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The Nexus between Financial Regulation and Green Sustainable Economy

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Abstract: Following the international financial trend, several countries launched comprehensive and coordinated financial system reform programs to reach green sustainable economy. These reforms have included significant adjustments in financial regulation and supervision policies designed precisely to stimulate the improvement in the performance of green economy. This paper explores the literature regarding the importance of financial regulation and the state of green sustainable economy as a first objective. The second objective is to develop a linear regression model for empirically understanding how the financial regulation can affect green sustainable economy and apply it for 25 European Union countries, over the period of time 2000–2018, covering pre-crisis, crisis, and post-crisis period. Our findings support the idea that coherent financial regulation framework determines green economy to be growth-friendly and sustainable. The paper can be considered a useful viewpoint in understanding the complex relationship between regulation and green sustainable economy, thus adding to existing literature.

Keywords: clean/healthy environment; green financial legislation; ecological economy; sustainable development; integration of public policies

1. Introduction

Pollution, environmental degradation, and biodiversity loss are considered inevitable consequences of the development of human society, most often identified with economic growth. However, the sustainability of development is defined by the coherence and interdependence of its three fundamental components, respectively environmental, economic, and social. Thus, the attention of researchers and practitioners was focused on this interrelationship, reaching a common point that development will be possible in the future only with the improvement of environmental conditions, all public policies being oriented towards building a regulatory framework, and especially a financial regulatory framework that allows this green growth as the development and diffusion of technologies and products that have environmental benefits.

The role of an effective regulatory financial framework in promoting green sustainable economy has generated considerable interest among researchers and practitioners in recent years, with the first studies being connected with economic growth [1–5]. Many studies are developed on the relationship between the green sustainable economy and its different determinants [6–15]. There are also studies developed with a strong emphasis on the link between environmental legislation and economic growth [16–20].

Currently, in terms of regulatory framework, the most widely circulated documents are the Paris Agreement on climate change [21] and the UN 2030 Agenda for Sustainable Development [22], where the EU has committed to three ambitious climate and energy targets by 2030 that will lead to sustainability in economies: (i) Minimum 40% cut in greenhouse gas emissions compared to 1990 levels; (ii) At least a 27% share of renewables in final energy consumption; (iii) At least 30% energy savings compared with the business-as-usual scenario. The implementation of these measures at the national level requires public policies to be rebuilt based also on green financial legislation.

In this context, building effective national and international financial regulation framework should take into consideration that it is not simply an issue of the technical design of the regulatory instruments, but that it is also concerned with the quality of supporting regulatory institutions and capacity of each country, so that implementation leads to green sustainable development. Thus, the regulatory framework should be combined with institutional architecture coherence and efficiency. Otherwise, the study of World Bank [4] pointed that excessive regulation has an inaccurate effect encouraging entrepreneurs to operate in the informal economy, because heavy regulation is generally associated with more inefficiency in public institutions generating longer delays and higher cost and more unemployed people, high corruption, and less productivity and investment, but not with better quality of private or public goods. However, the study of World Bank [4] concludes there is not found an optimal level of regulation until now, but it recommends less than what is currently found in most countries, and especially poor ones.

The novelty of the paper is given by the fact that this paper explores the possible relationship between financial regulation complexity framework and green sustainable economy for 25 European Union countries, over the period of time 2000–2018 using an econometric model. Our hypothesis is that the green sustainable economy is linked, however, to the continuous monitoring and reviewing financial regulation.

The paper is organized as follows: Section 2 reviews issues in the literature pertinent to the debate on the role of financial regulation in economic growth; Section 3 provides the status of the European Union in terms of strategies applied through legal framework; Section 4 describes the method, variables, and data sources; Section 5 deals with a descriptive analysis of the data and reports the regression results; and Section 6 provides conclusions and the implications for development policy.

2. Literature Review

World Bank [4] seriously raises the issue of legislation in states with a developed or developing market economy. The economic theory developed by Hayek [23] suggests that state ownership is associated with inadequate incentives to gather and use this information to maximize economic welfare. However, the theory of economic regulation is developed from the 19th century and revealed that for reducing the market failure the case for public regulation is stronger in developing countries [24]. The World Bank [4] draws the same conclusion, but it links the effectiveness of regulations to institutional efficiency, which it considers an indissoluble relationship. However, Jalilian et al. [3] consider that regulation of markets may not result in a welfare improvement as compared to the economic outcome under imperfect market conditions, where information asymmetries can contribute to imperfect regulation. Many researchers [25–28] have shown links between law and economics, highlighting the roles of legal foundations and well-defined property rights for the proper functioning of market economies. In this regard, La Porta et al. [25] found evidence that legal environment has strong effects on the size and extent of a country's capital market. La Porta et al. [26] explains that the legal protection of investors in a country is a significant determinant of its financial market development. Claessens and Yurtoglu [29] conclude that the shareholders' rights are less defined in transition economies than in emerging markets and developed economies and that better creditor and shareholder rights (by legal framework) can be associated with deeper and more developed capital markets. Parker [30] finds that a well-functioning regulatory system should be the one that balances three important issues: accountability, transparency, and consistency. Of all these, the variable with a strong qualitative impact is mainly consistency because consistent regulatory decisions determine public confidence in a regulatory system. Transparency can also justify the quality of the decision-makers, of the institutions. This results in the role of states generating green economy [31].

