GREEN ECONOMICS
Vol.1, No.1, 2023, pp.33-45

GREEN FINANCE AND GREEN ECONOMY: A PANEL VAR ANALYSIS OF THE DYNAMIC RELATIONSHIP FOR SUSTAINABLE DEVELOPMENT IN EUROPE

Ardita Bytiqy, Hyrijie Abazi-Alili, Gadaf Rexhepi*

Faculty of Business and Economy, South East European University, North Macedonia

Abstract. Green Finance and Green Economy are essential for promoting sustainable development, protecting the environment, and fostering economic growth. So understanding the relationship between is very important in ensuring a better future for both current and future generations. This paper explores the relationship between green economy and green finance in the context of sustainable development in Europe. The study uses a Bivariate Panel VAR model to analyze and investigate the relationship between these two concepts for 27 EU countries for the period from 2011 to 2020. The empirical findings suggest that there is a positive and bidirectional relationship between green finance and green economy in the long run, which has important policy implications. Policy-makers should encourage investment in environmental protection, promote sustainable economic growth, foster international cooperation, and enhance green finance to support sustainable development and ecological protection while fostering economic growth. The study contributes to the growing literature on sustainable finance and green economy in Europe and can guide policymakers in promoting sustainable development.

Keywords: *Green finance, Green economy, Panel VAR model.*

Corresponding Author: *Gadaf Rexhepi, Faculty of Business and Economy, South East European University, North Macedonia, e-mail: g.rexhepi@seeu.edu.mk*

Received: *9 April 2023;* ***Accepted:*** *12 May 2023;* ***Published:*** *30 May 2023.*

1. Introduction

The concept of sustainable development has gained significant attention globally, with Europe being at the forefront of adopting various practices to achieve sustainability in economic growth, ecological balance, and environmental protection. The European Union (EU) has set an ambitious goal of achieving climate neutrality by 2050, which requires significant investments in green infrastructure, renewable energy, and other sustainable practices. To achieve this goal, the EU has been exploring various ways of integrating green finance and green economy, as they are interdependent and can contribute to each other's growth.

Green finance refers to financial products and services that promote sustainable development by encouraging investments in environmentally friendly projects (Sachs *et al.*, 2019). On the other hand, the green economy includes all economic activities that contribute to reducing greenhouse gas emissions and enhancing resource efficiency (He *et al*., 2019). The synergy between these two concepts can lead to the creation of a sustainable economic model that fosters environmental protection, social development, and economic growth.

The EU has been implementing various policies and initiatives to promote green finance and green economy, such as the European Green Deal, Sustainable Finance Action Plan, and the Taxonomy Regulation. These policies aim to incentivize private and

public investments in sustainable projects and to ensure that financial institutions consider environmental risks in their decision-making processes and have been exploring ways to promote sustainable development and address ecological imbalances and environmental pollution as well. Measures such as green finance and green economy have been increasingly recognized as essential components of this process.

To better understand the interaction between green finance and green economy, this paper aims to construct a bivariate Panel VAR model and use different analyses to empirically analyze the relationship between these two concepts for 27 EU countries for the period from 2011 to 2020.

This research can have both theoretical and practical implications, as it can guide policymakers in promoting sustainable development and ecological protection while fostering economic growth. Overall, this study contributes to the growing body of literature on sustainable finance and green economy in Europe and can inform future research in this field.

2. Literature review

***Green Economy*:** Over the past decade, policymakers have shown growing interest in the idea of a green economy. Nevertheless, the green economy encompasses a wide range of concepts and its relationship with sustainability is not always apparent. The concept of the green economy has gained influence in government policy-making in recent years, partly due to the global economic crisis and concerns around climate change and environmental degradation. It is seen as a way to protect the environment, stimulate economic growth, and eradicate poverty.

David W. Pearce, a British environmental economist, introduced the idea of a "green economy" in his 1989 book titled the Green Economy Blueprint. Pearce argued that economic progress should be sustainable and not surpass the natural environment's and human beings' limits. He emphasized that economic growth pursued blindly without considering ecological consequences could cause environmental crises, social, and economic downfall (Pearce *et al*., 2012). Green economy is fundamentally a form of sustainable development that integrates ecology and the economy, and it helps to improve high energy consumption, adjust economic structure, and promote stable economic growth according to (He *et al*., 2019).

In some cases, the incorporation of the green economy into economic growth agendas has been done with alarming enthusiasm, often leading to the merging of more positive interpretations of the green economy with economic growth and free market initiatives. (ESA, 2012).

