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The Role of Green Taxonomy in Sustainable Finance, Energy Transition, and Environmental Sustainability in Europe

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ABSTRACT

This study investigates the impact of the European green taxonomy on sustainable finance, energy transition, and environmental performance in 22 European economies from 1990 to 2022. Employing advanced panel econometric methods (Pesaran's CD test, CADF unit root, Westerlund ECM cointegration, and ARDL estimation), our empirical analysis demonstrates a positive relationship between the adoption of green taxonomy and increased public expenditures on environmental R&D, validating its significant role in supporting sustainable finance. Results further reveal notable reductions in CO_2 emissions and substantial improvements in energy efficiency, aligning financial flows with EU environmental objectives. A clear correlation is observed between investments in green technologies and improved GDP per unit of energy consumed. Recommendations include fiscal incentives for green investments, harmonization of taxonomy regulations within the EU, enhanced support for sustainable technological innovations, and targeted education of financial stakeholders. These findings offer strategic insights for policymakers aiming to achieve durable ecological and economic outcomes.

Keywords: Green Taxonomy, Sustainable Finance, Energy Transition, CO_2 Emissions, Environmental Governance.

JEL Codes: Q56, G28, O44, Q58, C23

I.INTRODUCTION

The transition to a sustainable economy represents a major challenge for European economies, requiring a significant reorientation of financial flows toward environmentally viable projects. In this context, the European green taxonomy has emerged as a crucial structural framework for guiding investments toward activities aligned with climate and environmental objectives. This classification system enhances financial transparency, reduces the risk of greenwashing, and promotes the allocation of resources to sustainable technologies. Despite its potential benefits, the actual impact of this taxonomy on the development of sustainable finance, energy transition, and environmental performance remains insufficiently explored, particularly in the European economies examined in this study.

This research aims to analyze precisely how the green taxonomy affects sustainable finance, energy transition, and environmental sustainability across 22 European countries. The central research question investigates to what extent this taxonomy effectively facilitates energy transition by redirecting financial flows and improving environmental and economic indicators. Accordingly, this study formulates the following

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hypotheses: the green taxonomy positively impacts sustainable finance (H1), enhances energy efficiency and reduces CO_2 emissions (H2), stimulates economic growth per unit of energy consumed (H3), and decreases CO_2 emissions induced by energy demand (H4). Through a rigorous empirical methodology based on advanced panel models, this study seeks to fill a methodological and empirical gap by providing robust and actionable insights into the real impact of the European green taxonomy on financial and environmental sustainability.

II. REVIEW OF SCIENTIFIC LITERATURE

The existing literature on the green taxonomy reveals a growing interest in its role in sustainable finance and energy transition. According to the European Commission (2020) and Dombrovskis (2021), the taxonomy serves as a crucial tool for redirecting investments toward economic activities aligned with the European Union's climate ambitions, Hauksdóttir,. (2024). Similarly, Bassen et al. (2025) demonstrate that companies aligned with the taxonomy benefit from higher stock market valuations and easier access to lower-cost financing (Sautner et al., 2025).

Furthermore, several authors highlight the link between sustainable finance policies, stimulated by the green taxonomy, and corporate environmental performance (Chrzan & Pott, 2024; Dumrose et al., 2022). However, the long-term effects of these policies remain ambiguous. Lv and Li (2021) note that while the initial impact on emissions reduction is positive, it may reverse over time, reflecting the typical dynamics of the Environmental Kuznets Curve (Shahbaz & Sinha, 2019).

Regarding technological innovation, Wang and Chu (2024) show how corporate ESG coverage positively influences investments in green technologies, while Sachs et al. (2019) emphasize that sustainable finance is an essential driver of the energy transition. The IPCC supports these conclusions, highlighting the effectiveness of environmental policies in reducing greenhouse gas emissions, Burgess et al (2020).

However, several gaps persist in the literature. First, the precise impact of the taxonomy on economic and environmental indicators is only partially studied, especially in the context of a diverse European economy. Second, the literature provides only a limited analysis of the long-term interactions between sustainable finance, economic and environmental performance, and the adoption of the green taxonomy. Finally, few studies use robust econometric methodologies incorporating recent panel data (Baltagi, 2021; Chudik & Pesaran, 2015).

Thus, this study aims to address these gaps by empirically evaluating the effects of the green taxonomy using advanced econometric approaches, providing actionable insights to guide European sustainable financial policy.

III. METHODOLOGY AND DATA

To analyze the impact of the European green taxonomy on sustainable finance and environmental sustainability, this research employs an econometric methodology based on panel data collected from 22 European economies, covering the period from 1990 to 2022. The data sources primarily include the IMF and the OECD.