Based on such regulatory legitimacy issues, Kaufman et al. [32] developed a set of governance variables comprising a set of six aggregate indicators developed by the World Bank and drawn from 194 different measures to show quality of regulation and quality of governance: (i) Voice and accountability; (ii) Political instability; (iii) Government effectiveness; (iv) Regulatory quality; (v) Rule of law; and (vi) Control of corruption. These six aggregate indicators are the most used in scientific analysis. However, the literature is quite complex in indicators [32,33], which is a positive aspect, but there is no consistency in the reporting of indicators by year and country, which makes it difficult to include them in econometric analyses.

Green economy provides a bridge between global environmental priorities and the economic system. Greening growth is considered necessary, efficient, and affordable [34]. The 1992 UN Conference on Environment and Development (the Rio Earth Summit) connected environmental and climate protection objectives with economic development. The concept of "green growth" is found in literature [35–40], but is also recognized by policymakers as an alternative perspective on the possibility for advancing welfare while explicitly taking into account environmental constraints [34,41–43].

The relationship of economic and ecological indicators can be explained by the Environmental Kuznets curve [44], concluding that in countries with rapidly developing economic indicators (GDP—Gross Domestic Product growth), the environment can be affected and, at the same time, the demand for cleaner and safer environments grows as the country's welfare increases [45]. World Bank [34] answers the question of how to make growth greener in two ways: classic literature invokes environmental taxation, norms, and regulations being the main tools of a green growth strategy or basic instruments, and modern literature adds technology which is making it easier to implement classical instruments and monitor their impacts.

On the other hand, World Bank [34] considers that the main obstacles to greening growth are two, as following: political and behavioral inertia, and a lack of financing instrument. The World Bank [34] does not identify the cost of green policies as an obstacle as is commonly thought. At the business level, the cost of environmental regulation to firms is typically modest because organizations have the ability to adapt and innovate, and in this context, there is no evidence that environmental regulation systematically hurts profitability. Theoretical studies of '80s found negative impacts, but the empirical, more recent studies find more positive results, partly because of better designed environmental regulations that promote efficiency gains [46]. Regarding financial regulation is required to facilitate the best possible financing and financial services supply to the real economy and to society without endangering the stability and liquidity of the financial sector and society's trust in financial markets [47]. Besides regulation, also leadership is key elements to consider in any well-founded discussion on scaling up private sector investments required for a transition towards a green economy. Green financial regulation [47] is based on two pillars which interconnect with each other, respectively; on the one hand, increased pollution and environmental risks affect the stability of the financial sector, and on the other, regulation is required to force the financial sector to drive global transformation towards a green economy.

Applying financial regulation for a sustainable green economy, policymakers and regulators should take into account issues [48] such as: (i) The characteristics of the market economy; (ii) How the individual organizations are structured and make decisions; (iii) What incentives are likely to motivate both the affected individuals and organizations to comply with the regulation; and (iv) The obstacles to their compliance. The effectiveness of regulatory compliance should be based on a few conditions [48]: (i) the target group has to be aware of the rule and understand it; (ii) the target group has to be willing to comply and economic incentives can motivate compliance, and (iii) the target group is able to comply.

Much has been said in terms of sustainability or environmentally friendly economic development. Repetto et al. [49] argues that the difference in the treatment of natural resources and other intangible assets deepens what he considers to be a "false dichotomy between the economy and the environment" which leads to public policies inclined to put the economic development first at the cost of the environment. The traditional indicators such as the GDP, which is considered most common and reliable in terms of economic description, are not connected enough to the new realities and development growth which includes the environmental and social goals and limitations [50]. Thus, the greening of the economic growth should meet the goals of real sustainable development and the consideration of both directions (economic and environment) [51].

Among the different identified possibilities of connecting the environmental issues and the economic growth, we mention the Sustainable National Income, the National Accounting Matrix including Environmental Accounts NAMEA, System of Environmental Economic Accounting (SEEA), the Genuine Savings, the Green GDP, and Carbon Productivity. The vast majority of these possible solutions of measuring economic growth in connection with the environment suffer from the lack of accurate measurement of the natural capital depletion and environmental damage. The two major approaches we consider most feasible and most developed are the green GDP and the carbon productivity.

Taking into account the environment as an asset being used during the economic reproduction, the green GDP is a true income explained by Hicks' concept of income [52] as the excess of asset consumption. This indicator is one of the most popular when it comes to assess the trade-off between the environment and the economic growth [53].

