking & Leffel, 2021). The integration of green financial practices with green financial instruments is, therefore, able to promote the reduction of pollution, as well as the investment in the environment, according to different national studies undertaken on the matter (Xu & Zhu, 2022; Dokuzoğlu & Güzel, 2024). "Power relations, interests, and institutional structures are crucial in shaping the consequences of environmental policies from the perspective of political economy" (Labonté, 2018). Only countries with good governing capabilities can effectively deliver green financial instruments, carbon pricing, or green bonds, and realise the intended outcomes for the environment. The success of economic policies in turning countries green is linked with the "ability of the institutional system to correct the environmental externality" (Nguyen et al., 2024).

2.2 Good Governance and Green Finance

The good-governance theory indicates that a strong quality of institutions, as approximated by government effectiveness, regulation quality, and control of corruption, is a foundation of the efficiency of implementation of policies (Daliri, 2024). In the context of green finance, good-governance practices help avoid risks associated with resource misallocation, strengthen adherence to environment-related targets, and avoid acts like greenwashing (Zhang et al., 2022; Antwi et al., 2024).

Evidence from the BRICS countries indicates a positive reinforcement of the impact of green finance, as well as investments in renewable energy, on the mitigation of CO₂ emissions, as a result of effective governance performance in those countries (Yadav et al., 2024). The quality of institutions has a positive impact on sustainable development, enhancing the impact of green finance on results associated with sustainable development (Sun et al., 2025).

The availability of quality institutions, such as government efficiency, political stability, anti-corruption, and the rule of law, guarantees effective distribution of funds to green investments, yielding a positive result in the socioeconomic environment (Degbedji et al., 2024). The lack of quality institutions results in diverted funds, thereby making policies ineffective (Zhao et al., 2024; Entezari et al., 2023).

Institutional quality (rule of law, regulatory quality, control of corruption, and government effectiveness) is a necessary condition for transforming green-finance flows into tangible environmental and sustainability outcomes (Ma & Chang, 2023). Huo et al. (2022) demonstrate that governance indicators enhance the growth of green-bond markets and moderate the effect of green-economy expansion on green-bond development.

Jiang et al. (2025), using the STIRPAT model with advanced econometric methods, analyse BRICS countries from 2000 to 2020 and find that ICT trade exerts a positive influence on renewable-energy generation, with effective governance as a pivotal moderator of this relationship. By contrast, traditional financial development shows a negative link with renewable-energy output and accentuates the need for targeted and well-designed green-finance mechanisms to support energy transitions.

2.3 Democracy and Sustainable Development

Democratic institutions increase policymakers' responsiveness to environmental issues through participation, accountability, and civic supervision. In an egalitarian democratic state, citizens have a higher propensity towards inclusive and environmentally sustainable policies. Empirical findings show that egalitarian governance encourages high levels of public support for green energy because of equal distribution, which boosts societal acceptance of renewable energy policies (de Soysa et al., 2025).

Differences in democratic styles, being liberal versus egalitarian, result in divergent results for the environment. Even though in egalitarian democracies, more expenditures are made on environment-related R&D, progress on reducing CO₂ levels takes a longer period because of the consensual approach to decision-making (Mildenberger, 2020; de Soysa, 2025). This practice can be referred to as carbon capture in policymaking, wherein economic and employment priorities are often significant to climate goals.

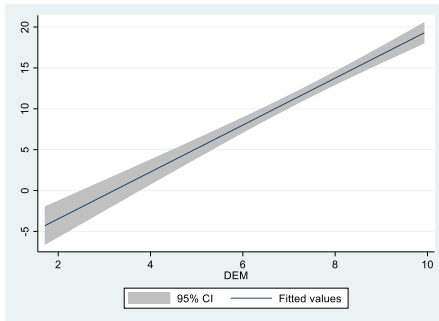
The liberal market democracies, focusing on personal freedoms, as well as a market-driven approach, display a higher degree of flexibility as well as innovation within the context of the greening of policies (Hübner, 2018). On the other hand, the coordinated market democracies, based on social cohesion, as well as a consensual approach, implement comprehensive welfare-related environment policies (Christoff & Eckersley, 2011). But, powerful lobbies within the pollution-generating industries can obstruct speedy transformation (Mildenberger, 2020). Thus, under both democratic variants, larger budgets are allocated to renewable energy as well as green research & development, though the decrease in CO₂ emissions takes place.

[Pucheta-Martínez and Gallego \(2024\)](#) put forth a compelling argument that the intricate relationship between civil liberties and political rights has a significant impact on the degree and quality of corporate environmental disclosure practices, positing that when civic freedoms are robust and well-established, they effectively create a conducive environment that fosters and promotes sustainability initiatives, which notably include the adoption of renewable energy technologies and practices. This position is coordinated with the more extensive argument that proposes participatory governance, which is essentially supported and promoted by the idea of civil rights, is not only a positive factor but is, in fact, a vital necessity within the context of transformational changes in policies, which can ultimately contribute towards the implementation of cleaner energy. [Saadaoui et al. \(2024\)](#) provide empirical evidence from Tunisia that democracy enhances the adoption of renewable energy through its enabling effect on higher public influence over energy policy. They point out that strong democratic institutions—usually paired with solid civil rights—drive both government stability and technological progress. These are big reasons why renewable energy investments go up. The takeaway? Civil rights form the backbone of democracy, giving people more power to push for energy policies that actually help the planet and themselves. [Nekooei et al. \(2015\)](#) investigate the relationship between democracy and environment quality in selected Organization of Islamic Cooperation countries by using panel data model for the period 2000-2010. They found that democracy affects environment quality directly in these countries.

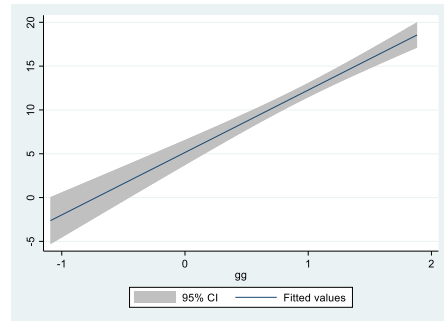
2.4. Some statistical facts

In this section, we demonstrate the relationship between green finance, democracy, and the quality of governments in three different income level countries (high, middle, and low). Based on a comprehensive analysis in Figure 1, we find that, in contrast to low- and middle-income countries, in high-income economies, democracy and governance indicators have a strong reinforcing effect on green finance development. This empirical result shows that in this category of countries, a strong and direct relationship between institutional quality and green financial level can be observed, which can be caused by the existence of advanced financial markets, extensive investment, and stable institutions. Democracy and governance through accountability and transparency mechanisms, quality regulation, legal frameworks, and policymaking provide the necessary enabling environment for the growth and prosperity of green finance in developed countries. However, for middle-income countries, the graph reveals a positive but less strong relationship between green finance, democracy, and governance. Although the financial capacity of these countries is more or less developed, limitations such as weak

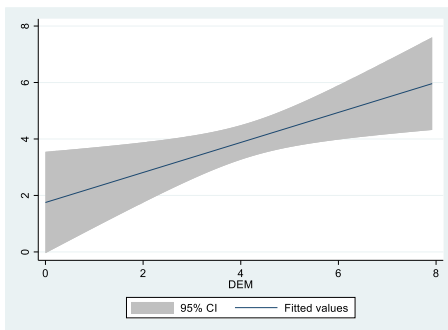
capital markets, institutional corruption, and economic fluctuations make the influence of institutions on green finance less than that of high-income countries. These countries are in a transitional phase. Although they may have improvements in democratic institutions and governance, these institutions may not be as strong or stable as in high-income countries. In comparison, for low-income economies, an ineffective and weak relationship is observed between green finance and indicators of democracy and good governance. This can be caused by the severe limitation of financial resources, the inability to attract foreign capital, and the weakness of the economic infrastructure. In general, the implemented analysis shows that for the effective promotion of green financing, institutional reforms must be made through economic strengthening and better access to financial resources, especially in countries that face significant financial and structural constraints.



