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The Impact of Environmental Management on Labour Productivity

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Abstract: The green transition and green economic growth are policy priorities in the European Union. In this context, this study estimates the effects of environmental management on firm performance, in particular labour productivity. There is currently a lack of empirical evidence on this topic, although it is of great importance due to the increasing need for environmental practices across the globe. Therefore, to address this gap, we explore the relationship between several environmental variables on labour productivity, through the use of cross-sectional firm-level data. These data were obtained using the sixth wave of the Business Environment and Enterprise Survey (BEEPS VI). This study focuses on ten EU countries. The results obtained from the empirical analysis reveal that firms who employ an environmental manager and firms that are subject to energy taxes or levies both have higher productivity than those who do not; thus, firms that have employed or are subject to certain environmental practices reap the benefits of higher labour productivity. Furthermore, firms that use renewable energy have higher labour productivity than those that do not. Therefore, the results obtained allowed us to draw implications for both policy makers and managers.

Keywords: environmental management; green management; CO_2 emission; labour productivity; BEEPS data

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1. Introduction

In recent years, the connection between firms and the environment has become a large-scale debate and issue. The debate largely consists of whether firms that adopt environmentally friendly practices are worse off than those who do not, and whether this impedes a firm's growth [1,2]. However, across the few pieces of literature that have been produced regarding this topic, there appears to be a wide variety of results found, and some of these have found there to be a positive relation between green management practices and a firm's performance. Porter and van der Linde [3] argue that properly designed environmental standards can trigger innovation, leading to lower total costs of products or improved value; therefore, innovations allow companies to use a range of inputs more productively, including raw materials, energy, and labour. Therefore, for this reason, there is great deliberation regarding the relationship between firms and the environment, and it is now a priority within research [1].

Within this study, labour productivity has been used as the measure of firm performance. This is an important method used to assess this, as some scholars believe that environmental management can improve working conditions, employees' health, and employees' skills [4,5]. Furthermore, Lannelongue et al. [1] and Russo and Fouts [6] note that the benefits of green management practices are related to human resources, and suggest that human factor and labour productivity have a decisive role when assessing the competitive effects of those who invest in environmental matters. In addition, Russo and Fouts [6] discuss that it has been forcefully argued that environmental regulation enhances economic performance in an efficiency-producing, innovation-stimulating relationship.

Moreover, Lannelongue et al. [1] discuss the importance of this factor, and that in tandem with greater globalisation and increased market competition in industrial products, labour productivity is now more than ever a decisive factor of competitiveness in international markets, and hence a stellar measure of firm performance.

Due to the growing threat of climate change, slow progress in energy efficiency, and increasing shares in renewables, environmental management within firms has become of increased importance across Europe. Therefore, carrying out such research allows us to further understand the benefits for firms of applying voluntary green management practices to their performance [7]. The European Union (EU) has imposed several targets to be reached, with indicative milestones for 2030, 2040 and 2050. These targets include a reduction of at least 55% in greenhouse gas emissions compared to 1990 levels by 2030, a reduction to net zero greenhouse gas emissions by 2030, and an improvement to 32% of the share of renewable energies in energy consumption [7]. Therefore, in line with these aims, it is expected that countries within the EU will begin to use government regulation to control business' green management practices and reach such goals. Thus, it is of great significance that such firms understand the benefits or costs of this for their performance; it will be of interest as to whether government regulation effects firm performance more or less than voluntary managerial environmental measures.

Given these arguments, the effects of environmental management on labour productivity are of great interest across the EU as well as the world. Therefore, we test hypotheses on whether four environmental management practices have an effect on firm performance, which is measured by labour productivity. We test the hypotheses using a sample of 4071 firms spread across ten European countries, collected from the sixth round of the World Bank Business Environment and Enterprise Performance Survey (BEEPS VI) dataset covering the period 2018–2020. Through doing so, we will provide implications for both policy makers through the relationship between environmental taxes or levies and labour productivity, and provide implications for firm management, for example, elucidating the relationship between labour productivity and firms who employee environmental managers.