Past studies classified and described the green GDP approach in two ways: the GDP that accounts for the value of ecosystem services or the traditional GDP from which is subtracted the cost of environmental pollution and resource depletion, but it excludes the value of natural ecosystem service [54,55].

Kunanuntakj et al. [56] is calculating the green GDP by subtracting the environmental cost from the traditional GDP. As environmental cost, they identify three components: depletion cost, degradation cost, and defensive cost.

SEEA identifies the resource depletion cost as the marginal abatement cost per unit for producing material and energy to compensate the material and energy consumption, environmental degradation cost as the cost of damage from emissions affecting human health, and ecosystem and defensive cost as those expenditures involved in environmental protection or emission reduction [57].

The other important approach regarding the inclusion in the economic growth assessment of environment "consumption" is the carbon productivity, a concept first developed by Kaya and Yokobori [58] as a ratio between GDP and the quantity of CO_2 emissions. The basic idea of the carbon productivity is to keep the economic growth as "green" as it can be, in terms of carbon emissions, without affecting the economic output. In other words, to improve the carbon productivity means to maintain the GDP growth while reducing the carbon emissions [59].

In the literature, there are different voices debating about the carbon productivity's influencing factors. For example, some authors discovered that the technological innovation is more important than the industrial structure of the national economic system [60,61]. On the other hand, Lu et al. [62] discuss about the impact of energy structure upon the carbon productivity in China. However, they investigate and describe the socioeconomic determinants of carbon productivity and the discrepancies in terms of carbon productivity between different provinces of China, but also the beneficial impact of technological progress [63].

Previous studies have shown that the environmental regulations have an impact upon the carbon productivity especially in regions with carbon intensive economy [18], confirming the Porter hypothesis that the compliance efforts due to a strong regulation system in terms of environment can induce better efficiency and innovation [16]. Although the positive impact of the compliance needs is widely accepted there are different opinions supporting the "green paradox." This theory implies that the environmental regulation policies regarding carbon intensive use of energy will have a gradual implementation leading to an acceleration in the usage of fossil energy followed by an increasing energy supply stimulating the demand [18]. In the opinion of Aidt [64], green taxes as an issue of financial regulation can internalize environmental externalities and raise revenues.

Related to regulations and regulatory systems, corruption is one of the main factors identified by previous studies having critical impact upon pollution, energy intensity, and in general upon the environmental performance of the economic activities [65,66]. It is especially the case for emerging and developing countries where poor governance and less restrictive regulatory system in terms of environmental protection is doubled by corruption influencing the dirty industry's relocation and so poor carbon performance [67]. Besides its direct impact on green growth, corruption also has the tendency to alter other variables and delay the transition from carbon intense to green economy [66].

3. Facts

According to the Paris Agreement on climate change [21], the acceding states have assumed "to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty."

The EU countries tried every year to increase the share of renewable energy in their energy balance according to the indicative goals of Europe Strategy [68], as can be seen in Figure 1. The scientists agree that increasing the share of renewable energy leads to a reduction of CO_2 emissions. The EU established 20% of renewable energy in gross final energy consumption for 2020.

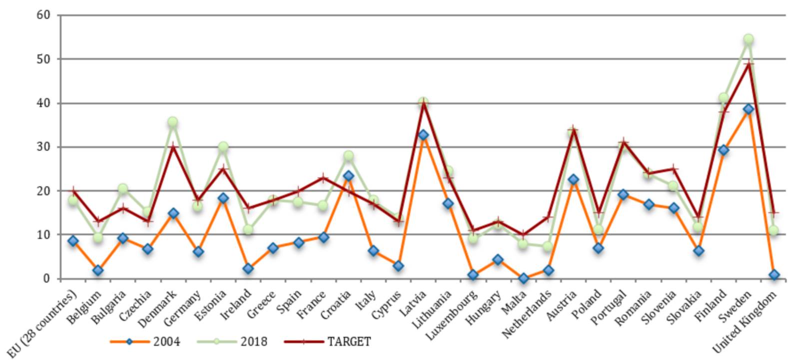

Figure 1. Share of renewable energy in gross final energy consumption (%) in EU-28. Source: European Commission—Eurostat, 2020.

According to Figure 1, some European Union countries have achieved the goal assumed in 2018, such as: Bulgaria (20.52 vs. 16), Czech Republic (15.15 vs. 13), Denmark (35.70 vs. 30), Estonia (29.996 vs. 25), Croatia (28.024 vs. 20), Lithuania (24.448 vs. 23), Finland (41.162 vs. 38), and Sweden (54.645 vs. 49). Romania, Portugal, Austria, and Hungary have very little left to reach the maximum threshold assumed. Greece, Italy, Cyprus, and Latvia exceeded in 2018 the goal assumed. The countries with the highest gap in 2018 compared to the assumed goal of 2020 are Belgium, Ireland, Spain, France, Luxembourg, Malta, Netherlands, Poland, Slovenia, Slovakia, and the United Kingdom. This indicator is the one that leads to a reduction of CO_2.