***Green Finance*:** Green finance refers to the financial instruments and mechanisms that promote investment in environmentally friendly projects and initiatives. The development of infrastructure projects, including energy projects, relies heavily on finance, but many financial institutions show more interest in fossil fuel projects than green projects due to associated risks and lower returns (Sachs *et al*., 2019). According to (Scholtens, 2017), green finance represents the overlap between eco-friendly practices and the financial and business spheres. Further (Böhringer *et al*., 2015) argue that green finance promotes investments in novel technologies and innovations, such as those related to renewable energy. However, there are a lot of concepts relating to green finance studied from different perspectives.

The concept of a green economy is closely linked with green finance, as both aim to create sustainable economic growth that balances environmental, social, and economic concerns. The relationship between green finance and green economy has been widely studied in the literature, particularly in the European context. The theoretical background of this relationship can be understood through the lens of the sustainable development paradigm, which emphasizes the integration of economic, social, and environmental goals (Walker *et al*., 2019). This paradigm requires a transition to a low-carbon, resource-efficient, and environmentally sustainable economy, which is only possible through the mobilization of financial resources towards sustainable investments (Iulia & Rădăcină, 2019).

One of the main theoretical frameworks used to explain the relationship between green finance and green economy is the "finance-real economy-environment nexus" (Madaleno *et al*., 2022). This framework suggests that green finance can influence the real economy by providing incentives for firms to adopt environmentally sustainable practices, which in turn can contribute to environmental protection and sustainable development. Green finance can also help to redirect financial flows away from environmentally harmful activities towards sustainable investments (Bhattacharyya, 2021). The real economy, in turn, can influence the environment through its production and consumption activities, which can generate environmental externalities. Therefore, green finance can help to internalize these externalities and promote sustainable economic growth (Saha *et al.*, 2022).

Another theoretical framework that is relevant to the relationship between green finance and green economy is the concept of "green growth" (Bowen & Hepburn, 2014). Green growth refers to the development of an economy that is environmentally sustainable, socially inclusive, and economically efficient. This requires a shift towards a low-carbon, resource-efficient, and environmentally sustainable economy, which can be achieved through the promotion of sustainable investments and the implementation of policies that support green growth (Kim *et al*., 2014). Green finance can play a key role in supporting green growth by providing financial resources for sustainable investments and helping to internalize environmental externalities.

Empirical evidence on the relationship between green finance and green economy is most of the time positively while can be complexed as well. For example, (Falcone, 2020) found green finance having a very important role to green economy, further the positive linkage between was also found by (Iraldo *et al*., 2011), Also (Yang *et al.*, 2022) provides evidence of a positive relationship between green finance and the green economy in G7 countries. They suggest that the development of green finance, clean energy, and the green economy are all important and constructive indicators of sustainable practices.

Evidence of a positive relationship between green finance and the green economy was also found by (Zhao *et al.*, 2022) indicating that green bonds, which are a form of green finance, are currently the primary financing source for energy efficiency projects and can enhance economic growth and potentially increase green economic recovery. (Ivanovic *et al*., 2017) explains that green economy aims to balance the economy, society, and the environment, and green finance is an instrument developed to achieve this goal.

However, (Geng *et al*., 2023) found that the impact of green finance on green economic efficiency had a "U"-shaped relationship, which was in line with the Environmental Kuznets Curve (EKC) hypothesis. This suggests that the relationship

between green finance and green economy is not a simple linear one, but rather a complex and nonlinear one.

Understanding the context-specific relationships between green finance, green innovation, and environmental performance in developing countries in order to promote sustainable development and green growth is quite important. This relationship between green finance and green economy can be both positive and negative, depending on the context. In emerging countries and countries with lower levels of green finance, green finance has a positive effect on green innovation, which can ultimately lead to improved environmental performance and contribute to the development of a green economy. But in countries with better green innovation or environmental performance, green finance may have a negative effect on green innovation as it is found by (Wang *et al*., 2022). This could be due to the fact that in these countries, the existing green innovation or environmental performance is already at a high level, and therefore, more investment in green finance may not necessarily lead to further improvements in green innovation or environmental performance.