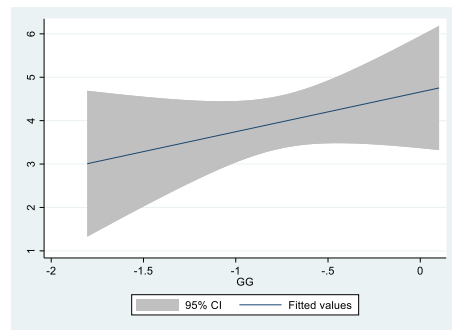
a. High income, green finance and Democracy



b. High income, green finance and Good Governance



c. Low income, green finance and Democracy



d. Low income, green finance and Good Governance

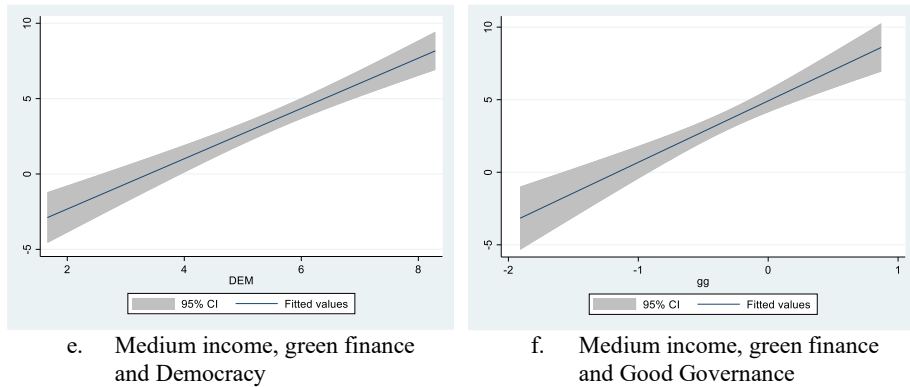


Figure 1. Green Finance, Democracy, and Good Governance

Source: Research findings

Using Paired coordinate scatter (in Figure 2), we present the relationship between green finance and two institutional variables in three groups of countries (high-income, middle-income, and low-income economies). Based on Figure 2, we found that the distribution pattern of points indicates a positive and relatively strong relationship between green finance and both institutional indicators in high-income countries. This result indicates that improving the quality of governance and improving the level of democracy are directly associated with increasing the level of green finance. For middle-income countries, the scatterplot of points shows a positive but more diffuse relationship. In other words, although democracy and good governance are related to green finance, the intensity of this relationship is not as strong as that of high-income countries. In addition, this evidence for low-income economies shows a very weak or even undetectable relationship between green finance and institutional indicators. However, Figure 2 additionally demonstrated that most of the data are concentrated on the low level of green finance, and even in situations where there is some degree of democracy or better governance, there is no noticeable change in the level of green finance. This diagram summarizes that economic development, strong institutions, and green finance often go hand in hand. This association supports the hypothesis of “sustainable development,” in which economic progress, institutional quality, and environmental protection can be achieved simultaneously.

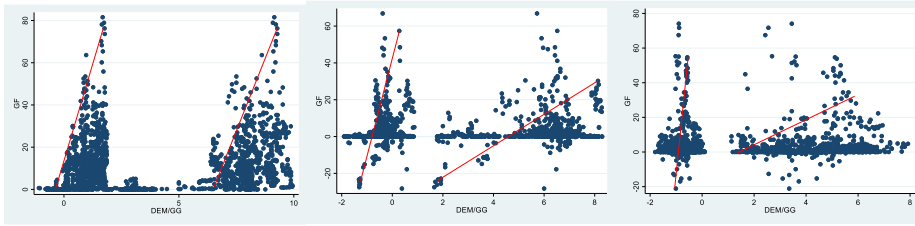


Figure 2. Paired coordinate scatter

Source: Research findings

According to Figure 3, the median and quartiles of GF, DEM, and GG variables for high-income countries are significantly higher than those of the other two groups. Also, the range of changes of these variables is the highest in middle-income countries, which indicates significant heterogeneity in this group. On the other hand, low-income countries have the lowest average and the lowest range of changes, indicating that these countries are concentrated in low levels of institutional development and green finance.

The evidence shows that in high-income countries, the GF index is at the highest level, which indicates extensive attention and investment in the field of renewable energy and green financial projects, and access to new technologies in these countries. Also, in this category of countries, the index of democracy and governance is in a more favorable position, because the political institutions in them are comparatively more transparent, and the possibility of wider participation of citizens is available. We observe a different situation for middle-income and low-income countries. In the low-income group, the GF index is at the lowest level and indicates financial limitations, lack of necessary infrastructure, and strong dependence on traditional energy sources. The democracy index is often at a lower level, which indicates restrictions on political freedoms and citizen participation. On the other hand, in middle-income countries, investment in green finance is less than in high-income countries, but it is growing, and the democracy index is also more dispersed. This chart provides strong statistical evidence for institutional and environmental gaps between different groups of countries.

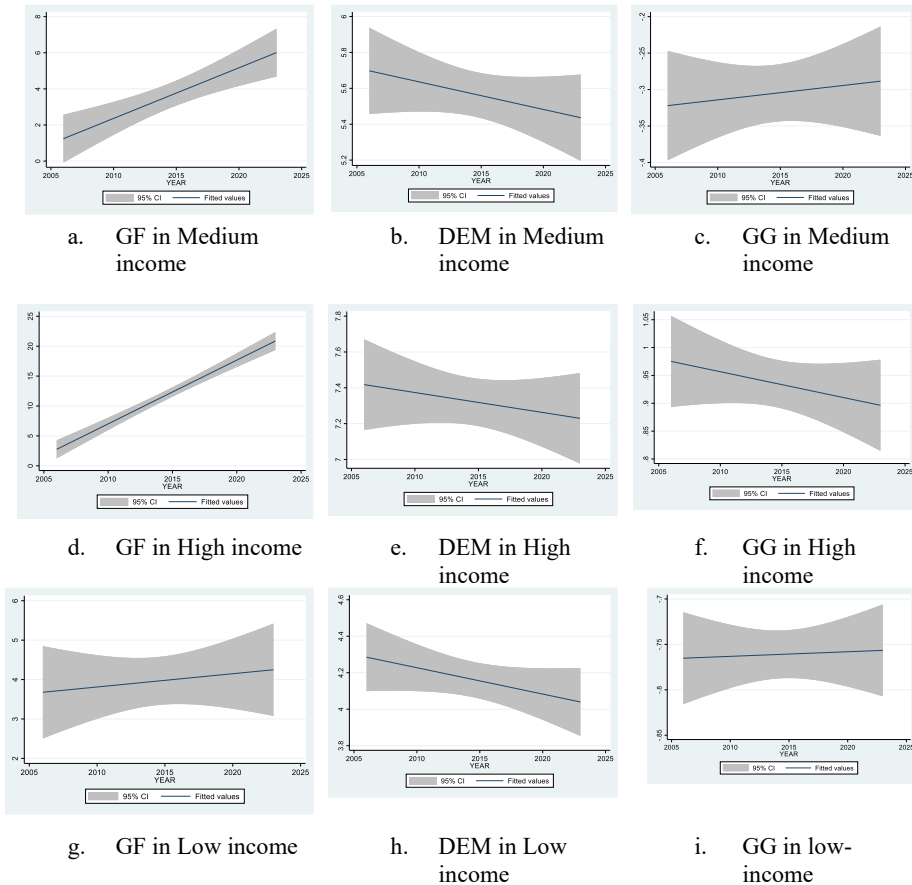


Figure 3. GF, DEM and GG in Income-Based Country Groups

Source: Research findings

3. The Model

Based on the topics presented, it is important to investigate whether the quality of institutions, democracy, and economic policies in the selected economies can contribute to the progress of green financing. This is particularly valuable for analyzing and assessing the sustainable development of green finance in developing, developed, and less developed economies. The current study aims to investigate the long-term effects and the causal relationship between the variables of good governance and democracy indicators and green financing in three classes of countries. For this purpose, drawing on several studies such as [Ahmed et al. \(2022\)](#), [Handoyo \(2024\)](#), [Wang et al. \(2023\)](#), [Tufail et al. \(2024\)](#), [Altaf et al. \(2025\)](#), and [Khan et al. \(2025\)](#), a comparative study is conducted between three categories of high-income, middle-income, and low-income countries during the period 2006 to 2023. The classification of countries in this study is based on gross national income per capita, using the World Bank's classification, as

presented in Appendix 1. The main variables of this study include two proxies for green finance indicators (GF and SOL), democracy (DEM), governance indicators (GG, corruption control, regulatory quality, rule of law, political stability and right to comment and accountability), fiscal policy (government spending, GEX), monetary policy (broad money, BM) and a set of control variables such as GDP, inflation (INF), trade openness (OPE), CO₂ emissions and unemployment (UNE). Furthermore, several interaction terms – such as Democracy × Fiscal Policy (DEMG) or Governance × Monetary Policy (GGM) – are introduced to show the moderating role of institutional quality in shaping the effectiveness of macroeconomic policies on green finance. The variables used in this research, along with the definition and extracted sources, are shown in Table 1.