According to Figure 2, for the EU-28 average, the level of Greenhouse gas emissions decreased from 93.69% in 2005 to 76.76% in 2018. The EU target was 20% less compared to 1990 levels. Greenhouse gas emissions show slight fluctuations, but there is an obvious downward trend, so there is a premise to meet the level proposed for 2020. Moreover, 2020 was peculiar in terms of the COVID-19 pandemic, which stopped production activities in all areas and transport (air, land, and sea) globally, and we consider that the level of Greenhouse gas emissions has decreased significantly.

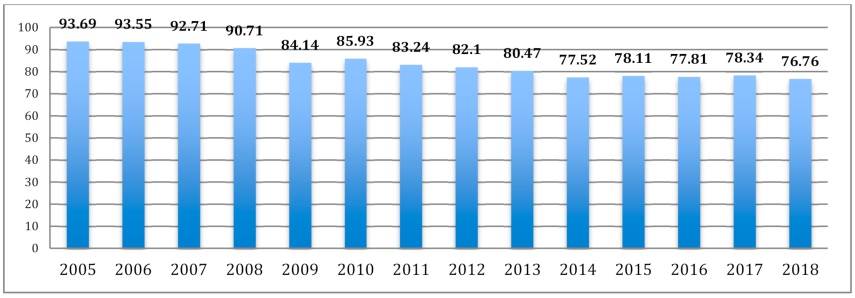

Figure 2. Greenhouse gas emissions, base year 1990, over the period 2005–2018 in EU-28. Source: computed by authors, based on data of European Commission [69].

Two important indicators are, on the one hand, the Gap between share of World GDP and share of the World CO_2 and, on the other hand, CO_2 per 1 bln $ of GDP that are presented in Table 1.

Table 1. EU-28' shares in CO_2 emissions and world GDP (average 2000–2014).

Countries	GDP, bln $	% of World GDP	CO_2 Emmissions, kt	% of the World CO_2	CO2 per 1 bln $ of GDP	Gap of % of World GDP and % of the World CO_2
Austria	320,934.1644	0.049	66,913.2158	0.026	0.216869704	0.023
Belgium	387,923.6712	0.094	105,373.6897	0.040	0.283291018	0.054
Bulgaria	91,199.6185	0.022	46,098.83487	0.018	0.551712354	0.004
Croatia	74,861.44298	0.011	20,781.6224	0.008	0.294644697	0.003
Cyprus	22,815.89114	0.006	7341.334	0.003	0.336699435	0.002
Czech Republic	254,199.4169	0.038	114,043.9445	0.044	0.478786545	−0.006
Denmark	209,273.6937	0.032	46,828.3234	0.018	0.236856824	0.014
Estonia	25,932.60676	0.004	17,144.6918	0.007	0.72099623	−0.003
Finland	187,716.6148	0.029	57,629.1052	0.022	0.319178053	0.007
France	2,121,147.703	0.327	358,881.7115	0.139	0.175066131	0.188
Germany	2,939,490.41	0.452	783,894.8345	0.303	0.276032245	0.149
Greece	285,622.5009	0.045	88,975.84353	0.035	0.317441516	0.010
Hungary	190,421.4466	0.029	52,470.3696	0.020	0.293763934	0.008
Ireland	180,465.2903	0.027	40,664.8298	0.016	0.238220168	0.012
Italy	1,915,616.887	0.299	425,905.4263	0.166	0.228130962	0.133
Latvia	34,315.27799	0.005	7365.291733	0.003	0.23019656	0.002
Lithuania	55,849.39588	0.008	13,438.8216	0.005	0.26267409	0.003
Luxembourg	38,120.47252	0.006	10,343.8736	0.004	0.288620277	0.002
Malta	10,262.79012	0.002	2495.271267	0.001	0.252078159	0.001
Netherlands	680,845.3699	0.105	176,952.7963	0.068	0.267743427	0.037
Poland	662,212.2064	0.098	304,767.0591	0.117	0.501064917	−0.019
Portugal	254,822.2622	0.039	56,262.781	0.022	0.228916	0.017
Romania	273,085.6921	0.040	89,963.73333	0.035	0.394062429	0.005
Slovakia	109,652.742	0.016	36,468.55947	0.014	0.37237759	0.002
Slovenia	51,596.43353	0.008	15,293.34573	0.006	0.306881131	0.002
Spain	1,304,849.473	0.200	301,587.7701	0.117	0.241734158	0.082
Sweden	354,114.9901	0.054	49,843.81973	0.019	0.147355511	0.035
United Kingdom	2,111,109.252	0.326	505,872.4287	0.196	0.248101634	0.129
European Union	13,037,348.46	1.999	3,803,603.328	1.472	0.303803661	0.527

Source: computed by authors, based on database of World Bank [70].

