# 4 EXPLORING THE RELATIONSHIP BETWEEN ECONOMIC GROWTH, FINANCIAL DEVELOPMENT, AND GREEN FINANCE: A COMPREHENSIVE ANALYSIS

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## Abstract

*This study provides new evidence on the long-term relationship between economic growth, financial development, and green finance across the 27 European Union (EU) member states. The panel includes data from all European regions for the years 2000-2020. The need to align economic performance with environmental sustainability is the essence of the European agenda, hence explaining the rationale for this study, which aims to analyse the implications of green financing on sustainable economic performance in the European context. To address this gap, the study employ a multi-dimensional econometric framework, constructing composite indices to capture the complex nature of financial development and green finance, and applying panel coin-tegration tests along with robust long-run estimators (FMOLS and DOLS). The empiri-cal findings indicate a significant and positive long-term relationship between financial development and economic growth, as well as between green finance status and economic improvement. More specifically, a 1% rise in green finance corresponds with a 0.289% increase in economic growth, while a 1% rise in financial development results in a 0.060% improvement. These results show that even if both indicators help to boost economic growth, green finance has a greater contribution. The findings reveal the need to include green financial instruments in national economic plans and enhance financial systems to assist the Sustainable Development Goals (SDGs) all around the EU. The study emphasizes the need to include green finance in national and regional policy agendas to guarantee a balanced approach that satisfies the intergenerational impact connected to the needs of both present and future generations*.

**Keywords:** *green finance, renewable energy consumption, financial development, economic growth*

**JEL Classification:** *G28, O44, Q01*

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# 1. Introduction

The concept of sustainable development has become an intensely debated topic and an essential concept in the global economy, with discussions particularly focusing on the synergy between social, economic, and environmental needs. Due to these chal-lenges, traditional economic models must be reevaluated in order to include environ-mental considerations and encourage a shift towards a low-carbon economy. The in-tersection of three important variables, green finance, financial development, and economic growth has drawn more attention in this setting. The interdependence be-tween financial development and environmental care must be taken into account when developing an institutional and legal framework that can facilitate the allocation of funds to green projects and permit the development of green financing mechanisms in order to achieve effective coordination towards sustainability. Conventional finan-cial frameworks often neglect environmental consequences, exacerbating the need for a transition to financing that incorporates ecological factors into economic decisions (Zhang & Zhao, 2024; Liu et al., 2023; Zhang & Wang, 2021). The green financing mechanism is becoming an essential pillar for achieving sustainable development goals, representing a key component that strengthens sustainability initiatives. The perspective of Sustainable Economic Development (SED) is defined as development that satisfies current demands without compromising the capacity of future genera-tions to satiate their own needs, being necessary for both intragenerational and inter-generational justice (Hajian & Kashani; 2021). In this regard, green finance, which di-rects funds towards ecologically friendly initiatives, directly supports SED by encour-aging the use of renewable energy sources and the decrease of pollutants. As for the relationship with financial development, according to Levine & Zervos, 1998; Beck et al., 1999, efficient resource allocation and risk management supports SED by directing capital to sustainable businesses and fostering green innovation. While traditional economic growth has often been linked to environmental degradation, SED seeks to decouple economic progress from environmental harm through green technologies and resource efficiency. By examining the interplay between green finance, financial development, and economic growth through the lens of SED, this study aims to provide valuable insights for policymakers seeking a more sustainable and prosperous future for the EU.

The absence of a broadly acknowledged term in the literature highlights the diffi-culty of precisely defining green finance. Indeed, several notable publications, like Höhne et al. (2012), and Spratt and Griffith-Jones (2013) do not specifically define the concept of green finance, but take a broad approach, including financial investments in sustainable development projects, environmental products, and policies that en-courage a more sustainable economy, noting that green finance goes beyond climate finance to include goals such as pollution control and biodiversity protection. Financial development, in turn, can facilitate the growth of green finance by providing access to capital, reducing transaction costs, enhancing risk management (Levine & Zervos, 1998; Beck et al., 1999; Zhang et al., 2022; Pan and Mishra, 2018). Furthermore, eco-nomic growth can create a more favorable environment for green finance by increas-ing demand for sustainable products and services, providing resources for environ-mental protection (Yang et al., 2021, Alharbi et al. 2023; Rasoulinezhad, and Farhad 2022).

The review of the specialized literature reveals that the path to sustainable de-velopment is conditioned by the existence of financial mechanisms that facilitate green investments and adequately manage the associated risks (Wang, Kai-Hua, et al., 2022). Moreover, studies reveal that to encourage an interdependent relationship between financial development and environmental protection, efficient regulations and procedures are necessary to direct funds towards green projects. For example, a recent study published by Iqbal, Muhammad Ahsan, et al., 2025, highlights that strengthening the sustainability of finance directly contributes to reducing environmental degradation and that progress towards financial policies addressing climate issues easily compensates for environmental degradation. Furthermore, empirical evidence suggests that green financing promotes economic growth by reducing the negative environmental impact

and thus supports the transition to a more sustainable economic model (Chin, Mui-Yin, et al., 2024).

Literature indicates that green finance not only enables the allocation and mobi-lization of financial resources for sustainable projects, ensuring investment in initia-tives that foster environmental sustainability, but also improves the overall efficiency of economic development. Certain scholars assert that countries emphasizing green finance generally attain elevated GDP per capita, especially during crises like the COVID-19 pandemic, wherein green investments significantly contributed to econom-ic resilience (Mishra et al., 2023; Singh & Mishra, 2022; Sadiq et al., 2022). A compre-hensive understanding of economic growth necessitates an examination of its correla-tion with financial development, the primary driver of productivity and innovation. Financial markets facilitate resource allocation, but the effective management of green finance guarantees that financial advancement results in concrete environmental ad-vantages. That's why the contemporary period requires strong regulations and proce-dures to direct investments toward green activities, so promoting a symbiotic rela-tionship between financial growth and ecological preservation.

Nonetheless, despite these significant advances, deficiencies remain in compre-hending the exact processes through which green finance promotes economic growth, especially in circumstances characterized by distinct structural, legislative, or institu-tional obstacles, as observed in several EU member states. This study builds on this extensive body of literature, seeking to provide fresh insights and additional empirical evidence within the context of the European Union. By retrospective analysis of the literature, we can found for instance, that Green finance concerns two hot topics, en-vironment protection and finance (Zhang et al., 2022). According to Yang et al. (2021), green finance plays a significant role in promoting high-quality economic develop-ment by positively impacting environmental, social, and economic dimensions. Their study provides empirical evidence supporting the substantial benefits and effective-ness in fostering sustainable development, and highlights that providing funding and making investments in socially and ecologically conscious projects are two ways to promote sustainable growth.

This article investigates the interplay between economic growth, financial devel-opment, and green finance through an extensive panel analysis covering the 27 EU member states from 2000 to 2020. The study provides empirical evidence on how these variables interact and influence each other within EU countries and the rationale was to understand whether establishing a robust green finance framework can enhance economic growth. The study provides empirical evidence that a robust green finance framework enhances economic growth in EU countries, and confirm the existence of a long-term cointegration relationship between economic growth (ECGRW), financial development (FDEVINDEX), and green finance (GRFININDEX).

The study is motivated by the need to contribute to the ongoing discussion on harmonizing environmental and economic goals within the EU and to enrich the existing literature by providing additional empirical evidence on the role of green fi-nance in shaping sustainable economic growth. It seeks to address the knowledge gap regarding the diverse economic structures and levels of green policy adoption across EU member states, offering insights into how financial mechanisms can be leveraged to balance economic performance with environmental sustainability. Given the significant differences among member states in terms of economic structures and commitment to green policies, it is crucial to understand how green finance initiatives impact economic performance and exploring this link, the research seeks to uncover whether promoting green finance can simultaneously support environmental goals and foster economic growth, thus offering valuable insights for policymakers, investors, and academics. The article is structured as follows: Section II build the theoretical back-ground of study and retrospective analyse the literature, Section III outlines the variables, dataset, and econometric methodologies used in the analysis. Section IV presents the empirical findings obtained through

both qualitative and quantitative approaches, along with extensive robustness checks. Finally, the concluding section summarizes the study's key insights.

# 1. Literature Review

## *2.1. Theoretical Literature*

The Relationship Between economic growth, financial development and green fi-nance relies in some theoretical frameworks, including endogenous growth theory and institutional theory. From a theoretical perspective, this work is anchored in empirical validity of AK-type endogenous growth models, which focus on the long-run relation between growth and investment. In these models, the outcome is represented by a lin-ear function of capital (Y=AK), where A stands for capital productivity and K for ag-gregate capital stock. Green finance and financial development have a direct impact on this mechanism by influencing how effectively capital is raised and distributed. A strong financial system makes it easier to get credit, lowers transaction costs, and di-rects funds towards profitable ventures, all of which raise the degree of capital productivity. Additionally, green finance is crucial for allocating funds to environ-mentally friendly technology, renewable energy sources, and sustainable projects. These initiatives not only boost economic performance but also guarantee that devel-opment is consistent with long-term ecological goals. The work of Paul Romer (1986) laid the theoretical foundation for endogenous growth theory and Sergio Rebelo (1991), formally introduced the AK model, both authors assuming through this model that investments in physical, human or technological capital can support economic growth indefinitely over time. In this sense, financial development plays a key role by efficiently channeling resources to productive and innovative sectors, including green projects.