This study offers several contributions to the literature on the productivity effects of environmental management at the firm level. First, there is a scarce amount of empirical evidence, in particular across non-core European countries. While there is extensive literature on the impact of CO_2 emissions and government regulations on GDP growth and total factor productivity at the macro level, there are a very limited number of studies at the micro or firm level. Second, more empirical findings are needed to provide insights into the current effects of environmental management on firm performance. These insights can help managers and policy makers in supporting firms to increase their productivity, while at the same time adopting practices that support sustainability and the green transition. Third, this study focuses on non-core EU countries that are in the Euro zone. Most empirical studies, in particular at macro level, focus on OECD countries. Non-core EU countries are also going through the green transition, which is the priority of the EU for the next several decades. However, these countries have a business environment that is less conducive to green economic growth, compared to the core EU countries.

2. Literature Review

With the amount of growth and prosperity the world is seeing now and in recent years, there are increasing concerns around environmental issues caused by it [8]. Along with this, there are growing concerns over the sustainability of the economy, in the long run, for both society and industry [9]. This is largely due to the large amount of industrial development the world has seen over recent years, causing the planet to experience severe environmental problems such as air and water pollution and global warming [10]. Most notably, China's economic development has caused a lot of severe environmental pollution due to cutting costs and less stringent government regulations. Therefore, this must be improved, and green investment is becoming an increasingly important decision for firms,

and hence an increasing display of firms' social responsibility [11]. Therefore, there is a split in opinion between those that believe environmental protection practices can slow economic development, and others that believe adopting eco-friendly practices has benefits for the environment as well as employees and performance [1]. Recent research has also shown that green entrepreneurial orientation (GEO) can have a decisive role in achieving better financial performance, in addition to reducing environmental impacts [8]. This split in opinions explains the need for environmental issues to be a priority in research [1].

Due to these increasing concerns about the environment, many businesses are using green management practices. Therefore, in recent years, there has been increased research into the relationship between environmental management and productivity. Across the literature, environmental performance is defined variably. Ma et al. [4] define environmental management as initiatives that companies take in order to improve their environmental performance. However, Sambasivan et al. [12] describe it as the extent to which a firm's processes and practices maximise efficient use of resources, and reduce wastage and environmental risk; thus, it is a measure of how successful a firm is in reducing its negative impact on the environment. Delmas and Petkovic [2] note that a firm's involvement in social courses usually increases a firm's reputation, and hence positively impacts employees' attitudes to work, leading to higher productivity. Furthermore, employees may be more committed to firms with high environmental standards, and this may result in higher organizational standards (for example, more training and interpersonal contacts), thereby effecting labour productivity.

In the past, there seemed to be empirical research showing that green practices had a negative effect on firm performance. An example of this was discussed by McGuire et al. [13], who note that when labour suffers from the imposition of environmental controls, and productivity is lost. However, there is also several more recent studies that have also found there to be a negative relationship between firm performance and green management practices [1,4,14]. Lannelongue et al. [1] report that firms with high capital intensity have a negative relationship between environmental management and labour productivity. Ma et al. [4] also find a negative relationship between environmental management and labour productivity, although this was limited to Chinese listed companies. However, within this literature, both Lannelongue et al. [1] and Ma et al. [4] find that other factors, such as capital intensity and quality management, can play a moderating role in the relationship between labour productivity and environmental management. Namely, Lannelongue et al. [1] posit that those firms with low capital intensity had showed the opposite effect, with a positive relationship between environmental management and labour productivity, whilst Ma et al. [4] find that quality management can offer a moderating role in this relationship, and reduce the burden of environmental management on productivity.

Adopting green practices is an important consideration for today's firms. Many organisations now been 'obliged' to increase their effort to balance their environmental performance, in particular those with community and competitive pressures [15]. Factors such as resource limitation, consumer preferences, societal pressures, and regulatory policies are pushing for a more equalised approach towards economic growth and environmental sustainability [16]. As such, there is some evidence in the literature that by implementing environmental management into firms' policies, there can be several benefits, including return on investment and increased sales [17]. However, there is an insufficient amount of literature suggesting which specific environmental implementations, such as reducing pollutant emissions, increasing energy efficiency, and using environmentally friendly materials, can help to achieve a higher firm performance [17].

Moreover, Lun [9] argues that the main reason for improved firm performance is due to GMP (green management practices) being a source of comparative advantage. This is because using GMP encourages firms to use more sophisticated environmental strategies, hence allowing the integration of external stakeholders into the business operations. Therefore, redesigning existing operating systems to reduce environmental impacts presents a first-rate opportunity to assess all aspects of operations jointly, in order to reduce the

shift of environmental harm from one subsystem to another [9] and hence improve organisational efficiency [18]. Thus, due to continuous environmental and organisational improvements, firms should see increased labour productivity, and firms can use further changes to their comparative advantage [9]. In addition, Delmas and Pekovic [2] note that the adoption of environmental practices likely leads to positive organisational representation, and therefore could have a positive impact on employees work attitudes. Lannelongue et al. [1] posit that better human resource management combined with cost reduction may result in a positive relationship with employee productivity. Therefore, this shows that in some circumstances, there is a positive relationship between environmental practices and employee performance.