Table 1. Descriptive characteristics of data.

Abbreviation	Variable	Indicators	Sources
<i>GF</i>	Green Finance	Investment in Renewable Energy (Electricity production from renewable sources)	International Renewable Energy Agency (IRENA)
<i>SOL</i>	Green Finance	Intl. Public Flows in Solar Energy	IRENA
<i>GEX</i>	Fiscal Policy	Government Expenditure	World Development Indicators (WDI)
<i>BM</i>	Monetary Policy	Broad money	WDI
<i>DEM</i>	Democracy index	Composite of citizens' free and fair elections, civil liberties, participation in politics, having a functioning government, etc.	Economist Intelligence Unit
<i>DEM M</i>	Interactive effect	Multiplicative effect of Democracy & Monetary Policy	
<i>GGM</i>	Interactive effect	Multiplicative effect of Good Governance & Monetary Policy	
<i>GGG</i>	Interactive effect	Multiplicative effect of Good Governance & Fiscal Policy	
<i>DEMG</i>	Interactive effect	Multiplicative effect of Democracy & Fiscal Policy	
<i>GG</i>	Good Governance Index	Average of 6 indices of good governance	Worldwide Governance Indicators (WGI)
<i>CC</i>	Control of Corruption	The extent to which public power is exercised for private gain	WGI

<i>GE</i>	Government Effectiveness	Indicates perceptions of the quality of public services, the quality of civil services and its independence from political pressures.	WGI
<i>PS</i>	Political Stability	Indicates political stability and the absence of violence or terrorism and this index measures the likelihood of political instability.	WGI
<i>RQ</i>	Regulatory Quality	Indicates perceptions of the government's ability to formulate and implement sound policies and regulations that permit and promote private sector development.	WGI
<i>RL</i>	Rule of Law	The extent to which agents have confidence in and abide by the rules of society, including the quality of contract enforcement, property rights, the police, and the courts.	WGI
<i>VA</i>	Voice and Accountability	A country's citizens can participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.	WGI
<i>INF</i>	Inflation	Inflation, consumer prices (annual %)	WDI
<i>GDP</i>	Gross Domestic Production	Gross Domestic Product in constant 2015 (US\$)	WDI
<i>OPE</i>	Trade openness	The ratio of exports of goods and services plus Imports of goods and services to GDP.	WDI
<i>CO2</i>	Co2 emission	Total of Carbon dioxide (CO2) emissions	WDI
<i>UNE</i>	Unemployment	Unemployment Ratio	WDI

Source: Research Findings

Next, to validate the statistical characteristics of the data, Breusch-Pagan LM and Pesaran CD cross-sectional dependence tests are used to assess a common structure between observations in the sample. Also, a series of panel unit root tests, including Levin-Lin-Chu (LLC), Im-Pesaran-Shin (IPS), and CIPS, are applied to determine the stationarity of the variables. In the next step, Westerlund and Kao panel cointegration tests are used to evaluate the existence of long-term equilibrium relationships between variables.

Due to cross-sectional dependence between countries, robust estimation techniques such as Driscoll and Kraay standard errors, are extracted for long-term results. This method, originally proposed by [Driscoll and Kraay \(1998\)](#), is robust to very general situations of cross-sectional dependence, as well as to serial correlation and heteroskedasticity ([Ganda, 2024; Meierrieks, 2025](#)). This method can provide accurate estimates if it is related to a large number of cross-sectional units ([Mohamad Taghvaei et al., 2024](#)). We also use [Jiang et al. \(2025\)](#) non-Granger causality test and one-step version of the system Generalized Method of Moments (GMM) estimator for sensitivity analysis. Therefore, we obtain the following basic theoretical model according to formulas 1 and 2:

$$GF_{i,t} = f(DEM_{i,t}, GEX_{i,t}, BM_{i,t}, GG_{it}, CC_{i,t}, GE_{i,t}, PS_{i,t}, RQ_{i,t}, RL_{i,t}) \quad (1)$$

$$SOL_{i,t} = f(DEM_{i,t}, GEX_{i,t}, BM_{i,t}, GG_{it}, CC_{i,t}, GE_{i,t}, PS_{i,t}, RQ_{i,t}, RL_{i,t}) \quad (2)$$

Where, i represents the countries and t represents the year. In the next step, the long-term linear effect of the democracy and governance index on green finance is rewritten in econometric form as follows:

$$GF_{i,t} = \alpha_0 + \beta_1 DEM_{i,t} + \beta_2 GEX_{i,t} + \beta_3 BM_{i,t} + \sum_{j=4}^9 \beta_j Governance_{i,t} + \sum_{z=10}^{14} \beta_z X_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$SOL_{i,t} = \gamma_0 + \delta_1 DEM_{i,t} + \delta_2 GEX_{i,t} + \delta_3 BM_{i,t} + \sum_{j=4}^9 \delta_j Governance_{i,t} + \sum_{z=10}^{14} \delta_z X_{i,t} + \varepsilon_{i,t} \quad (4)$$

In this equation, α_0 and γ_0 represent the intercept term, β_i and δ_i represent the long-run coefficients in the GF and SOL models, Governance represents a vector of institutional variables, X includes a vector of control and macroeconomic variables, and $\varepsilon_{i,t}$ represents the error terms. Table 2 presents the descriptive statistics of the key variables of this study by three groups of countries: high-income economies, upper-middle-income economies, and lower- and lower-middle-income economies. The findings show that high-income countries have the highest average green finance (11.8) and international public flows in the field of solar energy (117.3). This indicates that economic development, along with advanced financial infrastructure, has provided the necessary platform to direct capital toward clean energy. Institutional indicators showed significant differences among the different groups. High-income countries have higher levels of democracy (7.32), control of corruption (0.99), government efficiency (1.05), and political stability (0.65) compared to low- and middle-income countries. This implies that a sound institutional framework may help to generate an enabling environment for sustainable development and channel capital into green sectors. On the other hand, the average of government spending in high-income economies is higher than that in other groups. This finding reflects the greater financial capacity of these countries in providing public resources and implementing development policies. In contrast, in the group of lower-income countries, although the absolute level of government spending is lower, the ratio of the money supply (BM) fluctuates greatly.