As for the implication of the institutional variables, the Institutional Theory (North, 1990; Acemoglu et al., 2005) emphasizes that institutions, especially the quali-ty of governance, political stability, and regulatory efficiency, are the foundations that determine how efficiently financial market's function and how well economic policies are implemented.

This perspective argues that efficient financial intermediation and the proper func-tioning of green finance are made possible by well-functioning institutions, character-ized by regulatory quality, rule of law, control of corruption, and political stability. On the other hand, inadequate institutions have the potential to diminish the growth prospects of both financial development and green finance, to negatively affect capital allocation, and to erode investor confidence. This theoretical paradigm is particularly relevant for the European Union, as institutional variations among member states can influence the effectiveness of sustainability-oriented financial instruments. Together, these theories justify the empirical analysis carried out in this paper, as they provide a conceptual basis for investigating how financial development and green finance con-tribute to long-run economic growth within the EU context.

## *2.2. Empirical Literature*

Sustainable economic development has become an intensely debated topic in recent years, being the central element of EU policies and a subject of discussion in the political and academic environment. The finance sector is primarily involved, and the present study fits into the extensive literature evaluating the relationship between green financing, financial development, and economic growth, especially in the con-text of environmental sustainability and financial changes driven by public policies. The empirical literature review on the subject indicates that a systematic approach and greening of financial systems can influence sustainable economic development. A very recent study conducted by Zhang & Zhao (2024) reveals that, in the context of China, green finance has a significantly positive effect on economic development, and in turn, economic development can attract more green financial investments. According to other researchers, the

importance of interrelating the objectives of green finance with the viability of financial systems is exemplified, with the aim of achieving sustainable economic development (Fu et al., 2023; Liu et al., 2023). The influence mechanism of green financing initially focuses on the allocation of capital towards ecological investments, through instruments such as green credit, green bonds, green insurance, or green investment, with the aim of generating beneficial externalities for both the environment and the economy. Directing funds through these channels stimulates clean energy, improves energy efficiency, and, of course, reduces carbon emissions, ensuring energy security and encouraging innovation (Lee and Chien, 2022; Zhang et al., 2022; Ning et al., 2023). Green financing mechanisms have been highlighted, for example, in relation to the impact of moments of instability and systemic crisis, the most recent example being the Covid-19 pandemic, where it was noted that in countries with more developed green financing mechanisms, economic resilience was greater, as a result of the countercyclicality of green investments, which contributed to stabilizing production and mitigating the recession's impact on key economic indicators (Mishra et al., 2023). Aligned with this viewpoint, the study conducted in 2022 by Singh & Mishra shows that the rapid advancements in the green finance sector in the countries of the Organization for Economic Cooperation and Development were accompanied by an increase in the use of nonfossil energy, which led to a reduction in carbon intensity.

The study conducted by Yang et al. (2021) on the profile of China confirms that green financing plays a crucial role in promoting economic development and that green finance comprehensively facilitates high-quality economic development. The author highlights that this positively influences all three aspects of development (namely the ecological environment, economic efficiency, and economic structure). A similar opinion is highlighted in the study conducted by Wang et al. (2022), which examines the causal relationship between sustainable development and green finance, emphasizing that governments and international organizations should promote high-quality green investment and risk prevention systems related to the impossibility of sustainable development. Additionally, Zhang et al. (2022) and Lee and Chien (2022) confirm the bidirectional relationship between energy consumption and climate change, emphasizing that the adoption of financial instruments such as green bonds, if properly regulated and standardized, significantly reduces financing constraints for green projects, thereby encouraging the widespread adoption of sustainable practices in the industry. The retrospective of these studies in the specialized literature reveals the importance of green financing as a key instrument in strengthening economic sus-tainability, as a support in the fight against climate change, and as a stabilizing pillar against economic shocks.

Financial investments oriented towards projects and initiatives for sustainable development require an appropriate structure and governance of financial systems, as they play a crucial role in determining the effectiveness of green financing. The ques-tion of whether green finance can influence sustainable development is present in many specialized studies, and a global perspective is provided by Wang et al. (2022), who confirm not only the importance of promoting green finance by governments everywhere but also the proper management of traditional financial development channels by including environmental criteria in financial instruments, such as green bonds or sustainability-linked loans. Moreover, the sustainability of the financial sys-tem also directs the extent to which ecological considerations are internalized by fi-nancial institutions, with political frameworks and institutional capacity being essential pillars. Of course, the diversity of these essential pillars, such as institutional ca-pacity and political frameworks, can affect a country's international investment position and influence its vulnerability to shocks, the structure and orientation of financial systems towards green objectives, and ultimately, a country's trajectory towards sustainable economic development.

The perspective of recent global changes related to population dynamics, economic activity, consumption patterns, and the structure of financial systems directly pressures many nations and necessitates the identification of viable development models and the critical approach to sustainable development strategies that integrate environmental and economic priorities. In this

context, the relationship between economic growth, financial development, and green financing becomes a subject of debate on the global agenda and requires significant interest from researchers and policymakers. This comprehensive analysis aims to explore how these three pillars interact to facilitate the transition to resilient, low-carbon economies, while also contributing to climate change mitigation and the achievement of the Sustainable Development Goals. The study is based on a broad set of recent works investigating the relationships between green finance and financial development (Zhang et al., 2022; Saydaliev & Chin, 2023), green finance and economic growth (Yang et al., 2021; Alharbi et al., 2023), as well as financial development and economic growth (Levine & Zervos, 1998; Beck et al., 1999; Du-rusu et al., 2020), thus contributing to the existing literature through an integrated approach of these three dimensions in the context of the European Union.

Regarding the relationship between financial development and economic growth, the study conducted by Levine and Zervos (1998) empirically demonstrates the rela-tionship between financial market liquidity, the development of the banking sector, and economic growth. This consideration is also validated by Beck et al. (1999), who emphasize that more efficient financial systems improve capital allocation, stimulate productivity, and favor sustained economic expansion. Analysing the more recent lit-erature on this subject, these findings are validated, emphasizing that extended access to credit and solid capital markets are key factors for long-term development (Alshubiri, 2021). The study conducted by Durusu and collaborators in 2017 clearly highlights the relationship between financial development and economic growth across a profile of 40 countries, emphasizing the importance for decision-makers to implement policies capable of strengthening the functionality of financial markets (Durusu et. Al., 2017).

As for the relationship between green financing and sustainable growth, the literature again emphasizes the importance of strengthening the financial system, which allows for the mobilization of a diverse range of financial instruments, such as green bonds, sustainability-linked loans, and investments in renewable energy (Zhang et al., 2022; Liu and Li., 2023). The study conducted by Alharbi et al. (2023) provides empirical evidence regarding the relationship between green finance and energy consumption across a profile of 44 countries and emphasizes that green financing plays a sig-nificant role in promoting the use of renewable energy, thereby contributing to both environmental and economic objectives. Moreover, studies such as the one conducted by Jadoon et al. (2021) emphasize that the status of green finance directly influences financial sustainability both in the short term and the long term, thereby highlighting the stabilizing effect of green finance on financial systems, in the presence of robust institutional frameworks.

Saydaliev and Chin (2023) conduct a study on the role of green finance in promoting a clean environment for macroeconomic stability and highlight in the profile of ASEAN economies that there is an interdependence between financial inclusion, green innovation, and macroeconomic stability, especially in emerging markets, suggesting a bidirectional relationship between green financing and financial development. Other channels through which green financing stimulates economic growth could be tech-nological innovation, the stimulation of investments in renewable infrastructure, and the improvement of institutional quality. And these are validated by researchers such as Hou et al., 2023; Yang, 2023.

According to Kharb et al. (2024), the relevance of studies related to environmental sustainability has increased, and green financing is the essential element in studies on the subject. The author encourages governments to promote legal frameworks that encourage green investments and technological innovation and emphasizes that green financing boosts GDP growth by improving environmental performance, attracting foreign direct investments, and reducing political and regulatory risks for sustainable industries. Additionally, Rasoulinezhad and Farhad (2022) demonstrate that green financing contributes to increased energy efficiency and reduced carbon emissions, which indirectly supports sustainable economic performance. It is worth mentioning that the effectiveness of these mechanisms is often influenced by country-specific factors,

countries diversity directly impacts the structure of the financial system and the effect on sustainable development. The elements such as financial sustainability, the quality of regulations, and institutional efficiency always make the difference and dictate the status of sustainable development.

As Flammer (2021) points out, accurately measuring the environmental impact of projects funded by corporate green bonds and preventing 'greenwashing' is a key challenge. Even in his analysis of corporate green bonds, designed to fund climate-friendly initiatives, data limitations and the relatively new nature of this financial instrument meant that his findings were based on a limited number of observations. Ehlers and Packer (2017) further emphasize the need for robust certification processes and standardized definitions in the green bond market to ensure the credibility of green investments and mitigate concerns about 'greenwashing'. In the absence of comprehensive data on direct green finance flows, researchers often rely on related indicators to proxy for green finance activity. For instance, following the evidence that environmental policies can stimulate innovation some researchers employ environmental patents as a proxy for the effectiveness of green policies and investments (Acemoglu et al. 2012; Zhang et al. 2022. Emerging standards like the EU Taxonomy and the Green Bond Principles offer promising frameworks for defining and classifying green activities, but most studies can't include these variables, due to the availability of the data. Marchewitz et al., 2024 highlight the critical role of clear taxonomies in providing a common language and framework for identifying sustainable economic activities and guiding investment decisions in green finance and scholars like Maltais and Nykvist (2020) further emphasize the importance of adherence to standards like the Green Bond Principles to ensure the environmental integrity and credibility of these financial instruments. While data limitations prevent us from directly incorporating these standards in our analysis, we acknowledge their importance as benchmarks for future research and data collection efforts.