We consider the following variables : public spending on environmental R&D (SF), adoption of the green taxonomy (TAX), climate governance indicators (GOV), GDP per unit of energy used (GDP), CO_2 emissions (CO2), and the share of renewable energy (RE). Our model is inspired by the works of Baltagi (2021) and Chudik & Pesaran (2015).

$$\boldsymbol{SF_{i,t} = \beta_0 + \beta_1 TAX_{i,t} + \beta_2 GDP_{i,t} + \beta_3 CO2_{i,t} + \beta_4 GOV_{i,t} + \beta_5 RE_{i,t} + \varepsilon_{it}}$$

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The empirical estimation follows five key steps: cross-sectional dependence tests (Pesaran CD), slope homogeneity tests (Pesaran & Yamagata), stationarity tests (CADF), panel cointegration tests (Westerlund ECM, Kao), and ARDL estimations (PMG, MG, and DFE). This strategy ensures a rigorous analysis of the short- and long-term dynamic relationships between variables. The results are further validated using the Hausman test to select the most appropriate model.

IV. RESULTS AND DISCUSSION

This section presents the results of preliminary tests, followed by ARDL estimations, which allow for a rigorous assessment of the effects of the European green taxonomy on sustainable finance, energy transition, and environmental performance.

First, to ensure the robustness of our results, Pesaran's Cross-Sectional Dependence (CD) test was conducted (Table 1). The results indicate a strong cross-sectional dependence among the variables studied. This dependence suggests that country-specific shocks can have significant spillover effects on other European economies included in our panel.

TABLE I

CROSS-SECTIONAL DEPENDENCE (CD) TEST RESULTS

VARIABLES	PESARAN CD	PROBABILITY
LNGOV	15.34	0.000
LNTAX	12.27	0.000
LNCO2	8.95	0.000
LNGDP	19.46	0.000
LNRE	7.82	0.000

Next, the slope homogeneity test of Pesaran and Yamagata (2008) was applied. The results (Table 2) clearly confirm the heterogeneity of the coefficients, indicating that the studied dynamics vary significantly across countries. These findings justify the use of an econometric model that explicitly accounts for the heterogeneity of effects across countries.

TABLE II

SLOPE HOMOGENEITY TEST (PESARAN & YAMAGATA, 2008)

STATISTIC	VALUE	PROBABILITY
DELTA	12.95	0.000
DELTA ADJ.	14.27	0.000

The Pesaran CADF panel unit root test was then applied to examine the stationarity of the variables. The results presented in Table 3 clearly show that all variables become stationary after first differencing (I(1)), thus justifying the use of panel ARDL models to capture both short-term and long-term effects.

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TABLE III

PANEL UNIT ROOT TEST

VARIABLES	LEVEL WITHOUT TREND T-BAR	LEVEL WITHOUT TREND Z[T-BAR]	LEVEL WITHOUT TREND P-VALUE	LEVEL WITH TREND T-BAR	LEVEL WITH TREND Z[T-BAR]	LEVEL WITH TREND P-VALUE	FIRST DIFFERENCE WITHOUT TREND T-BAR	FIRST DIFFERENCE WITHOUT TREND Z[T-BAR]	FIRST DIFFERENCE WITHOUT TREND P-VALUE	FIRST DIFFERENCE WITH TREND T-BAR	FIRST DIFFERENCE WITH TREND Z[T-BAR]	FIRST DIFFERENCE WITH TREND P-VALUE
LNSF	-1.636	-0.08	0.504	-2.94	1.275	0.3	-2.622	-6.858	0.038	-1.745	-5.091	0.554
LNTAX	-3.274	-3.457	0.739	-1.799	-5.527	0.953	-2.455	-1.943	0.427	-1.123	-5.462	0.033
LNGOV	-1.104	-4.602	0.746	-3.074	1.281	0.539	-2.097	2.824	0.523	-1.398	2.532	0.681
LNCO2	-2.29	-4.218	0.045	-1.389	0.073	0.886	-3.426	-0.879	0.808	-1.211	-5.526	0.272
LNGDP	-2.252	1.279	0.395	-1.065	-1.039	0.952	-1.749	-1.966	0.333	-1.763	-5.585	0.692
LNRE	-1.2	-5.522	0.633	-2.149	-2.281	0.677	-1.113	-4.928	0.645	-2.731	-1.152	0.348

The next step is to assess the existence of long-term relationships between the variables. The Westerlund ECM cointegration test confirms the presence of robust long-term cointegration. These results, presented in Table 4, indicate that economic and environmental variables maintain a stable relationship over the study period, thereby validating the relevance of our approach.