Table 2. Descriptive statistics

Variables	Mean	Std.dev	Min	Max	Obs
High-Income Economics					

GF	11.80	13.15	-0.10	81.55	
SOL	117.30	186.76	0.06	731.03	882
GEX	10.70	0.76	9.02	12.50	
BM	47.55	69.97	0	461.60	
DEM	7.32	1.99	1.71	9.93	
CC	0.99	0.88	-1.14	2.45	
GE	1.05	0.68	-0.71	2.46	
PS	0.65	0.52	-1.33	1.61	
Upper-Middle- Income Economics					
GF	3.62	9.45	-28.23	66.85	
SOL	20.29	91.55	0	1101.52	702
GEX	10.03	0.72	8.21	11.56	
BM	53.73	34.56	0	222.01	
DEM	5.56	1.69	1.66	8.29	
CC	-0.44	0.52	-1.64	1.02	
GE	-0.23	0.56	-1.85	1.23	
PS	-0.32	0.75	-2.82	1.20	
Lower Middle- & Low-Income Economics					
GF	3.96	9.417	-21.13	74.06	
SOL	28.04	113.89	0	1588.94	918
GEX	9.46	0.706	7.86	11.50	
BM	36.15	20.115	0	09.133	
DEM	4.16	1.48	1.13	7.92	
CC	-0.79	0.44	-1.59	0.77	
GE	-0.79	0.50	-2.22	0.67	
PS	-0.80	0.70	-2.45	0.66	

Source: Research Findings

In the following, we consider the sensitivity analysis of the variables under investigation. The results of Table 3 indicate that in all income groups, democracy has a positive and meaningful relationship with green investment and solar energy. However, this relationship is much stronger in high-income countries. On the other hand, it can be seen that in high-income countries, governance quality has a positive and strong correlation with GF and SOL, but in middle and low-income countries, this relationship is much weaker or even insignificant. Also, government spending and financial policies in high-income countries have a positive correlation with GF and SOL, while in middle-income countries, this relationship is negative and significant, and in low-income countries, there is no significant relationship.

Table 3. Results of correlation analysis

V ariables	High-Income Economics		Upper-Middle- Income Economics		Lower Middle- & Low-Income Economics	
	GF	SOL	GF	SOL	GF	SOL

D	0.695***	0.268***	0.298***	0.101**	0.084**	0.159***
EM						
G	0.62***	0.392***	0.236***	0.038	0.039	0.157*
G						
G	0.292***	0.222***	-0.093***	0.314	-0.047	-0.026*
EX						
B	-0.128***	0.392*	0.156***	0.314***	-0.012*	-0.592
M						

Note: ***, **, and * represent statistically significant level at 1%, 5%, and 10%

Source: Research Findings

4. Empirical Results

4-1. Cross-sectional dependence tests

At this stage, we performed diagnostic tests to determine the compatibility and validity of the selected model. Baltagi (2008) states that cross-sectional dependence may exist in panel data and is problematic. The Breusch-Pagan LM proposed by Breusch and Pagan (1980) and the Pesaran CD tests proposed by Pesaran (2004) were used, and both are suitable for heterogeneous and non-stationary panels (see Yadav & Mahalik, 2024; Akinsola & Odhiambo, 2020).

Table 4 presents result from the CD tests for the key variables in three groups of countries, namely high-income economies, upper-middle-income economies, and lower-middle-income economies. The results indicate the existence of significant dependence between countries; these values are significant mainly at the 1% and 5% confidence levels. Therefore, it can be found that the behavior of economic, institutional, and financial variables of countries is not independent from each other and is strongly affected by common global trends and shocks. Therefore, the existence of cross-sectional dependence shows that the use of traditional panel models, which are based on the assumption of independence of cross-sectional units, can lead to biased results.

Table 4. The results of the cross-sectional dependence tests

Vari able	Bre usch- Pagan LM	Pes aran CD	Bre usch- Pagan LM	Pes aran CD	Bre usch- Pagan LM	Pes aran CD
High-Income Economies			Upper-Middle- Income Economies		Lower Middle- & Low-Income Economies	
<i>GF</i>	7508***	72.09***	7021***	44.98***	7508***	72.09***
<i>SOL</i>	6982**	29.12***	6425**	32.39***	6972**	29.12***
<i>GG</i>	6007**	1.89*	5018**	3.25**	6007**	1.89*

<i>GEX</i>	5523**	20.02**	4902**	26.45***	5523**	20.02**
<i>BM</i>	4789**	7.56**	4936**	32.39***	4789**	7.56**
<i>DEM</i>	5477*	9.36*	2931*	4.62*	5477*	9.36*
<i>CC</i>	6129*	-1.99**	3446*	-0.83	6129*	-1.99**
<i>GE</i>	4171*	1.07	2704*	5.66*	4171*	1.07
<i>PS</i>	6442*	8.34*	3403*	0.70	6442*	8.34*
<i>INF</i>	4228*	40.2*	2785*	40.3*	4228*	40.2*
<i>GDP</i>	15367*	115.3*	6995*	73.5*	15367*	115.3*
<i>OPE</i>	4834*	13.0*	3410*	25.7*	4834*	13.0*
<i>CO2</i>	13429*	102*	6221*	34.4*	13429*	102*
<i>UNE</i>	3157*	3.31*	3157*	3.31*	3157*	3.31*

Note: ***, **, and * represent statistically significant level at 1%, 5%, and 10%, respectively

Source: Research Findings

4-2. Panel unit root tests

In this section, we use the first-generation panel test, including Levin-Lin-Chu (LLC) and Im-Pesaran-Shin (IPS), as well as the second-generation test (CIPS Test) to check the unit root analysis. A unit root in variables means the absence of a constant mean and variance, and hence indicates non-stationarity and the presence of a random process (see Oluseun Olayungbo, 2021; Huo et al, 2025).

Based on the results of the panel unit root tests presented in Table 5, it is clear that in most of the models under review, green financing indicators and governance indicators such as the quality of regulations, the rule of law and the voice of the people and accountability are stationary at levels and reflect more institutional stability; While macroeconomic variables such as GDP, inflation, inequality, and CO2 emissions are non-stationary at levels and only become stationary after first differencing. In general, these results show that there is a combination of I(0) and I(1) variables among the entire sample. Also, this situation justifies the necessity of using panel cointegration techniques to capture both long-run relationships among the variables.

Table 5. Panel unit root tests.

Variable	Levin-Lin-Chu Test (LLC)		Im-Pesaran-Shin (IPS)		CIPS Test	
	Level	First Difference	Level	First Difference	Level	First Difference
High-Income Economics						
<i>GF</i>	-2.87	373.6*	-2.13**	-	-2.45**	-
<i>SOL</i>	-	3.78**	-1.02	-	-	-
	1.98			5.02**	2.22**	

<i>GG</i>	-	4.25**	0.02*	-	-	-
	0.09			-2.85**	1.68	4.98**
<i>GEX</i>	-	-	-	-	-	-
	6.56***		2.96**			
<i>BM</i>	-	-	0.95*	-	-	-
	1.05	5.25**		6.95***		
<i>DEM</i>	-	-	-	-	-	-
	1.30	7.12**	2.01*	5.26***	2.51***	
<i>CC</i>	-	-	-	-	-	-
	1.07	5.12**	2.52**		1.75	3.83*
<i>GE</i>	-	-	-	-	-	-
	0.95	3.55**	2.02*	7.25**	1.76	4.21*
<i>PS</i>	-	-	1.41	-	-	-
	1.02	5.91***		3.86**	2.35*	3.89*
<i>RQ</i>	-	-	-	-	-	-
	3.74***		3.06***		3.52***	
<i>RL</i>	-	-	-1.69	-	-	-
	3.63***			6.37***	2.23**	
<i>VA</i>	-	-	-	-	-	-
	3.15***		5.07***		3.85***	
<i>INF</i>	-	-	-	-	-	-
	1.98*	3.49**	1.86*	2.94**	2.36*	4.39*
<i>GDP</i>	-	-	-0.78	6.9**	-	-
	0.39	4.18***		*	1.85	3.39*
<i>OPE</i>	-	-	-	-	-	-
	3.47***		2.77**		1.43	3.22*
<i>CO2</i>	-	-	-	-	-	-
	1.98*	2.18**	2.01**		1.34	3.73*
<i>INEQ</i>	-	-	-	-	-	-
	2.62*	3.65**	2.07**		2.37*	4.13*