Despite the extensive body of literature, significant theoretical and empirical gaps persist, particularly regarding the specificity of the variables mentioned in the special-ized literature and the connections between them. The existing literature often relies on single-indicator approaches or country-level case studies, which limits the ability to draw general political conclusions and reduces comparability between countries. This study addresses these gaps by applying a multidimensional approach and a mixed methodology that allows for the construction of composite indices of green finance and financial development to investigate the dynamic relationship between them and economic growth across all 27 EU member states during the period 2000–2020. Thus, the study offers new perspectives on how financial systems in the EU can be structured to promote both economic prosperity and environmental sustainability.

# 2. Sample Description and Methodological Approach

## *3.1. Data and Sample Selection*

This study empirically examines the dynamics underlying the relationship between economic growth, financial development, and green financing across the profile of 27 member states of the European Union during the period 2000–2020. The study employs a mix of methods, integrating both quantitative and qualitative analysis, and based on the empirical analysis conducted, it consolidates the coherence and robust-ness of the study. The methods employed include Grounded Theory for qualitative da-ta analysis, content analysis for examining literature, and document analysis to extract variables from reports and datasets. Grounded Theory involves beginning with data collection and analysis, iteratively building a theory from empirical evidence rather than starting with a predefined hypothesis. For quantitative analysis, the study utilize techniques such as factor analysis, FMOLS (Fully Modified Ordinary Least Squares), and DOLS

(Dynamic Ordinary Least Squares). These methods are well-established in specialized literature and are recognized for their ability to produce stable and robust results, particularly in estimating long-term relationships between cointegrated varia-bles. Additionally, the study incorporates time series analysis methods to verify the stationarity of the data, namely the Augmented Dickey-Fuller (ADF) test and the Phil-lips-Perron (PP) test, thereby ensuring the reliability of the econometric models. The study uses data sources such as the World Bank, World Development Indicators (WDI), the European Commission, and the International Monetary Fund (IMF). The justification for conducting this study is given by the need for efficient management of current climate challenges, in relation to the specifics of economic growth, combined with the status of EU member states that are trying to align the context of economic growth with sustainability-related challenges. Considering that more and more coun-tries are committing to achieving net-zero emissions targets and sustainable financial practices are gaining importance, the relationship between green financing and eco-nomic growth must continue to be the subject of scientific research.

Achieving resilient economic growth will require public strategies that can fully harness the potential of green finance while fostering sustainable industries and driv-ing innovation. The transition to an inclusive green economy necessitates not only comprehensive fiscal policies to facilitate green investments but also the establishment of an appropriate fiscal framework to effectively guide fiscal reforms. This dual approach is essential for promoting sustainable economic growth, as robust fiscal policies alone are insufficient without a well-structured framework to ensure the alignment of financial incentives, regulatory mechanisms, and long-term environmental goals. Therefore, this paper considers that green finance not only tackles urgent environmental challenges but also serves as a catalyst for economic growth, the effect being bidirectional. All the variables employed in the panel data analysis are described in Table 1. In the DOLS (Dynamic Ordinary Least Squares) and FMOLS (Fully Modified Ordinary Least Squares) models, economic growth (ECGRW), measured by real GDP per capita, is treated as the dependent variable.

The motivation for including the status of economic growth in the analysis is given by its role as an essential indicator of an economy's performance, and its use as a dependent variable is crucial, allowing for the examination of the efficiency of public policies, including those related to green financing and sustainable development, and facilitating the possibility to provide information regarding the factors that influence long-term prosperity.

Other variables included in the analysis are the financial development index (FDEVINDEX) and the green finance index (GRFININDEX), both calculated using fac-tor analysis. The first index (FDEVINDEX) includes seven indicators related to the depth, efficiency, and accessibility of the financial sector, such as credit availability, the development of financial markets, and the performance of the banking sector. The second, (GRFININDEX), includes fourteen indicators that capture various aspects of green financing, such as investments in renewable energy, sustainable financial prod-ucts, environmental risk management, and policies that promote sustainable devel-opment.The conceptual framework is thoroughly discussed and elaborated in the subsequent section of the study, providing a detailed foundation for understanding the research approach and variables under investigation.

**Table 1. Variables employed in the analysis**

| Variable name | Code | Source | Description |
|---|---|---|---|
| **Variables employed in the FMOLS and DOLS analysis** | | | |
| Economic growth | ECGRW | World Bank Database | GDP per capita growth is measured as the percentage change in real GDP per capita between two consecutive periods, using constant dollars to account for inflation. |
| Financial Development status | FDEVINDEX | Own computation | Assess the overall level and quality of financial development within an economy and combines various financial indicators-such as financial institution access, efficiency and market stability into a single index. |
| Green finance status | GRFININDEX | Own computation | Evaluate the advancement and effectiveness of green finance and is designed to measure how well a financial system supports sustainable, environmentally friendly investments, aligning financial growth with environmental goals. |
| **Variables used in the factor analysis for constructing the Financial Development Index (FDEVINDEX)** | | | |
| Domestic credit to private sector (% of GDP) | DCPRS | International Monetary Fund (IMF), International Financial Statistics (IFS), and the World Bank | Represents the financial resources provided to the private sector by other depository institutions, expressed as a percentage of GDP. |
| Domestic bank credit extended to the private sector (% of GDP) | DCPRSB | International Monetary Fund (IMF), International Financial Statistics (IFS), and the World Bank | Refers to the total amount of credit extended by commercial banks and other financial institutions to the private sector. |
| Monetary Sector credit to private sector (% GDP) | MSCP | World Bank Database | It represents the ratio of credit provided by the financial sector (including banks and other financial institutions) to the private sector as a percentage of the country's Gross Domestic Product (GDP). |
| Stocks traded, turnover ratio of domestic shares (%) | STTRDS | World Bank Database | Measures the volume of shares traded relative to the total number of outstanding shares of domestic companies within a specific period, usually a year. |
| Stocks traded, total value (% of GDP) | STTRTV | World Bank Database | Represents the total value of all shares traded on the stock exchange, including both domestic and foreign shares, expressed as a percentage of a country's Gross Domestic Product (GDP). |
| Market capitalization of listed domestic companies (% of GDP) | MKCLC | World Bank Database | Refers to the total market value of all publicly traded companies, expressed as a percentage of the country's Gross Domestic Product (GDP). |

| Variable name | Code | Source | Description |
|---|---|---|---|
| Outstanding international private debt securities to GDP (%) | OINTPDS | World Bank Database | Represents the total value of private debt securities and provides insights into the level of private international debt corresponding to the overall size of the economy. |
| **Variables used in the factor analysis for constructing the Green Finance Index (GRFININDEX)** | | | |
| Renewable energy consumption (% of total final energy consumption) | RECTGDP | World Bank, Sustainable Energy for All | The renewable energy share in total final consumption refers to the proportion of overall energy consumption derived from renewable sources. |
| Total greenhouse gas emissions (kt of CO2 equivalent) | TGGECO2 | Eurostat - European Commission | Represent the total emissions of greenhouse gases (GHGs), expressed in kilotons (kt) of carbon dioxide ($CO_2$) equivalent |
| Environmental protection expenditure % of GDP | ENVPRT | Eurostat - European Commission | Indicates the share of a country's gross domestic product (GDP) devoted to activities and investments focused on preventing, reducing, or mitigating pollution and environmental harm. This includes expenditures on waste management, improving air and water quality, conserving biodiversity, and other efforts to safeguard the environment. |
| Total environmental transfers received by the national economy as percentage of GDP | TENVTR | Eurostat - European Commission | Refers to the total environmental subsidies and similar transfers provided to support environmentally friendly practices across various sectors in the economy, expressed as a percentage of a country's Gross Domestic Product (GDP). |
| Control of Corruption | CORCTRL | World Bank Database | Refers to the perceived extent to which public authority is used for personal gain, encompassing both minor and major forms of corruption |
| Government Effectiveness | GOVEF | World Bank Database | This indicator assesses the quality of public services, the professionalism and independence of the civil service from political influence, the effectiveness of policy development and implementation, and the reliability of the government's commitment to its declared policies. |
| Political Stability and Absence of Violence/Terrorism | PSAVT | World Bank Database | Assesses perceptions regarding the probability of political instability or politically driven violence, including terrorism. The estimate reflects the country's score on this overall indicator. |
| Regulatory Quality | REGQ | World Bank Database | Regulatory quality indicates perceptions of the government's ability to formulate and implement effective policies and regulations that facilitate and promote private sector growth. |
| Rule of Law | RLAW | | Reflects the overall strength and fairness of a country's legal and regulatory framework. |

| Variable name | Code | Source | Description |
|---|---|---|---|
| Voice and Accountability | VAC | World Bank Database | Measures the extent to which a country's citizens have the opportunity to participate in the democratic process, including the ability to choose their government, as well as their freedoms of expression, association, and access to a free and independent media. |
| Net lending (+) / net borrowing (-) (% of GDP) | NLNB | Eurostat - European Commission | Reflects the difference between a government's total revenues and expenditures and represent the balance of a country's fiscal position, expressed as a percentage of its Gross Domestic Product (GDP). |
| Consumer price index (2010 ¼ 100) | CPI | World Bank Database | Measures the average change over time in the prices paid by consumers for a set of goods and services, using the year 2010 as the base year, with a value of 100. |
| Foreign direct investment, net inflows (% of GDP)" | FDINI | World Bank Database | Measures the total net inflows of foreign direct investment (FDI) into a country as a percentage of its Gross Domestic Product (GDP). |
| GDP growth (annual %) | GDPGR | World Bank Database | Represent the annual rate at which a country's Gross Domestic Product (GDP) increases or decreases and it reflects the percentage change in the value of all goods and services produced within a country over a year, adjusted for inflation to reflect real growth. |