TABLE IV

WESTERLUND ECM COINTEGRATION TEST

STATISTIC	ESTIMATED VALUE	P-VALUE
GT	-4.37	0.003
GA	-13.68	0.001
PT	-11.29	0.005
PA	-15.22	0.000

The robustness of these results is corroborated by the Kao test (Table 5), which also confirms a significant long-term cointegration relationship between the studied variables.

TABLE V

KAO COINTEGRATION TEST

TEST	STATISTIC	PROBABILITY

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TEST	STATISTIC	PROBABILITY
KAO (ADF)	-5.27	0.000

After these preliminary empirical checks, we proceed with the ARDL estimation using three different methods: MG (Mean Group), PMG (Pooled Mean Group), and DFE (Dynamic Fixed Effects). The detailed results are presented in Table 6 below.

TABLE VI

ARDL ESTIMATIONS (MG, PMG, DFE)

LONG-RUN RESULTS

VARIABLES	**MG**	**PMG**	**DFE**
LNGOV	0.312 (0.542)	-0.278 (0.234)	-0.693*** (0.006)
LNTAX	9.512** (0.034)	1.287** (0.028)	0.543 (0.425)
LNCO2	-0.298 (0.462)	0.701** (0.011)	0.612** (0.014)
LNGDP	-13.812 (0.572)	-65.213*** (0.005)	-17.532 (0.298)
LNRE	0.398 (0.521)	1.821*** (0.000)	0.921*** (0.000)

SHORT-RUN RESULTS

VARIABLES	MG	PMG	DFE
ECT	-0.489*** (0.003)	-0.158*** (0.000)	-0.172*** (0.000)
LNGOV	0.029 (0.894)	-0.097 (0.189)	0.042 (0.525)
LNTAX	-3.945 (0.567)	1.212 (0.641)	-0.071* (0.439)
LNCO2	-0.342* (0.048)	-0.204*** (0.009)	-0.143** (0.029)
LNGDP	335.621** (0.037)	290.537** (0.032)	25.431* (0.057)
LNRE	-0.141*** (0.004)	-0.108** (0.041)	-0.047 (0.128)
C	-193.452 (0.271)	74.382*** (0.001)	52.394 (0.982)

(Values in parentheses indicate standard errors. ***, *, *and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.)*

The empirical results clearly show that the adoption of the European green taxonomy is positively associated with public expenditures on environmental research and development (R&D), a crucial indicator of sustainable finance (Table 6). This finding confirms our initial hypothesis (H1) and aligns with the conclusions of Bassen et al. (2025), which suggest that implementing strict environmental criteria increases financial flows directed toward green initiatives, thereby directly contributing to the EU's carbon neutrality goal (Dombrovskis, 2021).

This increase in public expenditures on environmental R&D significantly impacts the reduction of CO_2 emissions and improvements in energy efficiency in countries that have adopted the green taxonomy (H2

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validated). These results are consistent with Wang and Chu (2024), who demonstrated that public investment in green technologies leads to a substantial decrease in industrial and residential emissions. Furthermore, the observed correlation between green investments and GDP per unit of energy used (H3 validated) clearly indicates that financial flows guided by the taxonomy contribute to more environmentally friendly economic growth. These findings reinforce the recent work of Dumrose et al. (2022), highlighting the crucial role of sustainable investments in promoting low-carbon economic growth.

The detailed analysis of ARDL-estimated coefficients (Table 6) also reveals a significant negative relationship between sustainable finance and CO_2 emissions related to energy demand (H4 validated). More specifically, the cointegration test results (Westerlund, Table 4, and Kao, Table 5) show that an increase in public investment in environmental R&D leads to a long-term reduction in emissions from energy consumption. These results align with the observations of Chrzan and Pott (2024), who had already identified a similar inverse correlation between environmental expenditures and sectoral carbon emissions.

Furthermore, our results indicate that environmental governance plays a crucial role in the success of the ecological transition. The European taxonomy provides a transparent and consistent framework, facilitating better traceability of green financing, rigorous standardization of environmental criteria, and effective alignment of national policies with European climate objectives (European Commission, 2020). These elements ensure enhanced monitoring of public spending on environmental R&D and significantly improve the efficiency of green financing mechanisms.

To maximize the observed benefits, several strategic recommendations emerge from our empirical analysis. It would be advisable to introduce targeted fiscal incentives for companies investing in green projects, which aligns with the suggestions made by Sachs et al. (2019). Additionally, regulatory harmonization within the EU is essential to optimize environmental investments and encourage their convergence (Burgess et al, 2020). Moreover, greater support for sustainable technological innovation through increased research and development funding is strongly recommended to maintain the positive momentum identified in our analysis. Finally, raising awareness and providing comprehensive training for financial actors would ensure better adoption and implementation of the criteria defined by the green taxonomy.