Upper-Middle- Income Economics

<i>GF</i>	0.96	-	-	-	-	-
		2.03**	1.88*	4.03**	2.13**	-
<i>SOL</i>	-	-	-	-	-	-
	6.47***		6.41***		2.68***	
<i>GG</i>	-	-	-	-	-	-
	3.66		4.89***		2.15**	
<i>GEX</i>	-	-	-	-	-	-
	2.03**		3.02***		3.05***	
<i>BM</i>	0.25	-	-0.99	-	-	-
		3.85***		3.41***	3.63***	
<i>DEM</i>	-	-	-	-	-	-
	1.33*	5.55***	6.37***		1.92	3.67*
<i>CC</i>	-	-	-	-	-	-
	3.20***		3.12***		1.65	3.46*
<i>GE</i>	8.02	235.6	-1.01	-	-	-
		*		2.52**	1.73	4.16*
<i>PS</i>	-	-	-	-	-	-
	3.98***		2.01**		1.68	3.81*
<i>RQ</i>	-	-	-	-	-	-
	3.59***		2.37**		3.05***	
<i>RL</i>	-	-	-	-	-	-
	3.42***		3.02***		2.24**	
<i>VA</i>	-	-	-	-	-	-
	3.10***		4.05***		3.01***	
<i>INF</i>	-	-	-	-	-	-
	2.82***		2.98**		2.49*	4.69*

<i>GDP</i>	-	-	-	-	-	-
	5.60***		3.07***		1.34	3.23*
<i>OPE</i>	-	-	-0.37	-	-	-
	0.07	3.65**		5.55***	1.83	3.30*
<i>CO2</i>	0.7		-	-	-	-
		3.94***	1.85*	4.37***	1.24	2.79*
<i>INEQ</i>	-	-	-	-	-	-
	1.9*	5.57***	2.01**		2.22**	3.70*

Lower Middle- & Low-Income Economics

<i>GF</i>	-	-	-	-	-	-
	4.82***		7.89***		2.04**	-
<i>SOL</i>	-	-	-	-	-	-
	6.91***		6.09***		3.98***	-
<i>GG</i>	-	-	-	-	-	-
	5.12***		3.05***		1.34	2.36**
<i>GEX</i>	-	4.02**	-	-	-	-
	2.01*	*	4.47***		2.75***	-
<i>BM</i>	-	-	-	-	-	-
	1.98*	2.28**	6.01***		2.22**	-
<i>DEM</i>	-	255.0*	-	-	-	-
	2.08**		2.84**		1.94	3.25*
<i>CC</i>	-	-	-	-	-	-
	2.68***		3.43***		1.28	3.30*
<i>GE</i>	-	-	-	-	-	-
	2.50**		5.07***		1.91	4.11
<i>PS</i>	-	-	-	-	-	-
	5.88***		2.37**		2.18**	3.96*
<i>RQ</i>	-	-	-0.67	-	-	-
	3.96***			4.07***	2.03*	2.52***
<i>RL</i>	-	-	-	-	-	-
	3.35***		2.28**		2.05*	2.81***
<i>VA</i>	-	-	-	-	-	-
	3.19***		7.02***		1.74	4.24**
<i>INF</i>	0.24	-	-	-	-	-
		3.04**	0.37***	2.74***	2.26*	5.09*
<i>GDP</i>	-	-	-	-	-	-
	3.03***		5.75***		1.85	3.67*
<i>OPE</i>	-	-	-	-	-	-
	5.86***		9.01***		1.99	3.54*
<i>CO2</i>	-1.8*	-	-	-	-	-
		4.56***	0.68***	5.07***	2.59*	5.13*
<i>INEQ</i>	-1.9*	-	-	-	-	-
		5.04***	2.85***		2.52*	3.09*

Note: ***, **, and * represent statistically significant level at 1%, 5%, and 10%

Source: Research Findings

4.3 Panel co-integration test

Table 6 displays the outcomes of the [Westerlund \(2006\)](#) and [Kao \(1999\)](#) panel cointegration tests to examine the long-run relationships among institutional, financial, and macroeconomic variables in three income groups. Both of these tests evaluate the null hypothesis of no cointegration against the alternative hypothesis of cointegration (see [Bildirici & Ersin, 2023](#); [Bazan Navarro et al., 2024](#)). In general, the results of both Westerlund and Kao tests in all income groups reject the null hypothesis of no cointegration and indicate the existence of a long-term and

stable relationship between governance indicators, financial, and economic variables.

Table 6. Panel co-integration test

	GF=f(DEM,G G,BM,GEX,DEMG, DEMM,INF,GDP,O PE)	SOL=f(DEM,G G,BM,GEX,DEMG,D EMM,INF,GDP,OPE)	GF=f(DEM,CC ,GE,RQ,RL,VA,BM, GEX,INF,GDP,OPE)	SOL=f(DEM,C C,GE,RQ,RL,VA,BM, GEX,INF,GDP,OPE)
High-Income Economics				
N esterl und test	4.57***	7.29***	2.95***	4.14***
K ao test	-3.02**	-3.41**	-2.41**	-3.98***
Upper-Middle- Income Economics				
N esterl und test	3.85**	3.89***	4.01**	1.93*
K ao test	-2.96***	-3.01***	-1.61**	-1.99**
Lower Middle- & Low-Income Economics				
N esterl und test	4.82**	2.74**	4.01**	3.02*
K ao test	-2.85***	-3.41***	-3.22**	-1.96**

Note: ***, **, and * represent statistically significant level at 1%, 5%, and 10%, respectively. H0: No cointegration

Source: Research Findings

4-4. Driscoll-Kraay standard errors results

In this section, we examine the results by considering green investment (GF) as a dependent variable in the framework of the model using the Driscoll-Kraay standard error method for the three economic groups. Based on Table 7, it can be seen that the democracy index (DEM) and good governance (GG) have a positive and significant effect on green investment in all three economic groups. This result shows that the existence of democratic institutions, political participation, and quality of governance strengthen the motivation to attract green investments and develop renewable energy. In relation to the interaction effects, the results show that in all three categories of countries, the effects of interactions between democracy and monetary policies (DEMM), democracy and fiscal policies (DEMG), good governance and monetary policies (GGM), and good governance and fiscal policies (GGG) are all positive and significant. This finding suggests that

the combination of economic policies with strong institutions can create additional effects on green financial development.

In relation to monetary and financial policy variables, it can be stated that monetary policy (BM) has a negative and significant effect on green investment in most economic groups (especially in high and middle-to-high-income countries). When you factor in institutions and their interactions, the simple negative link between broad money (BM) and green finance (GF) disappears. In countries with lower incomes, broad money alone seems slightly negative—it's usually tied to instability when money supply grows. But once you throw in elements like governance, democracy, and those interaction effects, something changes. The model shows that broad money actually helps green finance, but only if the institutions are strong enough to guide that extra liquidity where it needs to go. So, there's really a positive relationship here, hidden by the basic two-variable approach. This could indicate that increased liquidity without proper guidance leads to inflation or inefficient allocation of resources instead of encouraging green investment. However, the effects of fiscal policy (GEX) on green investment in this group of countries are positive and significant. Therefore, increased government spending (especially in the infrastructure and clean energy sectors) is an important driver for green investment development. In relation to other macroeconomic variables, it can be stated that inflation mainly hurts green investment. By creating uncertainty and increasing investment costs, inflation is considered an obstacle to attracting sustainable investments. The effects of gross domestic product (GDP) and the degree of trade openness on investment are positive and significant. This shows that economic growth and integration into the global economy strengthen the capacity of countries to attract green investments.

In general, the results show that green investment depends not only on economic variables (growth, inflation, and financial policies) but also on institutional quality (democracy and good governance). The existence of strong institutions, democratic participation, and transparent governance can make monetary and financial policies more efficient in line with sustainable development and green investment.