The cost of environmental protection for industries has increased substantially since the 1970s, and is expected to increase further. Therefore, cost-effective green management is largely significant for a firm's competitive position [9]. However, the environmental management literature suggests that firms can enhance their competitive positions and concurrently reduce the negative effect of their environmental wrongdoings by exploiting green management practices [9,19]. This is achieved by a firm having a set of business processes in which they assess their environmental impacts, determine environmental goals, implement environmental operations, monitor goal attainment, and undertake a management review [9]. Within the sixth wave of the World Bank Business Environment and Enterprise Performance Survey (BEEPS VI, 2018–2020), several environmental management practices are included, and hence can be tested within the empirical model in this study.

One of the first companies to first create a path towards controlling their levels of pollution was 3M, in 1975. Through this action, they collected and treated waste after it was created, and then went on to prevent the creation of such waste in the first place. This project included line workers and employees getting involved with identifying waste reduction opportunities. In embarking on this project 3M managed to reduce their total pollution by over 530,000 tons, which equated to a 50% reduction in total emissions. They then went on to prove the benefits of this action, saving $500 million due to lower raw materials, acquiescence, disposal, and liability costs. Due to 3M experiencing these benefits, many companies and analysts have now adopted a 'win-win' view of the business and green management, due to green management and regulation arguably improving competitiveness due to increasing efficiency and innovation [20].

2.1. The Impact of Taxes on Productivity

The well-known Porter hypothesis [21] suggests that environmental regulation stimulates firms to engage in innovative activities, which should enhance their competitiveness and productivity [22]. Energy taxes usually represent the largest share of total environmental taxes. In relation to energy taxes, firms face a productivity dilemma. An increase in energy efficiency leads to higher profitability and cost efficiency. This, in turn, can motivate firms to expand their production, which will lead to higher energy consumption and lower energy efficiency [23]. Therefore, the impact of energy taxes on firm performance is ambiguous. Those firms that become more innovative because of environmental regulation are more likely to experience productivity gains. In contrast, firms faced with the productivity dilemma might experience a lower energy efficiency, which could negatively impact productivity.

Empirical evidence regarding the Porter hypothesis points to sector-specific effects. In this respect, Steinbrunner [22] reports that energy and pollution tax rates positively affect productivity in energy-intensive sectors, industries producing energy-consuming goods, and polluting sectors. Furthermore, Fujii et al. [24] find that energy conservation laws have raised productivity in the metals and machinery sectors. Given that our sample is dominated by these industries, the following hypothesis is formulated.

H1. *Energy taxes have a positive effect on firms' productivity.*

2.2. The Importance of Environmental Managers

Masri and Jaaron [25] note that the adoption of green practices is not limited to specific organisational apartments, but rather employees in all organisation's functions are jointly responsible for keeping the organisational environment = green. Therefore, managers should incorporate employees at all levels within the environment preservation process. Furthermore, Lannelongue et al. [1] posit that firms with better environmental management have higher employee satisfaction, also noting that one pharmaceutical company found that improved image of the company led to a better atmosphere in the workplace, and thus to higher labour productivity. This begs the question as to whether improved productivity relates to better corporate image due to environmental practices.

Furthermore, Ma et al. [4] argue that environmental management can improve employee satisfaction, with a good level of environmental management leading employees to feel proud of their companies and thus have a propensity to perform better. It is also argued that environmental management can reduce labour costs, due to pollution emissions being potentially harmful to employees' health; thus, better environmental performance can reduce employee sick leave and absenteeism. This sick leave and absenteeism may lead to the need for new employees, and hence higher labour costs [4]. Furthermore, Masri and Jaaron [25] note that organisations need to focus on hiring employees who support and have an interest in the environment; in order to be attractive to an increasingly aware talent pool, organisations should build a good environmental reputation in order to create an image of environmental responsibility. Moreover, the recruitment process should require new recruits to understand the organisation's green culture and share its environmental values; hence, recruitment advertising should include environmental criteria, and such processes should include showing green accomplishments and explanations of what is expected of a green employee.