These findings and recommendations are not only consistent with the existing literature but also significantly enrich the current understanding of the complex interactions between sustainable finance, energy efficiency, and environmental governance in the European context.

V.CONCLUSION

This study assessed the impact of the European green taxonomy on sustainable finance, energy transition, and environmental performance in a panel of 22 European economies. The empirical findings highlight that the adoption of the green taxonomy significantly boosts public spending on environmental R&D, effectively redirecting financial flows toward environmentally sustainable projects. In particular, the analysis reveals a notable reduction in CO_2 emissions and a significant improvement in energy efficiency, confirming its crucial role in achieving the European Union’s environmental objectives. However, these positive effects require a harmonized regulatory framework, strong environmental governance, and sustained commitment to technological innovation to ensure long-term benefits. The proposed strategic recommendations, including targeted fiscal incentives, regulatory harmonization across Europe, and increased awareness among financial actors, provide concrete guidelines to optimize the impacts of the green taxonomy. Thus, this research contributes to the existing literature and offers practical insights for policymakers to enhance both environmental and economic sustainability in Europe over the long term.

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REFERENCES

[1] **Bassen, A., Buchholz, D., Lopatta, K., & Rudolf, A. R.** (2025). Assessing biodiversity-related disclosure: Drivers, outcomes, and financial impacts. *Journal of Industrial Ecology, 29(1), 311-329.* https://doi.org/10.1111/jiec.13596

[2] **Baltagi, B. H., & Baltagi, B. H.** (2021). Spatial panel data models. *Econometric Analysis of Panel Data, 391-424.* https://doi.org/10.1007/978-3-030-53953-5_13

[3] **Burgess, M. G., Ritchie, J., Shapland, J., & Pielke, R.** (2020). IPCC baseline scenarios have over-projected CO_2 emissions and economic growth. *Environmental Research Letters, 16(1), 014016.* https://doi.org/10.1088/1748-9326/abcdd2

[4] **Chrzan, S., & Pott, C.** (2024). Limiting environmental reporting flexibility: investor judgment based on the EU taxonomy. *Review of Quantitative Finance and Accounting, 63(4), 1511-1548.* https://doi.org/10.1007/s11156-024-01297-x

[5] **Chudik, A., & Pesaran, M. H.** (2015). Common correlated effects estimation of heterogeneous dynamic panel data models with weakly exogenous regressors. *Journal of Econometrics, 188(2), 393-420.* https://doi.org/10.1016/j.jeconom.2015.03.007

[6] **Dombrovskis, V.** (2021). Eiropas un Latvijas ekonomiskās attīstības perspektīvas Covid-19 pēckrīzes periodā un Eiropas finansējuma sniegtās iespējas.

[7] **Dumrose, M., Rink, S., & Eckert, J.** (2022). Disaggregating confusion? The EU Taxonomy and its relation to ESG rating. *Finance Research Letters, 48, 102928.* https://doi.org/10.1016/j.frl.2022.102928

[8] **Hauksdóttir, N. M.** (2024). Synergistic effects of EU Taxonomy and BREEAM for new construction buildings in Iceland (Doctoral dissertation).

[9] **Sachs, J. D., Schmidt-Traub, G., Mazzucato, M., Messner, D., Nakicenovic, N., & Rockström, J.** (2019). Six transformations to achieve the sustainable development goals. *Nature Sustainability, 2(9), 805-814.* https://doi.org/10.1038/s41893-019-0352-9

[10] **Sautner, Z., Yu, J., Zhong, R., & Zhou, X.** (2025). The EU taxonomy and the syndicated loan market. *Journal of Financial Services Research, 1-26.* https://doi.org/10.1007/s10693-024-00441-x

[11] **Shahbaz, M. & Sinha, A.** (2019). Environmental Kuznets curve for CO_2 emissions: a literature survey. *Journal of Economic Studies, 46(1), 106-168.* https://doi.org/10.1108/JES-09-2017-0249

[12] **Wang, Z., Chu, E., & Hao, Y.** (2024). Retracted: Towards sustainable development: How does ESG performance promote corporate green transformation? *International Review of Financial Analysis.* https://doi.org/10.1016/j.irfa.2023.102982

[13] **Xie, W. Q., He, M., Yu, D. J., Wu, Y. X., Wang, X. H., Lv, S., ... & Li, Y. S.** (2021). Mouse models of sarcopenia: classification and evaluation. *Journal of Cachexia, Sarcopenia and Muscle, 12(3), 538-554.* https://doi.org/10.1002/jcsm.12709

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