According to Table 1, to develop the premises of a sustainable green economy, the Gap of % of World GDP and % of the World CO_2 should be significantly positive. Germany produces 0.452% of world GDP, being the highest level in the EU-28, but, at the same time, it produces 0.303% of the world's CO_2 emissions, the Gap of % of World GDP and % of the World CO_2 being 0.149, the highest after France (0.188). France produces 0.327% of world GDP but, at the same time, it produces 0.139% of the world's CO_2 emissions. Italy produces 0.299% of world GDP and 0.166% of the world's CO_2

emissions, the Gap of % of World GDP and % of the World CO_2 being 0.133. Germany, France, Italy, and the United Kingdom are the states where the difference between % of World GDP and % of the World CO_2 is over 0.1, being significantly positive. Consequently, these states have managed to implement public strategies that have created a harmonious correlation between the environment, social, and economic, having the highest prerequisites for achieving the goal of green sustainable economy. A Gap level of % of World GDP and % of the World CO_2 of over 0.05 is found in Belgium (0.054) and Spain (0.084). The countries with the Gap of % of World GDP and % of the World CO_2 positive in the reference interval (0.050–0.010), such as Austria, Denmark, Croatia, Cyprus, Greece, Ireland, Netherlands, Portugal, and Sweden, are also on a good path to a sustainable green economy. The countries included in the reference interval (0.010–0.000), such as Bulgaria, Croatia, Cyprus, Finland, and Latvia. Lithuania, Luxemburg, Malta, Romania, Slovakia, and Slovenia should carry out green reforms with very strict implementation strategies, which also create the prerequisites for achieving the goal of green sustainable economy.

Poland and similar Czech Republic, Estonia, and Poland present a higher share in the world's CO_2 emissions compared with their share in world GDP, the gap being significant negative, respectively −0.006 for Czech Republic, −0.003 for Estonia, and −0.019 for Poland. These three states are put in a position to rethink their entire system of public policies and especially financial regulation, so that this correlation between GDP and CO_2 emissions is to be reversed, so that economic growth to be achieved in conditions of environmental protection.

We can emphasize that in the majority of the EU-28 countries (exception being Czech Republic, Estonia, and Poland with negative score) their share in the world's GDP is higher than their share in the world's CO_2 emissions, being on a good path to sustainability.

Another important indicator is CO_2 per 1 bln $ of GDP, where the value of the indicator must be as close to zero as possible. Thus, Estonia registered an alarming value of 0.72, being the state where also through the value of the other indicator (Gap of % of World GDP and % of the World CO_2) demonstrates that very strong green reforms are clearly and rapidly required. Relatively high values of this indicator are recorded in Bulgaria (0.55), Poland (0.50), and the Czech Republic (0.48). The rest of the European Union countries registered values below 0.40, the lowest value being in Sweden (0.15).

In accordance with the two indicators under analysis, we can emphasize that 25 of the EU-28 countries have high prerequisites for achieving the goal of green sustainable economy, and Estonia, Czech Republic, and Poland should improve their green policies immediately.

4. Data and Methodology

The aim of this paper is to provide empirical evidence on the relationship between financial regulation and a green sustainable economy on the profile of 25 European Union countries, over the period 2000–2018. In order to examine the channels through which financial regulation may affect economic growth, we used Ordinary least squares (OLS) regression. The EU-25 countries under analysis are in alphabetical order: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom. Our choice for EU-25 countries is due to the fact that the European Union adopts a common legislative framework that is transposed in the member countries, but in implementation there are some differences. The chosen period (2000–2018) is justified by the fact that it covers the pre-crisis, the world economic-financial crisis, and post-crisis period of time, but also by the importance of the availability of official databases, as World Bank's World Development Indicators database (2020) and European Commission (EUROSTAT, 2020).

The novelty of the research is justified by the choice of the determinants of green sustainable economy, too. The analytical framework of this paper is built on existing models [3] with some changes and our econometric model is developed as follows:

$$\ln(y_{i,t}) = \beta_1 x_{i1} + \ln(\beta_n \text{Economic\_Controls}_{i,t}) + \varepsilon_{i,t} \quad (1)$$

The dependent variable is carbon productivity (*CarbonProd*), as the literature [58] establishes it as the inclusion in the economic growth assessment of environment "consumption", being the ratio between GDP and the quantity of CO_2 emissions. Carbon productivity is considered a vitally important indicator to measure the quality of economic development because it takes into account on the one hand the economic growth and, on the other hand, CO_2 emission reduction [61], responding to the desideratum of sustainable green economy. In this context, the way to improving carbon productivity for a sustainable green economy is to maintain or to raise the GDP growth rate while mandatorily reducing the carbon emission growth rate [59]. Figure 3 shows the Kernel density estimate.