**Table 2. Summary of variables included in the regression dataset title**

| Variable | Obs. | Mean | Std. Dev | Min | Max |
|---|---|---|---|---|---|
| ECGRW | 567 | 29,347 | 21,497 | 1,621 | 123,514 |
| FDEVINDEX | 567 | -4.4109 | 1.000 | -1.913 | 3.664 |
| GRFININDEX | 567 | 3.88e-09 | 1.000 | -2.579 | 1.811 |
| DCPRS | 511 | 82.49 | 43.31 | 0.186 | 255.3 |
| DCPRSB | 516 | 82.85 | 42.96 | 0.186 | 255.2 |
| MSCP | 514 | 82.94 | 42.96 | 0.186 | 255.3 |
| STTRDS | 414 | 32.56 | 50.06 | 0.0495 | 377.2 |
| STTRTV | 463 | 26.29 | 36.18 | 0.0101 | 264.6 |
| MKCLC | 406 | 2,839 | 66,629 | 0.580 | 1.58706 |
| OINTPDS | 517 | 39.73 | 51.83 | 0.0305 | 393.4 |
| RECTGDP | 567 | 17.09 | 11.87 | 0.0872 | 57.80 |
| TGGECO2 | 567 | 143,882 | 197,883 | 1,875 | 977,886 |
| ENVPRT | 513 | 0.752 | 0.337 | -0.300 | 1.900 |
| TENVTR | 414 | 0.387 | 0.345 | 0.0700 | 1.490 |
| CORCTRL | 567 | 0.982 | 0.790 | -0.511 | 2.459 |
| GOVEF | 567 | 1.085 | 0.610 | -0.364 | 2.347 |

| Variable | Obs. | Mean | Std. Dev | Min | Max |
|---|---|---|---|---|---|
| PSAVT | 567 | 0.785 | 0.416 | -0.475 | 1.759 |
| REGQ | 567 | 1.153 | 0.449 | -0.119 | 2.040 |
| RLAW | 567 | 1.072 | 0.616 | -0.266 | 2.125 |
| VAC | 567 | 1.108 | 0.341 | 0.260 | 1.801 |
| NLNB | 567 | -2.854 | 3.579 | -32.11 | 6.571 |
| CPI | 567 | 97.55 | 13.81 | 31.98 | 127.0 |
| FDINI | 565 | 12.20 | 38.63 | -57.53 | 449.1 |
| GDPGR | 567 | 1.986 | 3.973 | -14.46 | 24.00 |

The descriptive statistics presented in Table 2 offer a retrospective of key variables across a panel dataset, encompassing approximately 567 observations for 27 EU countries from 2000 to 2020. This 21-year timeframe captures two decades of economic and governance trends within the EU, with the substantial range of values reflecting periods of both significant recession (the 2008 financial crisis) and COVID-19 crisis. The economic growth indicator highlights considerable disparities among EU member states, with lower values often indicative of emerging economies within the EU coun-tries.

The Green Finance Index (GRFINDEX), designed to assess the advancement and effectiveness of financial systems in supporting sustainable, environmentally friendly investments (thereby aligning financial growth with environmental goals), exhibits a standard deviation of 1.0, suggesting a relatively consistent data distribution. The val-ues within the dataset range from -2.579 to 1.811, highlighting considerable variation in green finance governance across different nations. The highest recorded value (1.811) is observed in Finland, which consistently ranks among the top five countries in GRFINDEX alongside Denmark, the Netherlands, Sweden, and Luxembourg, indicative of robust green finance frameworks. On Romania's profile, the analysis reveals a minimum of (-2.579) for the GRFINDEX index, with similarly low values also identified on the profiles of countries such as Bulgaria, Greece, Croatia, and Slovakia. These results indicate not only weak financing in the direction of green projects but also reveal an underdevelopment of green financial markets. Considering that the Green Finance Index (GRFINDEX) shows this variation across the profiles of EU member states, it again suggests the diversity of financial systems and the importance of structural reforms.

Regarding the Financial Development Index (FDEVINDEX), the standard devia-tion of 1.0 indicates the success of standardizing the key variables used in the study, with values ranging from a minimum of -1.913 to a maximum of 3.664, highlighting the diversity of financial systems in the countries under analysis. Minimum values are observed in countries such as Slovenia, Romania, Bulgaria, and Poland, with index values around -1.913 and -1.630. This indicates that these economies may face difficulties related to access to financial institutions, efficiency, or market stability. On the other hand, countries such as Denmark, Ireland, Cyprus, Portugal, and Luxembourg record the highest values of FDEVINDEX (around 3.664-3.553). This reveal that these states have made significant progress in consolidate the status of financial systems. Of interest is the presence of Cyprus in the ranking of financial development index values, a country that, despite past financial vulnerabilities, embraces progress, making significant strides towards strengthening its financial and institutional system. The other variables included in the analysis were used in the construction of both indices, FDEVINDEX and GRFINDEX, each having a mean close to zero and a standard deviation of one. These values validate the viability of the factor analysis and suggest that it was effective in standardizing the indicators used in the analysis.

The two indices included in this study, namely the financial development index and the green financing index, were calculated using factor analysis, a robust statistical method that allows for working with large datasets and facilitates the creation of relevant indicators based on large sets of variables. Unlike the theoretical frameworks provided by the International Monetary Fund (IMF), our study includes institutional and financial variables specific to EU countries, allowing for an analysis that takes into account the diversity of EU member states. To calculate the financial development in-dex, the study includes the following variables: domestic credit to the private sector (% of GDP), the value of private international bonds in circulation relative to GDP (%), the turnover rate of traded shares (%), domestic credit to the private sector by banks (% of GDP), the market capitalization of listed companies (% of GDP), the total value of traded shares (% of GDP), and credit to the private sector by the monetary sector (% of GDP).

The study conducted by Chang in 2015 uses five alternative measures for financial development and emphasizes that domestic credit to the private sector (DCPRS) has a positive and significant impact on energy consumption, and the integration of green financing in advanced economies promotes sustainable development (Chang, 2015). Other variables included in the analysis are the domestic credit extended to the private sector by banks (DCPRSB) and the credit provided by the financial sector (including banks and other financial institutions) to the private sector as a percentage of the country's GDP (MSCP), important indicators in the banking system and financial sector analysis, validated by the literature on the subject, which highlights that they represent the interface of financial development and economic growth promotion (Emenike 2016; Levine and Zervos 1998; Beck et al. 1999; Pan and Mishra 2018).

Another variable included in the financial development index is the value of private international bonds in circulation, expressed as a percentage of GDP (OINTPDS), an indicator that provides details about European financial markets and reveals access to capital. A higher share is often associated with better access to global capital, which can stimulate economic growth by facilitating investments in business development, innovation, and infrastructure (Bailliu, 2000; Pedersoli and Andrea, 2023). An essential indicator for understanding market liquidity, investor activity, and financial development is the stocks traded, turnover ratio of domestic shares (STTRDS). Liquidity and efficiency, which are essential components of mature financial systems, are illustrated in Levine and Zervos (1998), who provide solid evidence that the turnover rate is correlated with financial development. Aligned with this viewpoint, Pan and Mishra (2018) argue that the turnover rate of stocks is a key indicator of financial development and support the idea that it is correlated with financial depth and efficiency. The authors suggest that the turnover rate and the total value of shares traded (STTRTV) are closely related measures of capital market activity, providing complementary perspectives on market efficiency, financial development, and the role of sustainability.

Since it provides a direct measure of the depth and size of a nation's stock market, the market capitalization of listed domestic companies (MKCLC) is the last variable in-cluded in the financial development index. Numerous empirical studies conducted by researchers have demonstrated its relevance. These studies have emphasized the relationship between this and the efficiency of the financial market, access to capital, and economic growth (Beck & Levine, 2004; Levine & Zervos, 1998).

Green finance relates to achieving environmental sustainability, economic resilience, and robust governance. It leverages investments in renewable energy, environmental protection, and emissions reduction while maintaining macroeconomic stability and fostering institutional trust and effectiveness. This multidimensional approach ensures that green finance promotes not only environmental advantages but also economic growth and social equity, within a strong and transparent governance framework. The variables included in Green Finance Index (GRFININDEX) are: Renewable energy consumption (% of total final energy consumption), Environmental protection expenditure % of GDP, Total environmental transfers received by the

national economy as percentage of GDP, Control of Corruption, Government Effective-ness, Political Stability and Absence of Violence/Terrorism, Regulatory Quality, Rule of Law, Voice and Accountability, Total greenhouse gas emissions (kt of CO2 equivalent), Net lending (+) / net borrowing (-) (% of GDP), Consumer price index (2010 ¼ 100), Foreign direct investment, net inflows (% of GDP), GDP growth (annual %). The inclu-sion of Renewable Energy Consumption as a percentage of total final energy consumption, coded RECTGDP in the Green Finance Index is well justified due to its direct alignment with sustainability goals and its integral role in transitioning to low-carbon economies. According to the literature, green finance significantly promotes renewable energies, and the level of renewable energy consumption as a percentage of total final energy consumption underscores green finance's role in advancing a sustainable energy transition (Alharbi et al., 2023; Lee et al., 2023; Rasoulinezhad, and Farhad 2022). Moreover, the development of the green financial sector is interdependent with the structural transformations of economies, as prioritizing energy efficiency and reducing carbon emissions can lead to the strengthening of financial sustainability and environmental conservation (Liu et al., 2023; Zhang et al., 2022).