In conclusion, the concepts of green economy and green finance are intertwined and aim to create sustainable economic growth while balancing environmental, social, and economic concerns. The green economy has gained significant attention in recent years due to concerns around climate change and environmental degradation, while green finance promotes investment in environmentally friendly projects and initiatives. The relationship between green finance and green economy has been widely studied, and empirical evidence generally suggests a positive relationship between the two concepts. However, caution must be exercised when incorporating the green economy into economic growth agendas, as the concept should not be merged with more positive interpretations of economic growth and free market initiatives.

3. Methodology and data analysis

3.1. Sample Selection and Model Construction

Selection of Variables

1. Expenditure on environment protection (EEP): Based on the literature and databases of information from different sources analyzed (Dang, 2020; Falcone, 2020), (Lu, 2021) Expenditure on environment protection is one of the indicators which can be used as a measure of green investment as it reflects the resources that are being directed towards activities that are aimed at protecting the environment. This measure captures the amount of money spent on activities aimed at preventing, reducing, and controlling pollution, protecting and restoring natural habitats, and promoting sustainable use of natural resources. So In this paper the indicator Expenditure on environment protection is used to represent green financial indicators.

2. Green GDP (GreenGDP): Further more analyzing the existing literature we found Green GDP as the other index which we will use in this paper to measure the development of a green economy (Stjepanović *et al*., 2019; Talberth & Bohara, 2006).

We have defined Green GDP based on the equation as below:

$$\text{GreenGDP} = \text{GDP} - \text{Environmental taxes and charges} \quad (1)$$

As we found as a useful approach for estimating the economic costs of pollution and natural resource depletion, which are important components of environmental damage. The use of environmental taxes and charges as an indicator allows for a direct estimation

of the economic costs of environmental damage and can help to incentivize cleaner production and consumption patterns.

In Table 1. Below is presented the definitions of variables used in the model with summary of statistics.

Panel data of green economy index and green finance index are selected from two databases.

Table 1. Definitions of variables used in the model

Variable Code	Variable Definition	Unit of measure	Variable Description	Data Source	Obs	Mean	Std. Dev.	Min	Max
EEP	Expenditure on environment protection (EEP)	Percentage of gross domestic product (GDP)	Money spent by governments and private institutions on activities that aim to protect and conserve the environment.	ClimateData.imf.org	270	.7605289	.3477065	-.1720907	1.848628
				EuroStat	270	27217.87	18668.95	5489.412	101233.4
GreenGDP	Green GDP	Euro per capita	The gross domestic product (GDP) adjusted to account for the negative impact of environmental taxes and charges measuring the size of an economy while taking into account the costs associated with environmental degradation and pollution.						

3.2. Constructing a bivariate Panel VAR model

The bivariate Panel VAR (Vector Autoregression) model was proposed by a number of researchers in the field of econometrics and statistics. One of the earliest references to this model is by (Holtz-Eakin *et al*., 1988), also other notable researchers who have contributed to the development and refinement of the bivariate Panel VAR model include (Kiviet, 1995; Baltagi & Wu, 1999; Chudik & Pesaran, 2015), among others.

So in order to examine the dynamic relationship between green economic growth and green finance, this paper constructs a bivariate Panel VAR model using Expenditure on Environment Protection (EEP) and Green GDP as variables.

First we have specify the model, estimate the parameters, and test for its validity.

The bivariate Panel VAR model can be expressed as:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \beta_1 X_{t-1} + \varepsilon_t \quad (2)$$

where Y_t is a vector of the endogenous variables, α_0 is a constant, α_1 is a coefficient matrix for the endogenous variables, β_1 is a coefficient matrix for the exogenous variable, X_t is a vector of the exogenous variables, and ε_t is a vector of the error terms.

In our case, we have two endogenous variables, EEP and Green GDP, and no exogenous variables. We also have a panel dataset, so we need to account for both the cross-sectional and time dimensions of the data.

Next, we can specify our bivariate panel VAR model as follows:

$$EEP_{it} = \alpha_{10} + \alpha_{11} EEP_{(i,t-1)} + \beta_{12} GreenGDP_{(i,t-1)} + \varepsilon_{1it} \quad (3)$$

where EEP_{it} represents the level of EEP for unit *i* in time period *t*. The equation states that the current level of EEP is a function of its lagged value $EEP_{(i,t-1)}$, the lagged value of $GreenGDP_{(i,t-1)}$, and an error term ε_{1it}. The coefficient α_{11}represents the effect of

the lagged value of EEP on the current value of EEP, while β_{12} represents the effect of the lagged value of Green GDP on the current value of EEP. The constant term α_{10} represents the intercept of the equation, which represents the level of EEP when the lagged values of EEP and Green GDP are zero. And:

$$GreenGDP_{it} = \alpha_{20} + \alpha_{21}EEP_{(i,t-1)} + \beta_{22}GreenGDP_{(i,t-1)} + \varepsilon_{2it} \quad (4)$$

where $GreenGDP_{it}$ represents the level of Green GDP for unit *i* in time period *t*. The equation states that the current level of Green GDP is a function of its lagged value $GreenGDP_{(i,t-1)}$, the lagged value of $EEP_{(i,t-1)}$, and an error term ε_{2it} . The coefficient β_{22} represents the effect of the lagged value of Green GDP on the current value of Green GDP, while α_{21} represents the effect of the lagged value of EEP on the current value of Green GDP. The constant term α_{20}represents the intercept of the equation, which represents the level of Green GDP when the lagged values of EEP and Green GDP are zero.

The two equations represent the dynamic relationships between EEP and Green GDP in a panel data context, and are used to estimate the effects of past values of these variables on their current values, while controlling for other factors that may affect them.

3.3. Unit Root Test

Using a bivariate panel VAR model we have perform unit root tests in order to check the presence of unit roots in the variables that can affect the estimation and inference of the model. Non-stationary variables can lead to spurious regression results and unreliable estimates of the coefficients. This can happen because non-stationary variables tend to have high levels of autocorrelation and the VAR model assumes that the variables are stationary and have no unit roots.

So before estimating a bivariate panel VAR model performing Levin-Lin-Chu, (Harris & Tzavalis, 1999), (Breitung, 2000), (Im, Pesaran, & Shin, 2003) unit root test checking the presence of unit roots in the variables, where in the Table 2 below are presented the results of unit root tests.

Table 2. Panel Unit Root Tests

Variable name	**Levin-Lin-Chu**		**Harris-Tzavalis**		**Breitung**		**Im-Pesaran-Shin**	
	p-value		p-value		p-value		p-value	p-value
Stationary level	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)		I(0)
EEP	0.0000***	0.0000***	0.0000***	0.0000***	0.0620*	0.0000***	0.2115	0.0000***
GreenGDP	0.0001***	0.7479	1.0000	0.0000***	1.0000	0.0000***	1.0000	0.0795*

The results suggest that EEP is stationary at the stationary level (I(0)) and does not require differencing, while "GreenGDP" may require differencing to make it stationary. So the variables used in the bivariate panel VAR model are used as stationary to avoid spurious regression results and unreliable estimates of the coefficients.

3.4. Co-integration Test

In order to determine whether there exists a long-run relationship between Green Economy and Green Finance and whether the variables in the model are cointegrated over time and across different units we have performed co-integration test as next step using our variables.

In Table 3 below are presented the results from the test performed taking in consideration the hypothesis Ho: No cointegration and Ha: All panels are cointegrated.

Table 3. Co-integration Test

	GreenGDP		
	KAO	**Pedroni**	**Westerlund**
EEP	**p-value**	**p-value**	**p-value**
Modified Dickey-Fuller t	0.0000***		
Dickey-Fuller t	0.0000***		
Augmented Dickey-Fuller t	0.0000***	0.0000***	
Unadjusted modified Dickey	0.0000***		
Unadjusted Dickey-Fuller t	0.0000***		
Modified Phillips-Perron t		0.0692*	
Phillips-Perron t		0.0005**	
Variance ratio			0.0000***
	EEP		
	KAO	**Pedroni**	**Westerlund**
GreenGDP	**p-value**	**p-value**	**p-value**
Modified Dickey-Fuller t	0.0000***		
Dickey-Fuller t	0.0000***		
Augmented Dickey-Fuller t	0.0047**	0.0000***	
Unadjusted modified Dickey	0.0040**		
Unadjusted Dickey-Fuller t	0.0081**		
Modified Phillips-Perron t		0.0000***	
Phillips-Perron t		0.0001***	
Variance ratio			0.0049**

Based on the results of the cointegration we can conclude that there is strong evidence of cointegration between Expenditures on Environment Protection and GreenGDP, across all 27 Countries. This is supported by the results of the Kao and Pedroni tests, which both reject the null hypothesis of no cointegration. The Westerlund test also provides evidence of cointegration between the two variables. Overall, these results suggest that EEP and GreenGDP are likely to be bidirectional related in a long-term equilibrium. This suggest that there is a long-term relationship between a country's economic output and the amount they invests in environmental protection. These result were also found by (Wang *et al.*, 2022; Afzal *et al*., 2022). This relationship could be explained in several ways for example higher environmental expenditures could lead to increased efficiency and productivity in the long run, leading to increased economic output. Alternatively, economic growth could lead to increased environmental expenditures as countries become more able to afford such expenditures.