Table 7. Results from Driscoll-Kraay standard errors with GF as dependance variable

	High-Income Economics				Upper-Middle- Income Economics			Lower Middle- & Low-Income Economics		
Variable	GF as dependance variable				GF as dependance variable			GF as dependance variable		
<i>DEM</i>		0.01*	0.00*			0.02*	0.02**		0.02*	0.02**
<i>GG</i>		0.00*	0.01**			0.02	0.02**		0.02*	0.02*
<i>BM</i>	-0.002***	-0.02*	0.02	-0.02**		-0.06*	0.04*	-0.02*	-0.01	0.02*
<i>GEX</i>	0.196**	0.00**	0.04*	0.02*	-0.02	0.03*		-0.04**	0.12	0.04
<i>DEMM</i>			0.04*				0.12**			0.32**
<i>DEMG</i>			0.15*				0.01*			0.31**
<i>GGG</i>			0.03**				0.02**			0.03**
<i>GGM</i>			0.06**				0.01***			0.03**
<i>INF</i>	-0.002**	-0.02*	-0.02*	0.01	0.01	-0.01**	-0.01*	-0.01*	0.01	-0.01*

	0.00	0.01**	0.02*	0.01**	0.01**	0.02**	0.01*	0.05*	0.03*
<i>GDP</i>									
<i>OPE</i>	0.04*	0.00*	0.01**	0.00*	0.01*	0.00*	0.01*	0.01**	0.01**
R-squared	0.30	0.321	0.499	0.28	0.398	0.671	0.19	0.305	0.576
F-statistic	2.590**	2.740***	3.581***	2.452**	2.802***	4.281***	2.490**	2.630***	4.090***

Note: ***, **, and * represent statistically significant level at 1%, 5%, and 10%,
Source: Research Findings

In this section, based on Table 8, we examine the analysis of the determinants of international public finance flows in solar energy (SOL) for three groups of countries: high-income, upper-middle-income, and lower-middle-income economies. This table assesses the impact of monetary policy (BM), fiscal policy (GEX), good governance indicators (CC, GE, PS, RQ, RL, VA), democracy (DEM), control variables (INF, GDP, OPE), and various interactions between governance, democracy, and economic policies.

Table 8 shows that in high and upper middle-income countries, the coefficient of democracy is positive but not statistically significant, while in low and low middle-income countries, this variable is significantly positive. This suggests that democracy in less developed countries plays a stronger role in stimulating green solar investment, perhaps due to a direct effect on transparency and attracting foreign capital. On the other hand, in high- and middle-income countries, corruption control has a positive and significant relationship with solar investment, but in low-income countries, this effect is negative and significant. This could be due to the fact that in weaker economies, anti-corruption reforms may temporarily limit informal investment flows. Regarding government effectiveness (GE), political stability (PS), regulatory quality (RQ), and rule of law (RL): it is observed that in high- and middle-income countries, these indicators are mostly positive and significant, indicating that institutional quality is a key prerequisite for renewable energy development in developed economies. On the contrary, in low-income countries, the effects are sometimes negative, which is probably due to weak legal structures and high costs of law enforcement. Monetary policy has a negative and significant effect in high-income countries (increasing liquidity is detrimental to green investment). In middle-income countries, the effect is variable, and in low-income countries, it has a significant positive effect. This difference shows that in developed economies, liquidity goes more toward traditional sectors, while in weaker economies, liquidity can serve as a source of financing for renewable energy projects. Fiscal policy also has a positive and significant relationship with SOL in high- and middle-income countries. In low-income countries, the results are inconsistent (sometimes negative or insignificant). This finding suggests that government spending plays a critical role in the expansion of solar energy in rich and emerging countries, while in poorer countries, this effect is weaker due to limited government financial resources. The combination of monetary and fiscal policies with governance indicators (such as DEMM, GEM, PSG, etc.) is often positive and significant, especially in medium-sized countries. This suggests that macro policies are more effective when accompanied by high institutional quality. Inflation is mostly negative and significant, especially in high- and low-income countries. This means that price volatility hinders investment in the solar energy sector. GDP has a positive and significant effect on most groups, indicating that economic growth is the main driver of the development of investment in solar energy. The degree of openness is positive and significant in all three groups of countries, especially in middle- and low-income economies; this would therefore

mean that international trade relations can facilitate technology transfer and investment in solar energy. Finally, direct effects show the standalone role of institutions, while interaction effects demonstrate that good governance enhances the policy transmission mechanism, making fiscal and monetary policies more effective in promoting green investment.

Table 8. Results from Driscoll-Kraay standard errors with SOL as dependance variable

	High-Income Economics			Upper-Middle- Income Economics			Lower Middle- & Low-Income Economics		
	SOL as dependance variable			SOL as dependance variable			SOL as dependance variable		
<i>DEM</i>	0.01	0.01		0.01	0.01		0.02*	0.01*	
<i>CC</i>	0.01*	0.02*		0.02*	0.01		-0.04**	-0.05**	
<i>GE</i>	0.01*	0.03*		0.01*	0.02*		0.01	0.04**	
<i>PS</i>	0.01	0.01*		0.01*	0.01*		0.01**	0.01*	
<i>RQ</i>	0.01*	0.01*		-0.01	0.01*		0.01*	0.01*	
<i>RL</i>	0.01*	0.01*		0.01*	-0.01		-0.01*	-0.01**	
<i>VA</i>		-0.01*	-0.01	-0.01	-0.01*		-0.01	-0.01*	
<i>BM</i>	-0.02**	-0.00**	0.02**	-0.00	-0.00	0.01***	-0.00**	-0.00	0.01**
<i>GEX</i>	0.01**		0.01*	-0.01		0.01*	-0.27		0.28*
<i>DEMM</i>			0.01*			0.01*			0.01***
<i>DEMG</i>			0.01*			0.00*			0.01**
<i>CCM</i>			0.01*			0.01*			0.09**
<i>GEM</i>			0.01*			0.01**			0.01***
<i>PSM</i>			0.01*			0.01*			0.01***
<i>RQM</i>			0.02*			0.02*			0.02*

<i>RLM</i>			0.02*			0.02*			0.02*
<i>VAM</i>			0.02*			0.02*			0.02*
<i>CCG</i>			0.02*			-0.01*			0.02*
<i>GEG</i>			0.05*			0.05*			0.05***
<i>PSG</i>			0.02*			0.02*			0.02**
<i>RQG</i>			0.02*			0.02*			0.02*
<i>RLG</i>			-0.04*			-0.03*			-0.04*
<i>VAG</i>			-0.01			-0.01*			-0.01**
<i>INF</i>	-0.02**	0.03	-0.03*	0.02	-0.01*	-0.01*	-0.01**	-0.01	-0.01**
<i>GDP</i>	0.00	0.01**	0.00*	0.00**	0.00**	0.00*	0.01**	0.01*	0.00*
<i>OPE</i>	0.00*	0.00**	0.01**	0.00*	0.00**	0.00***	0.00***	0.00	0.00**
R-squared	0.295	0.362	0.592	0.220	0.495	0.625	0.202	0.295	0.592
F-statistic	2.410**	2.691**	3.180***	2.395**	2.742***	4.001***	2.490**	2.550***	4.195***

Note: ***, **, and * represent statistically significant level at 1%, 5%, and 10%. CCM, GEM, PSM, RQM, RLM and VAM are multiple effects of good governance indices and monetary policy. Also, CCG, GEG, PSG, RQG, RLG and VAG are multiple effects of good governance indices and fiscal policy.

Source: Rese

5-5. Robustness tests

The findings of the Granger causality test (Table 9), according to the definitions of the variables in Table 1, show that the relationship between monetary and fiscal policies, governance indicators, democracy, and green finance manifests itself heterogeneously at different levels of economic development. In high-income economies, we observe a one-way causality relationship from democracy and governance indicators, as well as monetary and fiscal policy indicators, toward green finance. In a way that not only economic policies affect green governance and finance indicators, but also institutional quality and democracy can significantly moderate or strengthen the path of policy effectiveness. A similar relationship was observed for the middle- and low-income countries. Thus, green financial development is more dependent not only on reforming economic policies, but also on improving the quality of governance and institutions. In middle-income economies, there is no causal relationship between monetary policies and green finance.