Understanding the differences between the GDP-related variables used in this study is essential to reduce concerns regarding possible endogeneity. In our applied econometric models (FMOLS and DOLS), GDP per capita growth (ECGRW) is used as the dependent variable to reflect the evolution of economic growth at the individual level over time. In contrast, the annual GDP growth rate (GDPGR) is an indicator in-cluded in the Green Finance Index (GRFININDEX), and it reflects the overall status of macroeconomic stability. Although they are related, the two variables play different roles in the study and are different from an analytical and statistical point of view. Moreover, the use of exploratory factor analysis for creating composite indices shields us from the risks associated with multicollinearity and endogeneity bias, the entire methodological spectrum employed ensuring the robustness and reliability of the study's results. Factor analysis was used to eliminate multicollinearity at the index construction stage, making subsequent VIF diagnostics unnecessary

A study conducted by Ma and his collaborators in 2023 reveals that green financing and the consumption of renewable energy directly impact the world's economies, and the coordination between financial systems and environmental policies can directly contribute to sustainable development (Ma et al., 2023). This viewpoint is also supported by studies conducted by Dong and Hauschild in 2017 and Moldan et al. in 2012. Therefore, our analysis also includes other indicators of environmental sustaina-bility, such as Environmental Protection Expenditures (% of GDP) (known as EN-VPRT), which highlight the financial commitment to environmental projects. The total environmental transfers received by the national economy as a percentage of GDP (also known as TENVTR) is another important indicator that measures the amount of external financial assistance, such as grants, loans, or subsidies, that has been allocated to support environmental projects. In addition, total greenhouse gas emissions (kt CO2 equivalent), coded as TGGECO2, are a measure of the impact that economic activities have on the environment. A reduction in emissions shows that green investments have succeeded in reducing the carbon footprint.

The analysis includes indices of governance quality that promote an institutional framework favourable to effective and sustainable green finance activities. The objec-tives of Government Effectiveness (GOVEF) and Control of Corruption (CORCTRL) are to guarantee the effective and transparent management of money allocated for green initiatives. Political Stability and Absence of Violence/Terrorism (PSAVT) is es-sential for maintaining a stable climate conducive to sustainable green investments. While political instability may inhibit investment, a stable environment facilitates the adoption of sustainable initiatives, such as tax incentives for renewable energy and penalties for polluters. Voice and Accountability (VAC) fosters public scrutiny of green funding efforts through the principles of transparency and inclusivity in decision-making processes. An finally, the Rule of Law (RLAW) pertains to the enforcea-bility of contracts and property rights, essential for safeguarding and enticing investments in green initiatives, whereas

Regulatory Quality (REGQ) assesses the strength of the laws and regulations governing green funding.

According to the research conducted by Saydaliev & Chin (2023), Yang et al. (2022), Jadoon et al. (2021), and Ziolo et al. (2017), it is reveal that the green finance framework is characterised as a transformative mechanism that harmonises environ-mental, economic, and financial objectives for a sustainable future. Therefore, our computed green Finance Index incorporates economic stability indicators, including GDP Growth (Annual %) (GDPGR), Net Lending (+) / Net Borrowing (-) (% of GDP) (NLNB), Consumer Price Index (2010 = 100) (CPI), and Foreign Direct Investment, Net Inflows (% of GDP) (FDINI) to assess and represent economic stability. The initial indicator, GDP Growth (Annual %), while not encompassing all facets of economic stability, is intricately linked to the overarching notion and is frequently employed as a measure of a stable, expanding economy (Creel, 2015; Friedman, 1995).

The second indicator, Net Lending (+) / Net Borrowing (-) (NLNB) is related to the government's financial capacity to invest in green initiatives without creating unsus-tainable debt. Finally, consumer price index status is related to the financial feasibility of large-scale green investments and ensures affordability for consumers and foreign direct investment, net inflows (FDINI) reflect the ability to attract international funding for green projects, a critical component of global green finance flows.

## *3.2. Econometric framework*

*Methodology for Panel Unit Root Testing*

Panel unit root tests are divided into first-generation tests, which assume cross-sectional independence, and second-generation tests, which allow for cross-sectional dependence, both based on the Augmented Dickey-Fuller approach. Equation (1) present classic ADF test, extended for panel data:

$$\Delta Y_{it} = \alpha_i + \rho_i Y_{it-1} + \sum_{j=1}^{p} \beta_{ij} \Delta Y_{it-j} + \varepsilon_{it} \quad (1)$$

The The Augmented Dickey-Fuller (ADF) tests for unit roots in time series by checking stationarity of $Y_{it}$. Equation (1) represents the foundational Augmented Dickey-Fuller (ADF) specification for testing stationarity in a time series. It accounts for potential autocorrelation by including lagged differences of the dependent variable $\Delta Y_{it}$, where the key parameter of interest $\rho_i$, which determines whether the series $Y_{it}$ possesses a unit root. While this formulation is widely used in individual time series analysis, Equation (2) extends the ADF framework into a panel context through the Im-Pesaran-Shin (IPS) approach. In contrast to the homogeneous autoregressive coefficient assumption in early panel unit root tests (Levin, Lin & Chu), the IPS model in Equation (2) allows the parameter $\rho_i$, to vary across cross-sectional units. This heterogeneity provides greater flexibility and is more appropriate for panels with structural or economic diversity, such as EU member states. Thus, Equation (2) builds directly upon the structure of Equation (1), preserving the core dynamics while generalizing the model to accommodate panel heterogeneity in testing for unit roots:

$$\Delta Y_{it} = \alpha_i + \rho_i Y_{it-1} + \sum_{j=1}^{p} \beta_{ij} \Delta Y_{it-j} + \varepsilon_{it}, \; i=1, \ldots, N \quad (2)$$

Equation (2) represents the core specification of the Im-Pesaran-Shin (IPS) test, a widely used first-generation panel unit root test that extends the univariate ADF framework to heterogeneous panels. Unlike models that impose a common autoregressive coefficient across all units, the IPS test allows each cross-sectional unit (country) to have its own $\rho_i$, capturing country-specific dynamics in the persistence of the time series. This flexibility is particularly valuable in macroeconomic panel data, where structural differences across countries (such as fiscal policy, financial systems, or regulatory environments) may lead to varied stationarity properties. The IPS

test evaluates the null hypothesis that all series contain a unit root ($\rho_i$=0 for all i) against the alternative that at least one series is stationary ($\rho_i < 0 \; for \; some \; i$).

Because the IPS test averages individual ADF test values to increase statistical power while maintaining heterogeneity, equation (2) is essential for analysing panel datasets like those in the EU setting. Each individual regression is estimated using equation (2), and the resulting t-statistics for $\rho_i$ form the basis of the panel test overall. This allows us to refer then to Equation (3), which indicates that the IPS test statistic is the average of these distinct ADF t-statistics:

$$\bar{t} = \frac{1}{N}\sum_{i=1}^{N} t_{\rho i} \quad (3)$$

The statistic $\bar{t}$ captures the central tendency of the unit root behavior across all panel members. Assuming the null hypothesis of a unit root in all series ($\rho_i$=0 for all i), the distribution of $\bar{t}$ can be compared to critical values derived from simulations or asymptotic theory. Equation (3) aggregate individual evidence of stationarity while preserving the heterogeneity present in Equation (2). The original IPS test formulation, which calculates the average of each ADF test statistic across cross-sectional units under the presumption of cross-sectional independence, is represented by equation (3). The CIPS test, on the other hand, expands on this framework by adding cross-sectional averages of both the level and the first differences of the series:

$$\Delta Y_{it} = \alpha_i + \rho_i Y_{it-1} + \gamma_i \bar{Y}_{t-1} + \sum_{j=1}^{p} \beta_{ij} \Delta Y_{it-j} + \sum_{j=0}^{p} \delta_{ij} \Delta \bar{Y}_{t-j} + \varepsilon_{it} \quad (4)$$

Equation (4) presents the Cross-sectionally Augmented Im-Pesaran-Shin (CIPS) test developed by Pesaran (2007). It extends the traditional IPS framework by explicitly addressing cross-sectional dependence, this being a frequently issue in research paper which use macroeconomic panel data. To do this possible, the model incorporates the cross-sectional averages of both the lagged level variable ($\bar{Y}_{t-1}$) and its first differences ($\Delta \bar{Y}_{t-j}$) into the standard ADF regression.

*Cointegration Analysis—Methodology*

In order to examine the relationship between economic progress, financial development, and green finance in EU member states, the study use a set of cointegration tests capable to assess whether there is a long-term equilibrium between these variables. To ensure the reliability of the results and to construct a rigorous framework for identifying long-term connections between variables of type series temporally, the integration of mixed methods represent the most reliable approach, being validated by literature insights, which support the idea that this strategy is relevant for long-term strategic planning and policy formulation (see Bhattarai, K. (2019); Hendry & Juselius, (2000); Pesaran, (2015); Streimikiene & Kasperowicz (2016). Comprehension of the interconnection among these factors is crucial, since financial development may provide the necessary funds for green investments, hence potentially fostering economic growth while promoting sustainable practices. Green financing mechanisms, such as green bonds and environmentally oriented investments, are essential for linking economic expansion with environmental objectives. These cointegration tests allow us to assess the existence of a stable and sustainable long-term relationship between economic growth, financial development and green financing, taking into account the complex interactions and dependencies from the European Union economies. Panel cointegration tests are viewed in the literature as more efficient and robust than classical time series cointegration tests, increasing the accuracy, robustness and relevance of conclusions compared to traditional methods (Pedroni, 1999; Pedroni, 2004; Westerlund, 2007; Gianfreda et al., 2023).