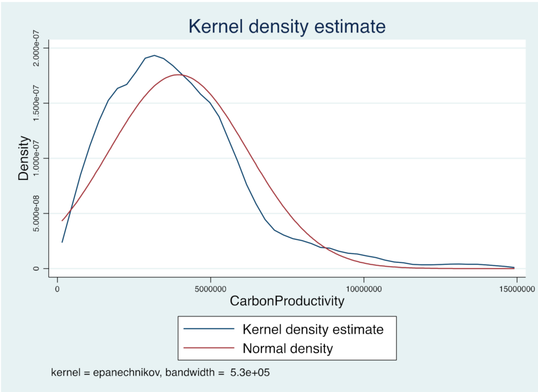

Figure 3. Kernel density estimate. Source: computed by authors using Stata 15.1.

The kdensity plot also indicates that the dependent variable carbon productivity (*CarbonProd*) does not look normal, and to help to make it more normally distributed, we investigated and decided in accord with Figure 4 that the log transform has the smallest chi-square and the log transformation would help to make enroll more normally distributed.

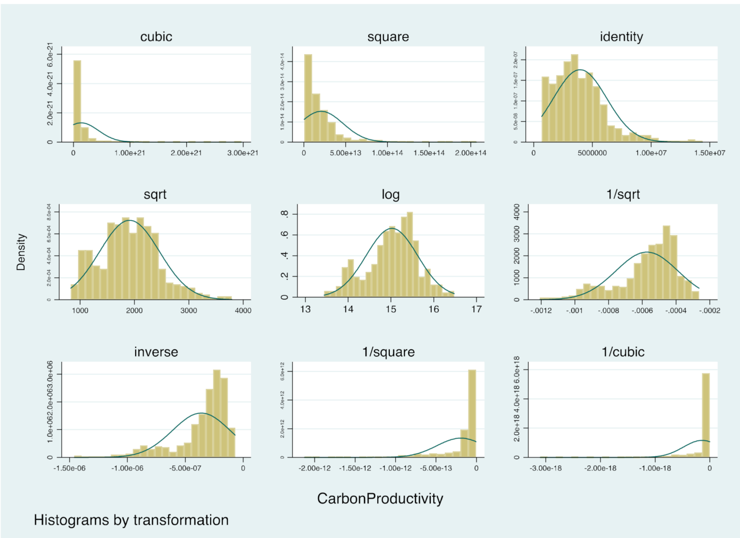

Figure 4. Histogram by transformation. Source: computed by authors using Stata 15.1.

We use in our paper the four variables out of six in the World Bank dataset [32] that come closest to capturing the quality of the outcome and process dimensions of regulation and which are the most common in the literature for econometric analysis [3], namely: (a) Government effectiveness (*Gov_eff*); (b) Regulatory quality (*Reg_q*); (c) Rule of law (*Rule_law*); and (d) Control of corruption (*Contr_corr*). Another important indicator of financial regulation is economic freedom (*EconFree*).

The variables added to Equation (1) broadly follow the growth empirical literature, according to several authors [71–75]. Among the control variables included in most empirical research are initial conditions, in terms of the human capital and institutions, based on school enrollment, secondary (% gross) because secondary education completes the provision of basic education that began at the primary level, and aims at laying the foundations for lifelong learning and human development by offering more subject- or skill-oriented instruction using more specialized teachers (*Edu*). Proxies for the macroeconomic environment are inflation (*Infl*), trade openness (*Trade*), and the government's involvement in economic activities (*Exp*). Qualitative variables can also be added to account for specific events in a country, as well as data heterogeneity when panel data are used. In our analysis, depending on the nature of dataset constructed, we make use of all or some of these variables with the aim of ensuring that our regressions are appropriately specified.

The variables used for robustness checks in our model detailed by the Equation (1) are described in Table 2.

Table 2. The variables included in the analysis.

Variable	Definition	Data Source
CarbonProd	Carbon Productivity—as a ratio between GDP and the quantity of CO_2 emissions.	Computed by authors using World Bank database [70]
Gov_eff	Government effectiveness (*Gov_eff*), which show perceptions of the quality of public provision, quality of bureaucracy, competence of civil servants and their independence from political pressure, and the credibility of government decisions.	World Bank [70]
Reg_q	Regulatory quality (*Reg_q*) which reflects burden on business via quantitative regulations, price controls, and other interventions in the economy.	World Bank [70]
Rule_law	Rule of law (*Rule_law*) showing respect for law and order, predictability and effectiveness of the judiciary system, enforceability of contracts.	World Bank [70]
Contr_corr	Control of corruption (*Contr_corr*) as perceptions of the exercise of public power for private gain.	World Bank [70]
EconFree	Index of economic freedom.	Heritage Foundation [75]
Edu	School enrollment, secondary (% gross)—gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown.	World Bank [70]
Infl	Inflation, GDP deflator (annual %)—inflation as measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy as a whole. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency.	World Bank [70]
Trade	Trade (% of GDP)—trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.	World Bank [70]
Exp	General government final consumption expenditure (% of GDP).	World Bank [70]

Source: computed by authors.