3.5. Granger causality test

Table 4 below presents the estimated results by using Granger causality test:

Table 4. Ganger Causality Test

			HPJ Wald test	p-value
GreenGDP	Coef.	P>|z|	18.5582	0.0001
L1.	-.0000397	0.000		
L2.	.0000336	0.000		
			HPJ Wald test	p-value
EEP			65.2533	0.0000
L1.	-5773.632	0.000		
L2.	-1749.067	0.011		

The results of the Granger causality tests suggest that there is a significant causal relationship between EEP and GreenGDP. Specifically, the test results indicate that GreenGDP Granger-causes EEP, while EEP Granger-causes GreenGDP, indicating that increasing expenditure on environmental protection (EEP) has a negative impact on GreenGDP in the short term, but may have positive effects in the long term. On the other hand, GreenGDP has a negative impact on EEP in the short term, but may have positive effects in the long term.

For example, a government may invest in clean energy technologies or environmental protection regulations, which would lead to an initial decrease in GreenGDP due to the costs of these investments. However, in the long term, the investment may lead to a more sustainable and efficient economy, resulting in an increase in GreenGDP.

Similarly, a decrease in GreenGDP may lead to a reduction in investment in environmental protection in the short term, but may also create incentives for companies and governments to invest in green technologies and practices in the long term, resulting in an increase in EEP.

Overall, the results suggest that the relationship between green economy and green finance is complex and requires further investigation to fully understand the causal mechanisms and long-term effects.

4. Empirical results and discussion

4.1. VAR Model Estimation Results

Table 5 below present the estimated results of the the bivariate Panel VAR model used suggesting that the model is a good fit for predicting EEP values, as evidenced by the relatively high R-sq and F-value, the high R-sq and F-value suggest that the model is significant in explaining the variability in GreenGDP as well.

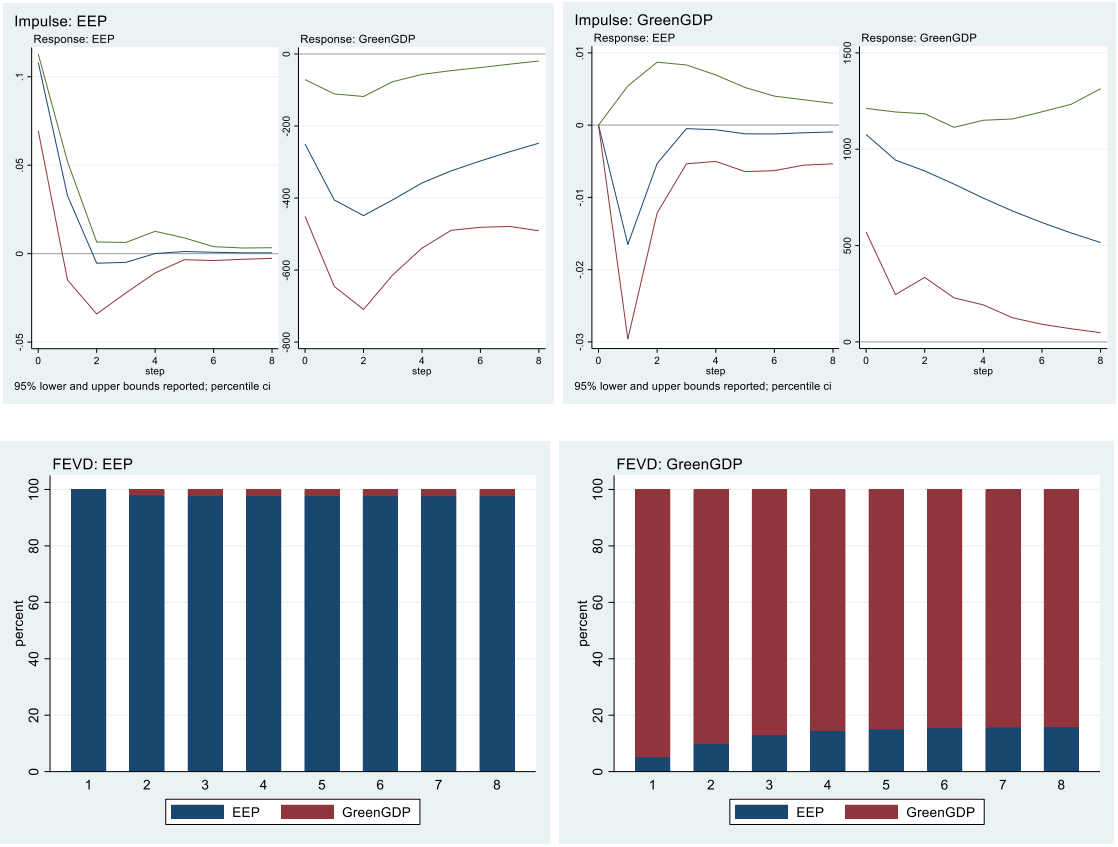
Table 5. Panel (LSDV) vector autoregression