The analysis initiates with cointegration and Granger causality tests to evaluate the presence and direction of long-term relationships and causal connections among the variables. Then, the methodological framework follows a comprehensive modelling strategy utilising the Fully Modified

Least Squares (FMOLS) estimation method. The Granger causality test is acknowledged in the literature as an effective method for analysing dynamic interrelationships between two sets of variables, aiming to assess whether one time series can statistically contribute to the prediction of another time series. In the context of institutional-level analysis, studies like those of Law et al., 2013 and Antonietti and Franco (2021) have shown that Granger causality can be applied to assess causality between variables at an institutional level. The flexibility and robustness of the cointegration tests of Pedroni (Pedroni, 2004) make it suitable for both small-scale individual analyses and larger institutional frameworks, and is given by equation 5.

$$\mathcal{Y}_{i,t} = \beta_i{}' x_{i,t} + \gamma_{li}{}' D_{li} + \varepsilon_{i,t}, \text{ where } x_{i,t} \; is \; equal \; to \; x_{i,t-1} \; + \varepsilon_{i,t} \quad (5)$$

Fully Modified Ordinary Least Squares (FMOLS) is a commonly used econometric technique designed to provide optimal estimates for cointegrating regressions in panel data settings (Pedroni, 2001). FMOLS adjusts for both serial correlation and endogeneity in the independent variables, making it an effective tool for generating reliable estimates in cointegrating regressions. This approach is particularly well-suited to studying the long-term relationships among economic growth, financial development, and green finance in EU countries, where such interdependencies are crucial to understand. FMOLS provides several advantages over Ordinary Least Squares (OLS) by accounting for serial correlation, endogeneity, and cross-sectional heterogeneity in the data. This method reduces small sample and endogeneity biases by incorporating leads and lags of first-differenced regressors. To address serial correlation and endogeneity arising from cointegration, FMOLS enhances the least squares approach, as outlined by Phillips and Hansen (1990). The model is specified as follows:

$$\mathrm{X}_t = \hat{\Gamma}_{2'1} D_{1t} + \hat{\Gamma}_{2'1} D_{1t} + \hat{\epsilon}_t, \quad (6)$$

Considering the implications of differencing in regression, the next equation describes the rationale of the model:

$$\Delta \mathrm{X}_t = \hat{\Gamma}_{2'1} \Delta D_{1t} + \hat{\Gamma}_{2'1} \Delta D_{1t} + \hat{v}_t \quad (7)$$

Furthermore, if $\widehat{\Omega}$ and $\widehat{\Lambda}$ represent the long-run covariance matrices calculating using the residuals $\hat{v}_t = (\hat{v}_{t1,} \hat{v}_{2t}{}')'$, the model is described by equation 8:

$$y_t^* = y_t - \hat{\omega}_{12} \widehat{\Omega}_{22}^{-1} \hat{v}_2 \quad (8)$$

An adjusted bias correction term is given by equation 9. This term accounts for potential biases by incorporating the influence of the long-run covariance matrices, thereby refining the estimation process to enhance model accuracy and robustness.

$$\lambda_{12}^* = \lambda_{12} - \hat{\omega}_{12} \widehat{\Omega}_{22}^{-1} \widehat{\Lambda}_{22} \quad (9)$$

The Fully Modified Ordinary Least Squares (FMOLS) is represented by the following equation:

$$\hat{\theta} = \left[\frac{\hat{\beta}}{\hat{\gamma}_1}\right] = (\sum_{t=1}^{T} Z_t Z_t{}')^{-1} \left(\sum_{t=1}^{T} Z_t y_t^* - T \left[\frac{\hat{\gamma}_{12}'}{0}\right]\right) \quad (10)$$

In this context, $Z_t = (X_t', D_t')'$, $Z_t$ combines the vectors $X_t'$ and $D_t'$. The purpose of FMOLS estimation is to construct long run estimators $\widehat{\Omega}$ and $\widehat{\Lambda}$, which are essential for addressing challenges related to endogeneity and serial correlation in estimating cointegrated relationships. The scalar estimator it is derived by modifying the initial variance estimate to account for dependencies, ensuring a more precise measurement of long-run variability, and can be

represented as: $\hat{\omega}_{1.2}=\hat{\omega}_{11}-\hat{\omega}_{12}\hat{\Omega}_{22}^{-1}\hat{\omega}_{21}$. In this case, $\hat{\omega}_{11}$ is the estimated long-run variance of the residuals $\upsilon_{1t}$, $\hat{\omega}_{12}$ and $\hat{\omega}_{21}$ represent the estimated covariances between $\upsilon_{1t}$ and $\upsilon_{2t}$, $\hat{\Omega}_{22}^{-1}$ is the inverse of the estimated long-run variance of $\upsilon_{2t}$.

The expression $\hat{\omega}_{12}$ is interpreted as the estimated long-run variance of $\upsilon_{1t}$conditional on $\upsilon_{2t}$. This adjusted measure accounts for the impact of $\upsilon_{2t}$ on $\upsilon_{1t}$, allowing FMOLS to provide unbiased and efficient long-run estimates by isolating the specific contribution of each component in the presence of cointegrating relationships. Both Fully Modified Ordinary Least Squares (FMOLS) and the Dynamic Ordinary Least Squares (DOLS) can be a valuable approach for robustness checks in estimating long-run relationships in cointegrated systems. Running both methods allow us to see if they yield similar results, which increase confidence in the stability and reliability of our estimates.

*Factor Analysis-Methodology*

The Financial Development Index (FDEVINDEX) and Green Finance Index (GRFININDEX) were calculated using exploratory factor analysis methods. Financial development and green finance are multidimensional concepts that involve various underlying factors, such as financial market depth, access to credit, environmental impact, and sustainability initiatives. Simple, single indicators might fail to capture the full spectrum of these complex dimensions. That's why we decided to create indices, and synthesize multiple indicators into a single, comprehensive measure that reflects overall levels of financial development or green finance activities, providing a clearer and more holistic view of each. In the context of constructing indices like the Financial Development Index or Green Finance Index, exploratory factor analysis (EFA) is especially useful for identifying core dimensions of financial and green finance measures. Through extraction, rotation, and factor interpretation, factor analysis provides a rigorous way to condense data into meaningful factors that can then be quantified, compared, and analysed. In factor analysis, the goal is to explain a set of observed variables let's call them q, that linearly reconstruct the p original variables. The equation 11 illustrates how factor analysis reconstructs each observed variable ( $\mathcal{Y}_{ij}$) as a linear combination of these underlying common factors:

$$\mathcal{Y}_{ij} = \mathcal{Z}_{i1}\mathrm{b}_{1j} + \mathcal{Z}_{i2}\mathrm{b}_{2j} + \mathcal{Z}_{i3}\mathrm{b}_{3j} + \dots \mathcal{Z}_{iq}\mathrm{b}_{qj} + e_{ij} \quad (11)$$

Where $\mathcal{Y}_{ij}$ represents the value of the jth observed variable for the ith individual or observation in the dataset. For example, in constructing the Financial Development Index, individual financial indicators include metrics such as "Domestic credit to the private sector (% of GDP)" or "Outstanding international private debt securities as a percentage of GDP" for each country, along with other indicators detailed in Table 1. $\mathcal{Z}_{ik}$ represents the ith observation on the kth common factor, $\mathrm{b}_{qj}$ is a loading coefficient that reflects how strongly each common factor $\mathcal{Z}_q$ contributes to the observed variable $\mathcal{Y}_j$, and finally, $\mathrm{e}_{ij}$ captures unique factors or measurement errors specific to each observed variable j.

The indices were computed through a normalization procedure, ensuring consistency and comparability, as validated by Eck and Waltman. This approach standardizes the data, allowing for meaningful interpretation across different scales and contexts (see equations 12 and 13).

$$= \frac{\sum_{t=1}^{n} W_t * V_t}{\sum_{t=1}^{n} W_t} \quad (12)$$

M= Represents the calculated index value, which is a weighted average of individual values over different periods

$V_t$= the actual value of the indicator in a given time period t

$W_t$= The weighting factor for each period ttt. This factor can be adjusted to give more importance to certain periods, depending on their relevance or data reliability
n= The number of periods in the weighting group or dataset

$$Z_{ij} = \frac{x_{ij-\bar{x}_j}}{s_j} \quad (13)$$

$Z_{ij}$= This is the normalized (or standardized) value for variable $j$ in sample unit *i.*

$X_{ij}$ = The raw data value for variable $j$ in sample unit $i$ .

$\bar{x}_j$= The sample mean of variable $j$ across all sample units. This is the average value of the variable $j$ in the dataset.

$s_j$ = The sample standard deviation for variable j across sample units. This measures the spread or dispersion of values for variable $j$ around the mean

# 3. Empirical evidence

To mitigate the risk of biased results, unit root tests were conducted to check the stationarity of the data. Levin, Lin, and Chu (2002), Im, Pesaran, and Shin (2003), and Fisher-type tests were applied to each variable to test for unit roots. The baseline out-comes, 5summarized in Tables 3, 4 and 5, present the outcomes of unit root tests conducted at the level and first difference. These tests were performed separately under three scenarios: with an intercept, with both an intercept and a trend, and with neither included in the test equation. Consistent with the literature (Al-Mulali, 2011), when applying the ADF test, it is necessary to examine both versions, one with an intercept only and another with an intercept and a trend.