Table 3a,b provide descriptive statistics for the all variables included in the model for the EU-25 countries, over the period of time 2000–2018.

Table 3. (**a**) Pairwise correlations; (**b**) Summary statistics.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) lCarbonProd	1.000									
(2) Contr_corr	0.653 *	1.000								
(3) Rule_law	0.675 *	0.953 *	1.000							
(4)Reg_q	0.542 *	0.891 *	0.899 *	1.000						
(5) Gov_eff	0.662 *	0.939 *	0.939 *	0.871 *	1.000					
(6) EconFree	0.354 *	0.641 *	0.686 *	0.834 *	0.621 *	1.000				
(7) lTrade	−0.171 *	0.015	0.065	0.144 *	0.081	0.366 *	1.000			
(8) lInfl	−0.373 *	−0.275 *	−0.307 *	−0.242 *	−0.336 *	−0.204 *	0.016	1.000		
(9) lExp	0.449 *	0.495 *	0.478 *	0.401 *	0.548 *	0.131 *	−0.094 *	−0.307 *	1.000	
(10) lEdu	0.499 *	0.550 *	0.543 *	0.458 *	0.549 *	0.385 *	0.125 *	−0.278 *	0.401 *	1.000

* shows significance at the 0.05 level.

(**a**)

	N	St.Dev	Min	Max	Kurtosis	Skewness	t-Value
(1) lCarbonProd	475	0.601	13.438	16.481	2.731	−0.370	544.776
(2) Contr_corr	475	15.632	36.041	100	1.863	−0.291	109.556
(3) Rule_law	475	14.636	45.05	100	2.205	−0.524	120.238
(4)Reg_q	475	10.426	48.718	100	2.57	−0.374	175.348
(5) Gov_eff	475	13.12	42.564	100	3.044	−0.644	135.317
(6) EconFree	475	6.795	47.3	82.6	2.788	−0.274	217.409
(7) lTrade	475	0.387	3.816	5.421	1.911	0.067	256.014
(8) lInfl	445	0.999	−6.109	3.765	9.025	−1.181	14.341
(9) lExp	475	0.140	2.477	3.33	3.635	−0.168	465.782
(10) lEdu	449	0.135	4.379	5.099	4.877	1.295	728.91

(**b**) Source: computed by authors using Stata 15.1.

The econometric analysis with yearly panel data, use, individually and jointly, five quality dimensions of regulation variables, which are the most common in the literature for defining financial regulation, was based on a generalized linear model form of regression analysis known as a log-linear model, respectively OLS regression.

To estimate Equation (1) and structure the results for the baseline growth model, we first solve the problems of spurious regression. Therefore, the tests for multicollinearity show variance inflation factor (VIFs) of 1.40 for regressions (1), 1.38 for regression (2), 1.30 for regression (3), 1.40 for regression (4), and 1.27 for regression (5), meaning a tolerance of 1/VIF lower than 0.1 comparable to a VIF of 10, which means that the variable could be considered as a linear combination of other independent variables. Also, we note that the economic controls perform reasonably well in the model and check the robustness.

5. Results and Discussion

In this section, we present the results for estimating the equation stated above. The point of interest is represented by the implication of regulation on green economy, based on the relationship between carbon productivity and quality of the outcome and process dimensions of regulation. By approaching some variables government effectiveness (*Gov_eff*), regulatory quality (*Reg_q*), rule of law (*Rule_law*); and control of corruption (*Contr_corr*). Another important indicator of financial regulation is economic freedom (*EconFree*), being considered explanatory variable. Based on these five variables, we will capture possible interaction between each of them and the green economy.

The process of collecting the data was precise and the reliable sources include World Bank and Eurostat database, the sample consists of annual data from 2000–2018 and based on panel data analysis, we test the implication of regulation on the green economy in EU-25 countries. The results of the regression analysis based on OLS regression for panel data models are summarized in Table 4. We ran five regressions separately, each of the four alternative includes—along with some other determinants of the green economy—as explanatory variable: control of corruption (regression 1), rule of law (regression 2), regulatory quality (regression 3), government effectiveness (regression 4), and economic freedom (regression 5).

Table 4. The results of the regression analysis.