Equation	**R-sq**	**F**	**P > F**	
EEP	0.9156	6.433224	0.0001	
GreenGDP	0.9971	367.3108	0.0000	
		Coef.	**P>|t|**	
EEP				
l1_EEP		.2682865	0.000	***
l1_GreenGDP		-.0000153	0.058	**
l2_EEP		-.1597773	0.008	**
l2_GreenGDP		.0000126	0.148	
GreenGDP				
l1_EEP		-1721.094	0.018	**
l1_GreenGDP		.8767626	0.000	***
l2_EEP		-273.743	0.653	
l2_GreenGDP		.0290708	0.744	
Contemporary coefficients				
		EEP	**GreenGDP**	
EEP		1	0	
GreenGDP		-2317.0803	1	

The model finds that both EEP and GreenGDP have a statistically significant effect on each other over time. The contemporaneous coefficients show that the coefficient of EEP on GreenGDP is zero means that there is no immediate or short-term relationship between the two variables, i.e. a change in EEP does not lead to an immediate change in GreenGDP. However, the coefficient of GreenGDP on EEP is -2317.0803 means that there is a long-term relationship between the two variables. Specifically, a unit increase in EEP results in a decrease of 2317.0803 units in GreenGDP in the long run. This suggests that an increase in expenditure on environmental protection may have negative effects on economic growth in the long term. This finding may be useful for policymakers and businesses to consider when making decisions about environmental policies and practices. For example, it suggests that there may be a trade-off between short-term economic growth and long-term environmental sustainability, and that policies should be designed to balance these competing goals. It may also suggest that businesses should invest in environmentally sustainable practices that minimize the negative impact on economic growth.

4.2. The impulse response functions

In the Graphs below are presented the impulse response functions showing the dynamic response of each variable to a one-time shock in another variable on the current and future values of all variables in the system.



Source: Author results using STATA with information in Table 1

Result shows that a shock in EEP leads to an increase in EEP in the short term, which could be interpreted as an increase in environmental protection expenditure in response to a specific policy or event. However, in the long term, there is a decrease in EEP, which suggests that the short-term increase in expenditure is not sustainable and may not lead to lasting improvements in environmental protection.

Furthermore, the shock in EEP also leads to a decrease in GreenGDP in the short term, indicating that the increase in environmental protection expenditure negatively affects economic output in the short run. However, this negative effect becomes weaker over time, which suggests that there may be some long-term benefits to investing in environmental protection.

In contrast, a shock in GreenGDP leads to a decrease in GreenGDP in the short term, which could be due to a decline in economic activity or productivity. However, in the long term, there is an increase in GreenGDP, indicating that sustainable economic growth can be achieved through environmentally friendly practices and policies.

These findings suggest that there may be a trade-off between short-term economic growth and environmental protection, but investing in environmental protection may lead to long-term economic benefits. Therefore, it is important for policymakers to consider the long-term effects of their policies on both the economy and the environment.

5. Conclusion and Policy Recommendation

The aim of this study was to investigate the dynamic relationship between Green Economy and Green Finance in 27 EU countries, using bivariate panel VAR model, unit root tests, cointegration tests and the impulse response functions. The results of the unit root test showed that EEP is stationary at the stationary level, while GreenGDP may require differencing to make it stationary. The cointegration test indicated that there is strong evidence of cointegration between Expenditures on Environment Protection and GreenGDP, across all 27 Countries, indicating that there is a long-term relationship between a country's economic output and the amount they invest in environmental protection. Granger causality tests suggest that there is a significant causal relationship between EEP and GreenGDP. Finally, the VAR model estimation results showed that the lagged values of EEP have a positive effect on the current value of EEP, and the lagged values of GreenGDP also have a positive effect on the current value of GreenGDP.