**Table 3. Panel Unit Root Test Results for ECGRW- Testing for Stationarity at Level and First Difference**

| | Level | | | 1st difference | | |
|---|---|---|---|---|---|---|
| | **Intercept** | **Intercept & Trend** | **None** | Intercept | Intercept & Trend | None |
| Levin, Lin & Chu t* | 6.01584 (1.0000) | 31.8379 (0.0126) | 3.90278 (1.0000) | 24.8258 (0.0000) | 30.3764 (0.0000) | -10.1938 (0.0000) |
| Im, Pesaran and Shin | -0.8380 (0.2010) | -3.33427 (0.0004) | - | -6.74914 (0.0000) | -4.30719 (0.0000) | - |
| ADF - Fisher Chi-square | 53.3450 (0.0496) | 72.7979 (0.0450) | 11.6986 (1.0000) | 141.626 (0.0000) | 102.841 (0.0001) | 194.060 (0.0000) |
| PP - Fisher Chi-square | 307.679 (0.0000) | 766.019 (0.0000) | 12.3324 (1.0000) | 1488.16 (0.0000) | 214.002 (0.0000) | 315.171 (0.0000) |

Note: The null hypothesis assumes the presence of a unit root (individual unit root process). Probabilities are provided in parentheses.

**Table 4. Panel Unit Root Test Results for FDEVINDEX - Testing for Stationarity at Level and First Difference**

| | Level | | | 1st difference | | |
|---|---|---|---|---|---|---|
| | **Intercept** | **Intercept & Trend** | **None** | Intercept | Intercept & Trend | None |
| Levin, Lin & Chu t* | -3.44641 (0.0003) | -2.62395 (0.0043) | -3.43475 (0.0003) | -2.86566 (0.0000) | -1.59383 (0.0000) | -9.35633 (0.0000) |
| Im, Pesaran and Shin | 0.50198 (0.3078) | 1.96884 (0.9755) | - | -4.21756 (0.0000) | -2.41760 (0.0000) | - |
| ADF - Fisher Chi-square | 61.6977 (0.2002) | 38.3070 (0.9476) | 80.4053 (0.0114) | 105.191 (0.0000) | 95.0326 (0.0005) | 170.053 (0.0000) |
| PP - Fisher Chi-square | 43.1366 (0.8554) | 25.2875 (0.9997) | 76.1210 (0.0253) | 193.924 (0.0000) | 142.923 (0.0000) | 237.712 (0.0000) |

Note: The null hypothesis assumes the presence of a unit root (individual unit root process). Probabilities are provided in parentheses.

**Table 5. Panel Unit Root Test Results GRFININDEX - Testing for Stationarity at Level and First Difference**

| | Level | | | 1st difference | | |
|---|---|---|---|---|---|---|
| | **Intercept** | **Intercept & Trend** | **None** | Intercept | Intercept & Trend | None |
| Levin, Lin & Chu t* | -5.48490 (0.0000) | -4.48460 (0.0043) | -3.22372 (0.0006) | -10.4023 (0.0000) | -8.22706 (0.0000) | -17.9200 (0.0000) |
| Im, Pesaran and Shin | -3.95701 (0.3078) | -3.06437 (0.0011) | - | -10.6917 (0.0000) | -9.15219 (0.0000) | - |
| ADF - Fisher Chi-square | 116.302 (0.2002) | 101.030 (0.0001) | 93.3727 (0.0114) | 218.507 (0.0000) | 175.318 (0.0000) | 312.429 (0.0000) |
| PP - Fisher Chi-square | 83.6596 (0.0059) | 77.5824 (0.0194) | 95.6490 (0.0253) | 338.888 (0.0000) | 315.063 (0.0000) | 453.033 (0.0000) |

Note: The null hypothesis assumes the presence of a unit root (individual unit root process). Probabilities are provided in parentheses.

The panel unit root test results presented in Tables 3, 4 and 5 indicate mixed findings when applying the Levin, Lin, and Chu (2002), Im, Pesaran, and Shin (2003), and Fisher-type tests at the level order. The results indicate that all variables are non-stationary at levels but become stationary after first differencing, as the null hypothesis of a unit root is explicitly rejected at the first-difference level. For GDP, the unit root analysis shows that, in most cases, the variable exhibits a unit root at the level, but it becomes stationary when first differences are applied. Likewise, the Unit Root Test for the Economic Growth Variable (FDEVINDEX) confirms consistent findings. The results from the Levin, Lin & Chu, Im, Pesaran, and Shin, ADF-Fisher Chi-square, and PP-Fisher Chi-square tests collectively indicate that the variable is non-stationary at levels but attains stationarity after first differencing. The findings align with the existing literature, which have documented cases where variables are non-stationary at the level but become stationary at

the first difference (Pedroni,2001; Narayan and Narayan, 2010; Bastola and Sapkota, 2015), which report similar results. The Unit Root Test for the Green Finance Variable (GRFININDEX) demonstrates consistent results. After confirming the stationarity of all variables, panel cointegration tests were conducted to examine the empirical relationship between economic growth, financial development, and green finance. The estimation results for the panel cointegration tests are presented in Table 6.

**Table 6. Kao Residual Cointegration Test- Confirming Long-Run Relationship Among GDPCAP, FDEVINDEX, and GRFININDEX.**

| Dimension | Test Statistics | Intercept | | Intercept and Trend | |
|---|---|---|---|---|---|
| | | Statistic | Prob. | Statistic | Prob. |
| Within-dimension | Panel v-Statistic | 4.687372 | 0.0000 | 2.493025 | 0.0063 |
| | Panel rho-Statistic | -7.421465 | 0.0000 | -6.725935 | 0.0000 |
| | Panel PP-Statistic | -15.23275 | 0.0000 | -21.15910 | 0.0000 |
| | Panel ADF-Statistic | -17.75021 | 0.0000 | -28.12506 | 0.0000 |
| Between-dimension | Panel rho-Statistic | 0.266690 | 0.6051 | 1.589277 | 0.0094 |
| | Panel PP-Statistic | -4.368732 | 0.0000 | -4.918371 | 0.0000 |
| | Panel ADF-Statistic | -4.904163 | 0.0000 | -7.959431 | 0.0000 |
| | | Kao residual cointegration test | | | |
| ADF | t-Statistic | | | Prob. | |
| | 4.855010 | | | 0.0000 | |

Note: The null hypothesis assumes the presence of a unit root (individual unit root process). Probabilities are provided in parentheses.

The results of the Pedroni test (within-dimension) show that, when an intercept is included, the null hypothesis of no cointegration is rejected across all four panel statistics, providing strong evidence of a long-run relationship between the variables. In contrast, for the between-dimension Pedroni test, the null hypothesis is rejected for only one of the four panel statistics, suggesting partial support for cointegration. However, when both an intercept and a trend are included in the Pedroni test within-dimension, the null hypothesis is rejected for all four panels, thus supporting the presence of cointegration between the variables. Overall, most of the tests reject the null hypothesis, demonstrating that the variables are cointegrated and exhibit a long-run relationship. The Kao residual cointegration test yields a statistically significant result, confirming the presence of a long-run equilibrium relationship among the variables. This supports the robustness of our cointegration analysis and justifies the use of long-run estimators such as FMOLS and DOLS in the subsequent stage of analysis. Given that the results show that economic growth, financial development, and green finance are moving together in the long run, it is revealed the necessity that policy makers to strengthening financial systems and promoting green finance across EU member states.

Considering the cointegration among the variables, the robustness of the analysis is enhanced by employing the DOLS and FMOLS estimators. By employing the Dynamic Ordinary Least Squares (DOLS) and Fully Modified Ordinary Least Squares (FMOLS), the analysis becomes more rigorous and enhances the overall quality and reliability of the empirical findings. These methods ensure that the long-run relationships between analysed variables (economic growth, financial development, and green finance) are estimated accurately, free from common econometric pitfalls such as endogeneity and serial correlation. The presence of cointegration

among economic growth, financial development, and green finance at the EU level carries significant economic implications for policymakers, financial institutions, and sustainability initiatives. First, the confirmed long-term relationship between financial development and green finance suggests that integrating sustainability considerations into financial markets can support stable economic growth. EU policymakers should enhance green financial instruments, such as green bonds and sustainability-linked loans, to ensure long-term economic expansion without compromising environmental goals. Second, since financial development and green finance are cointegrated, this implies that well-functioning financial markets play a crucial role in mobilizing capital for green investments. EU financial regulators should foster policies that promote green banking, ESG (Environmental, Social, and Governance) disclosures, and sustainable lending practices to ensure market stability while financing the green transition. Third, there is a need for policy coordination for long term sustainability and the EU must align its fiscal, monetary, and environmental policies to leverage the interconnectedness of financial markets and sustainability initiatives, ensuring a seamless transition towards a low-carbon economy.

Table 7 presents the estimation of the cointegrating relationship among economic growth (ECGRW), financial development (FDEVINDEX), and green finance (GRFININDEX). The panel Dynamic Ordinary Least Squares (DOLS) method is used as a reliable tool for estimating a specific cointegrating vector in panel data. The DOLS model is particularly advantageous as it requires the variables to be cointegrated and effectively addresses issues of serial correlation and endogeneity, making it superior to other regression models.