	(1)	(2)	(3)	(4)	(5)
	OLS	**OLS**	**OLS**	**OLS**	**OLS**
Contr_corr	0.0181 ***				
	(0.00176)				
Rule_law		0.0207 ***			
		(0.00176)			
Reg_q			0.0214 ***		
			(0.00242)		
Gov_eff				0.0231 ***	
				(0.00218)	
EconFree					0.0252 ***
					(0.00365)
lTrade	−0.351 ***	−0.389 ***	−0.431 ***	−0.414 ***	−0.508 ***
	(0.0536)	(0.0526)	(0.0515)	(0.0505)	(0.0514)
lInfl	−0.0915 ***	−0.0748 ***	−0.0911 ***	−0.0729 ***	−0.0843 ***
	(0.0206)	(0.0213)	(0.0223)	(0.0206)	(0.0227)
lExp	0.537 *	0.542 *	0.788 ***	0.353	1.232 ***
	(0.225)	(0.220)	(0.233)	(0.235)	(0.239)
lEdu	0.764 ***	0.731 ***	1.066 ***	0.806 ***	1.194 ***
	(0.156)	(0.149)	(0.164)	(0.161)	(0.183)
_cons	10.06 ***	10.11 ***	7.888 ***	10.23 ***	6.403 ***
	(0.679)	(0.613)	(0.626)	(0.699)	(0.625)
N	419	419	419	419	419
R^2	0.561	0.587	0.528	0.571	0.494

Standard errors in parentheses. * $p< 0.05$, *** $p< 0.001$.

Based on the results provided in Table 4, it is noted that in the EU-25 countries, it is a direct relationship between each indicator of financial regulation and green economy. With respect to the literature insights [16,18], the study confirmed that regulation could stimulate the green economy.

According to the results of the OLS model, the coefficients of all variables defining the quality of regulation, such as government effectiveness (*Gov_eff*), regulatory quality (*Reg_q*), rule of law (*Rule_law*), control of corruption (*Contr_corr*), and economic freedom (*EconFree)* are positive and statistically significant as predicted by our hypothesis. The p-value is smaller than 0.05 and we can conclude that the independent variables reliably predict the dependent variable. The value of R-square as the proportion of variance in the dependent variable carbon productivity that can be predicted from the independent variables for regression (1) also indicates that 56% of the variance in carbon productivity can be predicted from the variables control of corruption (*Contr_corr*), education (*Edu*), inflation (*Infl*), trade openness (*Trade*), and expenditure (*Exp*). Regression (2) indicates that approximately 59% of variance in carbon productivity can be predicted from rule of law (*Rule_law*), and the other independent variables (education (*Edu*), inflation (*Infl*), trade openness (*Trade*), and expenditure (*Exp*)). Regression (3) indicates that approximately 53% of the variance in carbon productivity can be predicted from the variables regulatory quality (*Reg_q*) and the other independent variables ((education (*Edu*), inflation (*Infl*), trade openness (*Trade*), and expenditure (*Exp*)). Regression (4) indicates that 57% of the variance in carbon productivity can be predicted from the variable's government effectiveness (*Gov_eff*) and the other independent variables (education (*Edu*), inflation (*Infl*), trade openness (*Trade*), and expenditure (*Exp*)). Regression (5) indicates that 49% of the variance in carbon productivity can be predicted from the variables economic freedom (*EconFree*) and the other independent variables (education (*Edu*), inflation (*Infl*), trade openness (*Trade*), and expenditure (*Exp*)).

Education measured by School enrollment, secondary (% gross) being the foundations for lifelong learning and human development, by offering more subject- or skill-oriented instruction using more specialized teachers, has a significant positive impact on carbon productivity on all models, this being supported by empirical evidence of Jalilian et al. [3].

General government final consumption expenditure (% of GDP) as the indicator of government's involvement in economic activities is positive and significant in all four models [1–3,5]. In model 4, expenditure is positive, but not significant statistically.

With regard to the linkage between inflation as measured by the annual growth rate of the GDP implicit deflator, it shows the rate of price change in the economy as a whole and carbon productivity, there has been a marked negative relationship in all specifications of our models. High inflation leads to significant and permanent reductions in carbon productivity in all our models. Trade openness defined by the combined share of imports and exports in GDP has a significant negative impact on carbon productivity in all five models.

6. Conclusions

This study has successfully answered to the research paper objective, respectively to examine the relationship between regulation and green economy in EU-25 countries, over the period 2000–2018, the status of green economy and policy implications, testing interconnection between the three main dimensions mentioned above. In order to examine the channels through which regulation may affect green economy, the methodology employed in this study is OLS regression and the entire panel data methodological approach follows the OLS regression assumption. Regulation was described in terms of five literature-recognized indicators, namely government effectiveness (*Gov_eff*), regulatory quality (*Reg_q*), rule of law (*Rule_law*), control of corruption (*Contr_corr*), and economic freedom (*EconFree)*. Green economy has been described by carbon productivity, which reflects the ratio between GDP and the quantity of CO_2 emissions. Among the control variables were included education (*Edu*), inflation (*Infl*), trade openness (*Trade*), and the government's involvement in economic activities (*Exp*).

The results indicate a positive and significant relationship between the coefficients of all variable in all five models, highlighting the contribution of quality regulation on the green economy. In this context, the results from the five models suggest a strong causal link between regulatory quality and the green economy and confirm that the standard of regulation matters for economic performance.

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