Table 9. JKS (2021) Granger non-causality test results

Null hypothesis: no causality	HPJ Wald test	prob.	Decision of causality
High-Income Economies			
$GF \nRightarrow DEM$	0.32	0.58	$DEM \Rightarrow GF$
$DEM \nRightarrow GF$	2.02*	0.06	
$GF \nRightarrow GG$	0.01	0.95	$GG \Rightarrow GF$
$GG \nRightarrow GF$	**6.02*	0.00	
$GF \nRightarrow GEX$	0.02	0.84	$GEX \Rightarrow GF$
$GEX \nRightarrow GF$	*3.02*	0.04	
$GF \nRightarrow BM$	0.95	0.82	$BM \Rightarrow GF$
$BM \nRightarrow GF$	2.01*	0.07	
Upper-Middle- Income Economies			
$GF \nRightarrow DEM$	0.45	0.74	$DEM \Rightarrow GF$
$DEM \nRightarrow GF$	**5.21*	0.00	
$GF \nRightarrow GG$	0.70	0.86	$GG \Rightarrow GF$
$GG \nRightarrow GF$	*4.75*	0.02	
$GF \nRightarrow GEX$	0.35	0.41	$GEX \Rightarrow GF$
$GEX \nRightarrow GF$	*3.08*	0.03	
$GF \nRightarrow BM$	0.19	0.35	-
$BM \nRightarrow GF$	1.11	0.16	
Lower Middle- & Low-Income Economies			
$GF \nRightarrow DEM$	0.74	0.89	$DEM \Rightarrow GF$
$DEM \nRightarrow GF$	**6.35*	0.00	
$GF \nRightarrow GG$	0.13	0.54	$GG \Rightarrow GF$
$GG \nRightarrow GF$	**5.76*	0.00	

$GF \nRightarrow GEX$	0.25	0.86	$GEX \Rightarrow GF$
$GEX \nRightarrow GF$	*3.39*	0.02	
$GF \nRightarrow BM$	0.17	0.82	$BM \Rightarrow GF$
$BM \nRightarrow GF$	3.01*	0.07	

Note: ***, **, and * represent statistically significant level at 1%, 5%, and 10%, respectively. The symbol $\Rightarrow$ indicates unidirectional causality, while $\nRightarrow$ indicates no causality.

Source: Research Findings

In the following, to analyse the sensitivity of the long-term coefficients, the results of two methods, Driscoll-Kraay and GMM, are analysed for three groups of countries. The results of Table 10 show that in high-income countries, institutional variables including democracy (DEM) and good governance (GG) have a positive and significant effect on green financing (GF). This finding shows that improving the quality of democratic institutions, transparency, and accountability in government can increase investment attraction in the renewable energy sector. In addition, the interactive effects between institutional variables and macroeconomic policies (including DEMM, DEMG, GGG, and GGM) are also positive and significant; in such a way that the combination of democracy and efficient governance with monetary and fiscal policies has significantly increased the efficiency of environmental and green policies. In contrast, inflation (INF) and income inequality (INEQ) variables have a negative and significant effect. In other words, any economic instability or increase in inequality will reduce investment in green activities by reducing public trust and increasing financing costs. Also, gross domestic product (GDP) and CO₂ emissions have a positive effect.

On the other hand, in Table 11 for middle-income countries, the effect of democracy and good governance variables is similar to that of high-income countries, but with greater intensity. In particular, the positive and significant coefficients of DEMM, GGM, and GGG indicate that in transitioning institutional economies, the optimal combination of financial and monetary policies with political institutions and governance can be a significant driver for the development of green finance. Also, the government expenditure variable (GEX) has a positive and significant effect, indicating that increased public spending, especially on renewable energy infrastructure, can boost green financing. In contrast, the money supply variable (BM) has a negative effect in some models.

However, in Table 12 for low-income drawers, the coefficients related to institutional variables (DEM and GG) are still positive, but less strongly than the previous two groups. This finding indicates that the influence of institutions on the development of green finance has not yet been fully institutionalised. However, interactive effects such as DEMM, DEMG, GGG, and GGM are positive and statistically significant in all models, which indicates the importance of institutional and policy synergies in countries with weaker institutional structures. In this group, the variables of inflation and unemployment (UNE) have a negative and significant effect, which is consistent with the economic realities of these countries. Also, the coefficients of determination (R^2) and F and Wald statistics are at an acceptable level (especially $R^2 = 0.72$ in high-income countries), which indicates the

appropriate fit of the models. Also, the results of the Sargan and Arellano-Bond AR(2) tests show that the instruments used in the valid GMM method and the model do not suffer from the second-order autocorrelation problem.

The strong evidence for the significantly positive role of democracy (DEM) and good governance (GG) on green investment is largely aligned with key foundations of institutional theory and sustainable finance analysis. Looking closely at the findings, they largely validate the claims put forward by Fu et al. (2023) and [Yadav et al. \(2024\)](#) on how environments valuing openness and accountability have a stronger role to play in ensuring environmental considerations too come to fruition, thus impacts of policy uncertainty being further diminished for investors as stated by [Hunjra et al. \(2023\)](#). Most importantly, institutional quality being positively significant to additionally influence monetary and fiscal policies to generate further impacts (DEMM, GGG, etc.) largely verifies institutional efficiency assertions put forward by [Degbedji et al. \(2024\)](#) to directly achieve sustainable outcomes for green economic policies to be translated into fruitful outcomes for institutional efficiency to further accentuate standard moderating tools for financial performance analyses for [Jiang et al. \(2025\)](#).

Table 10. Results from Driscoll-Kraay Method with other control variables and GMM method. GF as dependance variable for High-Income Economics

Variable	Driscoll-Kraay Method			GMM method		
	1	2	3	1	2	3
<i>DEM</i>		0.41	0.01*		0.39	0.02**
<i>GG</i>		0.00*	0.02**		0.01**	0.04**
<i>BM</i>	-0.02**	-0.23	0.02*	-0.05**	-0.31	0.01*
<i>GEX</i>	0.15**	0.00*	0.03*	0.25**	0.01*	0.03*
<i>DEMM</i>			0.04*			0.04*
<i>DEMG</i>			0.14*			0.21*
<i>GGG</i>			0.04**			0.15**
<i>GGM</i>			0.09**			0.25***
<i>INF</i>		-0.02*	-0.02*		-0.01*	-0.05*
<i>GDP</i>	0.00		0.02*	0.00		0.03*
<i>CO2</i>	0.04*	0.00**	0.01*	0.05*	0.00***	0.01*
<i>INEQ</i>	-0.02**	-0.21**	-0.02**	-0.03	-0.21**	-0.03
<i>UNE</i>	-0.01*	-0.02**	-0.13**	-0.02	-0.05**	-0.21**
R-squared	0.325	0.401	0.722			
F-statistic	2.61**	2.79***	3.21***			
Wald Chi²				3.94***	3.74***	6.02***
Sargan Stat				1.326	1.215	1.526
df				9	10	12
Arellano–Bond AR²				0.945	1.854	1.005
(prob)				(0.84)	(0.201)	(0.45)

Note: ***, **, and * represent statistically significant level at 1%, 5%, and 10%, respectively.

Source: Research Findings

Table 11. Results from Driscoll-Kraay Method with other control variables and GMM method. GF as dependance variable for Upper-Middle- Income Economics

Variable	Driscoll-Kraay			GMM method		
	Method					
	1	2	3	1	2	3
<i>DEM</i>		0.01*	0.03**		0.01*	0.03**
<i>GG</i>		0.05	0.02**		0.05	0.02**
<i>BM</i>	-0.02*	-0.01	0.04*	-0.02*	-0.01	0.04*
<i>GEX</i>	0.01*	-0.02	0.02*	0.01*	-0.02	0.02*
<i>DEMM</i>			0.05**			0.05**
<i>DEMG</i>			0.01*			0.01*
<i>GGG</i>			0.02*			0.02*
<i>GGM</i>			0.00**			0.00**
<i>INF</i>		0.01	-0.01**		0.01	-0.01**
<i>GDP</i>	0.01**		0.02*	0.01*		0.02*
<i>CO2</i>	0.00**	0.01**	0.00*	0.00*	0.01	0.01*
<i>NEQ</i>	-0.01**	-0.08**	-0.02	-0.01*	-0.07*	-0.01
<i>UNE</i>	-0.02**	-0.002*	-0.09*	-0.01*	-0.02*	-0.09*
R-squared	0.221	0.501	0.698			
F-statistic	2.412**	2.842***	4.014***			
Wald Chi²				3.74***	9.94***	3.52***
Sargan Stat				1.015	1.125	0.512
df				9	9	11
Arellano–Bond				0.845	0.021	0.952
AR² (prob)				(0.40)	(0.99)	(0.32)

Note: ***, **, and * represent statistically significant level at 1%, 5%, and 10%,