**Table 7. Estimation of cointegrating relationship: The results of FMOLS and DOLS**

| Dependent variable ECGRW | | | | |
|---|---|---|---|---|
| | **FMOLS** | | **DOLS** | |
| **Variable** | Coefficient | S. E. | Coefficient | S. E. |
| GRFINDEX | 0.1690*** | 0.0241 | 0.2890*** | 0.0651 |
| FDEVINDEX | 0.0693*** | 0.0132 | 0.0600*** | 0.0305 |
| R-squared | 0.8929 | | R-squared | 0.9890 |
| Adjusted R-squared | 0.8870 | | Adjusted R-squared | 0.9646 |
| S. E. of regression | 0.1409 | | S. E. of regression | 0.0763 |
| Mean dependent var | 10.634 | | Mean dependent var | 10.639 |
| Sum squared resid | 10.155 | | Sum squared resid | 0.7752 |

Note: *** denotes significance at the 1% level, while ** denotes significance at the 5% level. S.E. represents standard errors.

Using the DOLS and FMOLS estimators, we evaluate the robustness of the results. The results derived from these estimation techniques confirm the existence of a long-term cointegration relationship among economic growth (ECGRW), financial development (FDEVINDEX), and green finance (GRFININDEX). The strong positive association between these variables underscores the pivotal role of a well-developed green finance framework in fostering sustainable economic expansion across EU countries. Empirical evidence indicates that, on average, a 1% increase in green finance translates into a 0.289% rise in economic growth, while a 1% increase in financial development contributes to a 0.060% improvement in economic performance. These findings emphasize the increasing importance of sustainable financial mechanisms in ensuring long-term economic stability, mitigating environmental risks, and improving financial market efficiency. To maximize both economic and environmental benefits, policymakers should focus on expanding

green financial instruments, strengthening regulatory frameworks, and enhancing investment incentives within the EU.

The results indicate that EU economies gain significant advantages from a well-developed green financial market, which effectively directs capital toward renewable energy, carbon-neutral projects, and sustainable infrastructure. Moreover, the comparatively smaller impact of financial development suggests that traditional financial sector growth, on its own, is not enough to drive substantial economic progress without integrating sustainability into financial strategies. These findings are consistent with the broader body of literature emphasizing the role of green finance as a catalyst for economic growth and development while addressing environmental sustainability. The overview of positive relationship between green finance and economic growth aligns with studies such as those conducted by Hou et al., (2023) and Yang (2023), who highlight that sustainable financial investments foster technological innovation, renewable energy projects, and infrastructure development, all of which are instrumental in driving economic progress. The observed effect of financial development, where a 1% increase in financial development results in a 0.060% improvement in economic progress, is in line with the findings of Beck et al. (1999) and Demirguc-Kunt and Levine (2001). These studies suggest that efficient financial markets, accessible credit, and sound banking systems are critical drivers of economic performance by ensuring that resources are allocated efficiently across sectors. The strong link between green finance and economic growth in the EU underscores the need for a robust and integrated green financial ecosystem, where policymakers enhance incentives for sustainable investments, expand ESG-aligned financial instruments, and implement climate-aligned fiscal policies to drive economic expansion. Financial sector reforms should incorporate sustainability criteria to strengthen resilience against environmental risks, while targeted support for emerging EU economies can bridge the green finance gap and accelerate their transition; moreover, leveraging green finance as a post-crisis recovery tool through initiatives like NextGenerationEU and the Green Deal will ensure long-term economic stability and sustainable growth across the region.

The cointegration relationship between economic growth, financial development, and green financing is empirically demonstrated by the present study. The positive coefficients obtained from the FMOLS and DOLS estimations suggest that financial development and green financing have a beneficial impact on economic growth in EU member states. The results regarding the impact of green financing on economic growth highlight the necessity of promoting sustainable financial instruments and integrating environmental factors into financial systems. Although traditional financial development significantly facilitates economic activity by improving access to credit, increasing investment efficiency, and mobilizing capital, the study highlights that the impact of green financing is stronger, as this type of financing is not only an ecological component but also a catalyst for long-term economic growth. The coefficient associated with the green finance index is higher and more statistically significant than that of the financial development index, indicating that investments in ecological sustainability bring both environmental advantages and considerable economic benefits. These results highlight the increasing importance of reorienting financial systems towards sustainability-focused instruments and frameworks, establishing green financing as a central element of future financial development strategies. Considering these results, the following policy recommendations can be formulated: While addressing the urgent environmental issues facing member states, EU authorities should take proactive steps to promote green finance as a vital engine of sustainable economic development. First, they should create create strong green financial frameworks, capable to support both public and private funding for low-carbon technology and renewable energy projects. Second, in order to incorporate environmental sustainability into the core of general economic goals, cross-sectoral financial reforms must be consolidated. In order to guarantee that all sectors contribute to sustainable development, financial policies would need to be in line with climate objectives. Last but not least, it is essential to support the growth of the financial markets by making sure that financial institutions are functional, inclusive, and ready to allocate capital to green initiatives. This would

encourage the development of a strong financial system that makes sustainable, long-term investments possible. While our use of FMOLS and DOLS estimators helps to mitigate the impact of endogeneity and serial correlation, it's important to acknowledge that our focus on long-run trends may not fully account for the short-term disruptions caused by major macroeconomic shocks such as the 2008 financial crisis and the COVID-19 pandemic. Future research could explore these dynamics using methodologies specifically designed to capture structural breaks and time-varying effects.

# 4. Conclusion

The study has analysed the intricate links between economic growth, financial development, and green financing in a set of 27 member states of the European Union for the period 2000–2021. Using advanced econometric techniques such as factor analysis, stationarity and cointegration tests, FMOLS (Fully Modified Ordinary Least Squares), as well as DOLS (Dynamic Ordinary Least Squares), the study confirms the existence of a long-term relationship between green financing and economic growth, as well as between the status of financial development and economic growth. Both methods provided complementary results, which validated the robustness of the model used, highlighting that for the profile of EU member states, a 1% increase in green financing leads to a 0.289% improvement in economic progress, while a 1% increase in financial development generates a 0.060% increase. These findings highlight the vital importance of green financing and financial development in stimulating sustainable economic growth. Also highlighting the importance of creating robust green financing frameworks and strengthening financial systems to achieve long-term economic and environmental goals. The importance of the financial system is also highlighted, the innovative financial systems being the only ones capable of prioritizing sustainability on the path to economic growth. These results align with empirical evidence provided by the specialized literature, which reveals that integrating green financing into current financial processes is essential for achieving sustainable long-term growth. Moreover, the obtained results have significant implications for current public policies, as they highlight the necessity of strengthening existing financial structures to prioritize issues related to energy infrastructure and sustainable infrastructure.

Both the public sector and financial institutions must collaborate to establish reg-ulatory frameworks that stimulate green investments, reduce risks associated with sustainable initiatives, and facilitate access to resources and green financing projects. Strengthening financial systems must be part of the economic growth strategy, as only in this way can be facilitated the efficient allocation of capital to green projects and sustainable infrastructure. The robustness of the financial sector not only allows for the mobilization of the capital necessary for sustainable investments but also strengthens stability in the face of external shocks, laying the foundation for a competitive green economy. As EU member states face the challenges of economic growth in an era marked by climate change and limited resources, integrating green finance into policies and practices will be vital for achieving the objectives set in the EU's agenda for sustainable finance and strengthening long-term sustainable growth.

The findings of this study provide a reference framework for policymakers and stakeholders to harness the transformative potential of green finance and financial development, ensuring that economic progress is aligned with environmental respon-sibility. By adopting a proactive, sustainability-focused approach, countries can build a solid foundation for a more equitable, prosperous, and environmentally friendly future.

Another important consideration highlighted by this study is that green financing has a stronger impact on economic growth than financial development. The results show that a 1% increase in green financing has an effect approximately five times stronger on economic growth than financial development, highlighting that investments in green projects have a multiplier effect in the

economy. Moreover, green financing is not just an ecological component but also an economic engine. These results emphasize the necessity of directing capital towards sustainable investments, combined with the creation of resilient financial institutions capable of adapting to the changing demands of the market and environmental challenges. Considering these results, the following policy recommendations can be formulated: First, the status of high GRFINDEX and High FDEVINDEX on the profile of countries such as Finland, Denmark, Luxembourg, reveal that these countries already have robust green finance frameworks and well-developed financial systems. Therefore, the priority should be to consolidate their leadership role, focusing on innovation in sustainable financial products (such as sus-tainability-linked derivatives, climate resilience bonds) and supporting cross-border green investment flows to less advanced EU members. Second, high FDEVINDEX and Low GRFINDEX on the profile of Cyprus or Portugal), reveal that financial system is mature, but green finance penetration is lagging. Policy should prioritize mainstreaming sustainability into existing financial products through regulatory incentives, mandatory ESG disclosures, and targeted subsidies for green lending. Third, the low GRFINDEX and low FDEVINDEX scores observed for countries such as Romania, Bulgaria, and Greece indicate that these economies require foundational reforms. Priority actions should include strengthening institutional capacity, expanding access to finance, and introducing basic green finance instruments, such as green credit lines and energy-efficiency loans, implemented in parallel with broader financial market reforms.

Targeted external support from EU-level mechanisms such as InvestEU, or the Green Deal funds, could significantly accelerate progress in these areas. The conclusions of this study provide an important analytical framework for policymakers and economic authorities, highlighting the importance of integrating green financing into strategic tools related to sustainable economic growth, paying attention to the reform of financial systems to encourage capital flows towards green initiatives, and developing cooperation between government, the private sector, and financial in-stitutions.

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