The results of the bivariate panel VAR model suggest that there is a significant relationship between green economy and green finance, but it is important to note that this relationship is complex and requires further investigation. The negative impact of EEP on GreenGDP in the short term may imply that the initial cost of implementing environmentally friendly practices may have a negative impact on economic growth, but the positive impact in the long term may outweigh the short-term costs.

These findings may have implications for businesses and governments who are interested in promoting sustainable practices. Businesses may need to consider the short-term costs of implementing environmentally friendly practices and weigh them against the long-term benefits, while governments may need to provide incentives or support for businesses to invest in green technology and practices.

In addition, the complex relationship between green economy and green finance may also require further investigation into the effectiveness of current policies and initiatives aimed at promoting sustainable practices. By understanding the relationship

between these two variables, policymakers may be better equipped to design policies and initiatives that promote sustainable practices while also supporting economic growth.

Overall, the empirical analysis suggests that there is a positive and bidirectional relationship between Green Economy and Green Finance in the long run. The results imply that investments in environmental protection could lead to increased efficiency and productivity, resulting in increased economic output. At the same time, economic growth could lead to increased environmental expenditures as countries become more able to afford such expenditures. Thus, policy-makers should promote policies that foster sustainable economic growth and encourage investments in environmental protection.

Policy Implications:

Based on the empirical findings, the following policy implications can be drawn:

- **Encourage investment in environmental protection:** Policy-makers should encourage investments in environmental protection, as it can lead to increased efficiency and productivity, which can result in increased economic output in the long run.
- **Promote sustainable economic growth:** Policies that promote sustainable economic growth should be promoted, as they can lead to increased environmental expenditures in the long run, as countries become more able to afford such expenditures.
- **Foster international cooperation:** International cooperation can play a critical role in promoting investments in environmental protection and sustainable economic growth. Therefore, policy-makers should foster international cooperation to address environmental challenges, such as climate change.
- **Enhance green finance:** Policy-makers should focus on enhancing green finance, as it can play a critical role in financing green projects and supporting sustainable economic growth. To this end, they could provide financial incentives to encourage investment in green projects and promote the development of green financial products.

In conclusion, the empirical analysis suggests that there is a positive and bidirectional relationship between Green Economy and Green Finance in the long run. Therefore, policy-makers should promote policies that foster sustainable economic growth and encourage investments in environmental protection, while enhancing green finance and fostering international cooperation.

References

Afzal, A., Rasoulinezhad, E., & Malikc, Z. (2022). Green finance and sustainable development in Europe. *Economic Research, 35*.

Baltagi, B., Wu, P. (1999). Unequally Spaced Panel Data Regressions with AR(1) Disturbances. *Econometric Theory*, *15*(6), 814-823.

Bhattacharyya, R. (2021). Green finance for energy transition, climate action and sustainable development: overview of concepts, applications, implementation and challenges. *Green Finance*, 1–35.

Böhringer, C., Rutherford, T., & Springmann, M. (2015). Clean-Development Investments: An Incentive-Compatible CGE Modelling Framework. *Environmental and Resource Economics*, 60, 633–651.

Bowen, A., Hepburn, C. (2014). Green growth: an assessment. *Oxford Review of Economic Policy*, *30*(3), 407–422.

Breitung, J. (2000). The local power of some unit root tests for panel data. *Advances in Econometrics, Nonstationary Panels, Panel Cointegration and Dynamic Panels, Volume 15*, 161–177.

Chudik, A., Pesaran , H. (2015). Common correlated effects estimation of heterogeneous dynamic panel data models with weakly exogenous regressors. *Journal of Econometrics, 188*(2), 393-420.

Dang, D. (2020). Can Environmental Subsidies Promote the Green Investment of Enterprises? *Modern Economy, 11*(01).

ESA. (2012). *Measuring the Green Economy.* Washington, DC: Economics and Statistics Administration, US Department of Commerce.

EuroStat. (n.d.). Retrieved from EuroStat: https://ec.europa.eu/eurostat/data/database

Falcone, P.M. (2020). Environmental regulation and green investments: the role of green finance. *International Journal of Green Economics, 14*(2), 159-173.