Source: Research Findings

Table 12. Results from Driscoll-Kraay Method with other control variables and GMM method. GF as dependance variable for Lower Middle- & Low-Income Economics

Variable	Driscoll-Kraay			GMM method		
	Method					
	1	2	3	1	2	3
<i>DEM</i>		0.03*	0.03**		0.18*	0.51**
<i>GG</i>		0.02	0.02**		0.12	0.15**
<i>BM</i>	-0.02*	-0.01	0.03*	-0.11*	-0.21*	0.03**
<i>GEX</i>	-0.03*	0.62	0.01*	-0.05**	0.71	0.81**
<i>DEMM</i>			0.25**			0.45**
<i>DEMG</i>			0.24**			0.32**
<i>GGG</i>			0.04**			0.13**
<i>GGM</i>			0.04**			0.05**
<i>INF</i>	-0.01*	0.01		-0.01	0.02*	-0.03**
<i>GDP</i>	0.01*		0.03*	0.09*		0.04*
<i>CO2</i>	0.01**	0.00**	0.00*	0.08**	0.00**	0.00*

<i>INEQ</i>	-0.02**	-	-0.07**	-0.02**	-0.18*	-0.07**
		0.008**				
<i>UNE</i>	-.002**	-0.01*	-.002**	-0.02*	-0.01*	-0.02*
R-squared	0.205	0.365	0.674			
F-statistic	2.52**	2.66***	4.251***			
Wald Chi²				4.45***	3.88***	5.08***
Sargan Stat				1.021	1.102	1.022
df				8	10	14
Arellano–Bond				0.685	0.842	0.745
AR²(prob)				(0.52)	(0.22)	(0.40)

Note: ***, **, and * represent statistically significant level at 1%, 5%, and 10%.

Source: Research Findings

5. Concluding Remarks

This study systematically examines the impact of good governance and democracy, as well as the effectiveness of economic policies, on green finance in three income groups of countries from 2006 to 2023. By analyzing panel data, this study's results confirm that the effectiveness of economic policies in promoting green financial development is highly dependent on the quality of governance, level of democracy, and institutional capacity of countries. These results fit with recent studies that show institutional channels—things like less policy risk, better transparency, and strong enforcement of environmental rules—really shape how well green finance works (Xu & Zhu, 2022; Çitil et al., 2023). Analysis of data across three groups of countries (high-, middle-, and low-income) revealed that countries with transparent, accountable, and democratic institutions were more effective in implementing their monetary and fiscal policies in line with green investment. The Driscoll-Kraay regression model confirms that in high-income countries, both governance quality and democracy have a positive and significant relationship with green finance indicators, especially when monetary and fiscal policies are combined with a strong institutional structure. In contrast, in low-income countries, institutional weaknesses, corruption, and political instability have hindered the impact of macroeconomic policies on renewable energy development. Other findings suggest that combining democracy and good governance with fiscal and monetary policies can create significant synergies in increasing green investment. Meanwhile, fiscal policies have a greater impact on the growth of green investments than monetary policies, especially through increased government spending on infrastructure and clean energy. At the same time, inflation and the weak control of corruption are considered as major factors that weaken these effects. Our findings support and extend current literature by showing that economic policy efficiency in stimulating green financial development essentially depends on the quality of governance, democracy, and institutional capacity across heterogeneous income groups. In tune with the arguments of institutional theory—e.g., Fu et al. (2023) and Yadav et al. (2024)—and good governance principles—e.g., Zhang et al. (2022) and Antwi et al. (2024), we affirm that transparent, accountable, and democratic institutions are crucial, especially for high-income countries, in

improving the indicators of green finance. On the other hand, institutional weakness, corruption, and political instability-e.g., [Zhao et al. \(2024\)](#) and [Entezari et al. \(2023\)](#)-essentially dampen the impact of macroeconomic policy on renewable energy in low-income settings. The observed synergy between democracy, good governance, and macroeconomic policies, with fiscal policies playing an intense role in driving green investment, further reinforces prior arguments on participatory governance and sound institutional frameworks for sustainable development-e.g., [Pucheta-Martínez & Gallego \(2024\)](#) and [Saadaoui et al. \(2024\)](#)-while emphasizing the adverse influence of inflation and lax control of corruption.

There are some real limitations here. First, using cross-country panel data hides a lot of detail. It doesn't show differences within countries or zoom in on how green-finance reforms look in specific sectors. Second, even though the Driscoll–Kraay estimator tackles cross-sectional dependence, it doesn't fully solve the foggy relationship between governance quality and green-finance development. Third, green-finance indicators, especially for lower-income countries, are often incomplete or reported unevenly—so comparing across groups isn't always precise. Finally, the assumption of homogeneous parameters within income groups is a simplifying approximation; therefore, future studies could apply heterogeneous panel models (e.g., MG/PMG) to better account for cross-country differences. Future research could address these gaps by digging into firm-level or sector-specific data to see how governance and democracy actually affect green bond issuance, environmental disclosures, or renewable energy financing. It'd also help to bring in political economy factors—like lobbying or resistance from powerful interest groups—to explain why some countries turn green-finance flows into real environmental results...and others just don't.

Based on the results of this study, some policy recommendations are presented: 1) institutional reform and strengthening governance through the establishment of transparent legal frameworks, effective control of corruption, and improvement of the quality of regulation to increase investor confidence in green financial markets; 2) democratizing the economic decision-making process through expanded public participation, free media, and accountability mechanisms to monitor green financial policies and prevent greenwashing; 3) aligning macro policies with environmental objectives and integrating sustainability criteria into fiscal and monetary policies, particularly by central banks and finance ministries; 4) developing green financial infrastructure and creating and expanding the green bond market, environmental investment funds, and tax incentives for renewable energy projects.

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Conceptualization, all authors; methodology, Mir Hadi Hosseini Kondelaji and Davoud Mahmoudinia; validation, Behrouz Sadeghi Amroabadi; formal analysis, all authors; resources, Davoud Mahmoudinia; writing—original draft preparation, review and editing, all authors; supervision, Mir Hadi Hosseini

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Appendices

Appendix 1. Countries by income classification

High-Income Economics					
Australia	Czechia	Iceland	Malta	Russia	United Arab Emirates
Austria	Denmark	Ireland	Netherlands	Saudi Arabia	United Kingdom
Bahrain	Estonia	Italy	New Zealand	Singapore	United States
Belgium	Finland	Japan	Norway	Slovakia	Uruguay
Bulgaria	France	Kazakhstan	Oman	Slovenia	
Canada	Germany	Kuwait	Panama	South Korea	
Chile	Greece	Latvia	Poland	Spain	
Croatia	Hong Kong	Lithuania	Portugal	Sweden	
Cyprus	Hungary	Luxembourg	Romania	Switzerland	
Upper-Middle- Income Economics					
Albania	Botswana	El Salvador	Iraq	Mongolia	South Africa
Algeria	Brazil	Equatorial Guinea	Jamaica	Montenegro	Thailand
Argentina	China	Gabon	Libya	Namibia	Turkey
Armenia	Colombia	Georgia	Malaysia	North Macedonia	Ukraine
Azerbaijan	Costa Rica	Guatemala	Mauritius	Paraguay	
Belarus	Dominican Republic	Indonesia	Mexico	Peru	

**Bosnia and
Herzegovina**

Ecuador

Iran

Moldova

Serbia

Lower Middle- & Low-Income Economics

Angola

Chad

Guinea

Madagascar

Philippines

Tunisia

Bangladesh

Comoros

Guinea-Bissau

Mali

Rwanda

Uganda

Benin

Congo

Haiti

Mauritania

Senegal

Uzbekistan

Bolivia

Cote d'Ivoire

Honduras

Morocco

Sierra Leone

Vietnam

Burkina Faso

Democratic
Republic of Congo

India

Mozambique

Sri Lanka

Zambia

Burundi

Egypt

Kenya

Nepal

Sudan

Zimbabwe

Cambodia

Ethiopia

Kyrgyzstan

Nicaragua

Tajikistan

Cameroon

Gambia

Lebanon

Niger

Tanzania

**Central African
Republic**

Ghana

Lesotho

Pakistan

Togo