Falcone, P.M. (2020). Environmental regulation and green investments: the role of green finance. *Int. J. Green Economics, 14(2)*.

Geng, Q., Wang, Y., & Wang, X. (2023). The impact of natural resource endowment and green finance on green economic efficiency in the context of COP26. *Resources Policy*, 80.

Harris, R., Tzavalis, E. (1999). Inference for Unit Roots in Dynamic Panels Where the Time Dimension Is Fixed. *Journal of Econometrics*, 201-226.

He, L., Zhang, L., Zhong, Z., Wang, D., & Wang, F. (2019). Green credit, renewable energy investment and green economy development: Empirical analysis based on 150 listed companies of China. *Journal of Cleaner Production*, 208, 363-372.

Holtz-Eakin, D., Newey, W., & Rosen, H. (1988). Estimating Vector Autoregressions with Panel Data. *Econometrica, 56*(6), 1371-1395 .

Im, K.S., Pesaran, M.H., & Shin, Y. (2003). Testingfor unit roots in heterogeneous panels. *Journal of Econometrics, 115*(2003), 53 – 74.

Iraldo, F., Testa, F., Melis, M., & Frey, M. (2011). A Literature Review on the Links between Environmental Regulation and Competitiveness. *Environmental Policy and Governance, 21*(3), 210-222.

Iulia, G., Rădăcină, B. (2019). The role of mandatory obligations in financing the transformation of the European energy sector. *The Journal Contemporary Economy*, 87-95.

Ivanovic, M.O., Zubović, J., & Mitić, P. (2017). Relationship between sustainable development and green economy - emphasis on green finance and banking. *Economics of Agriculture*.

Kim, E. S., Kim, H., & Chae, Y. (2014). A new approach to measuring green growth: Application to the OECD and Korea. *Futures, 63*, 37-48.

Kiviet, J. (1995). On bias, inconsistency, and efficiency of various estimators in dynamic panel data models. *Journal of Econometrics, Elsevier, 68*(1), 53-78.

Lu, J. (2021). Can the green merger and acquisition strategy improve the environmental protection investment of listed company? *Environmental Impact Assessment Review*, 86.

Madaleno, M., Dogan, E., & Taskin, D. (2022). A step forward on sustainability: The nexus of environmental responsibility, green technology, clean energy and green finance. *Energy Economics*, 109.

Pearce, D., Markandya, A., & Barbier, E. (2012). *Blueprint for a Green Economy.* London: Routledge.

Sachs, J., Woo, T.W., Yoshino, N., & Taghizadeh-Hesary, F. (2019). Why Is Green Finance Important? *ADBI Working Paper 917*.

Saha, T., Sinha, A., & Abbas, S. (2022). Green financing of eco-innovations: is the genderinclusivity taken care of? *Economic Research*.

Scholtens, B. (2017). Why Finance Should Care about Ecology. *Trends in Ecology & Evolution, 32*(7), 500-505.

Stjepanović, S., Tomic, D., & Skare, M. (2019). Green GDP: an analysis for developing and developed countries. *E+M Ekonomie a Management*, 4-17.

Talberth, J., Bohara, A. (2006). Economic openness and green GDP. *Ecological Economics, 58*(4), 743-758.

Walker, J., Pekmezovic, A., & Walker, G. (2019). *Sustainable Development Goals: Harnessing Business to Achieve the SDGs through Finance, Technology, and Law Reform.* United Kingdom: John Wiley & Sons Ltd.

Wang, K.-H., Zhao, Y.-X., Jiang, C.-F., & Li, Z.-Z. (2022). Does green finance inspire sustainable development? Evidence from a global perspective. *Economic Analysis and Policy, 75*, 412-426.

Wang, Q.-J., Wang, H.-J., & Chang, C.-P. (2022). Environmental performance, green finance and green innovation: What's the long-run relationships among variables? *Energy Economics*, 110.

World Bank. (n.d.). Retrieved from World Bank: https://data.worldbank.org/

Yang, Q., Du, Q., Razzaq, A., & Shang, Y. (2022). How volatility in green financing, clean energy, and green economic practices derive sustainable performance through ESG indicators? A sectoral study of G7 countries. *Resources Policy,* 75.

Zhao, L., Chau, Y. K., Tran, K. T., Sadiq, M., Xuyen, T. N., & Phan, H. T. (2022). Enhancing green economic recovery through green bonds financing and energy efficiency investments. *Economic Analysis and Policy,* 76, 488-501.