In addition, there is also a debate as to whether there should be rewards for employees that are more committed to environmental practices, from rewards and compensation for the avoidance of negative behaviours, to encouragement of eco-friendly behaviours. This could be achieved by mirroring management's commitment to environmental practices, while encouraging employees' pro-environmental behaviours [25,26]. Furthermore, Masri and Jaaron [25] also discuss that if management offer such rewards and commitments, this will then increase worker commitment by increasing their environmental responsibility and involvement in eco-initiatives. Additionally, Govindarajulu and Daily [27] argue that employee motivation for environmental improvement may be either supported or undermined by the organisational culture, as companies with rigid, top-heavy, and bureaucratic structures may struggle to implement changes more than companies with flexible and lean organisational structures. Therefore, management's commitments must include a culture that can encourage innovation and risk-taking, supporting environmental improvement efforts through values, norms, attitudes and behaviours [27].

Firms use ISO 14001 [28] to train their employees in environmental policies, which leads to employees taking part in environmental regulation; further employee training leads to increased association with the workplace, which could contribute to labour productivity [1,2]. Additionally, Morrow and Rondinelli [29] find that firms that have introduced widespread EMS practices report higher levels of information sharing, community relationship activities, and use of the internet to provide environmental information than companies who were not high adopters of such practices. Furthermore, Ma et al. [4] note that some scholars believe that environmental management can have a positive effect on working conditions and employees' health, and improve employee satisfaction, thereby stimulating labour productivity. Based on the above discussion, the following hypothesis was formulated:

H2. *Firms that have an environmental manager are more productive than firms that do not.*

2.3. Environmental Certifications and Environmental Standards

Environmental standards require the application of certain environmental practices and procedures to ensure that risks, liabilities and impacts are properly identified, minimised and managed, thus ensuring the potential to reduce risks related to environmental compliance [2]. This can be achieved through utilising practices such as environmental performance goals, internal and external environmental audits, and employee training [2,18]. Delmas and Pekovic [2] also discuss the gains of firms using environmental standards, such that they improve their efficiency as the adoption of environmental practices establishes new systems for gathering information and monitoring environmental performance, thus prompting a redesign of the production process, thereby improving innovation and therefore the firm's efficiency. Delmas and Petkovic [2] report that the adoption of environmental standards has a positive effect on labour productivity, with firms that adopted such standards achieving a 16% increase in average labour productivity.

Although the literature notes the benefits to firms of introducing environmental management practices, many firms are reluctant to do so. According to Montabon et al. [30], many firms are reluctant to take on more aggressive and proactive approaches to such practices, due to an apparent lack of evidence that the benefits exceed the costs of pursuing such initiatives. However, we must consider that their study was published in 2006, and therefore may not hold as true today. This reluctant is shown by the moderately low number of ISO 14001 certificates that have been issued to firms in the US [30]. The ISO 14001 standard was released in 1996, and added additional pressure to some industries to address environmental performance through the use of environmental management systems. This new standard (ISO 14001) is a set of guidelines through which a single plant or organisation can establish or improve its environmental policy, identify the environmentally friendly aspects of its organisation, create environmental targets and programmes to meet these targets, monitor effectiveness, correct deficiencies, and review management systems to encourage improvement [29,30]. Many firms have designed and implemented environmental management under this ISO 14001 standard, because it provides harmonised standards for managing a firm's environmental impacts [29]. Nowadays, the ability to handle environmental, social, and governance (ESG) issues in a proactive manner is part of effective firm management. Nevertheless, a lot of firms do not disclose their ESG information. Thus, enterprise surveys, such as the sixth wave of the Business Environment and Enterprise Performance survey (BEEPS VI: 2018–2020), carried out by the EBRD and World Bank Group include an additional Green Economy module designed to collect information on firms' green management practices, as well as other aspects of the firm's behaviour that relate to climate change. These included questions covering if the firm has strategic objectives pertaining to the environment and climate change, whether a firm employs a specific manager to deal with green management, if they monitor their energy and water usage, and finally if they have clear and attainable environmental targets. Therefore, these surveys will be very useful for this research, as we can use these secondary data to assess the relationship (if any) between green management and labour productivity.

Furthermore, Morrow and Rondinelli [29] examine many companies that have reaped benefits from the implementation of ISO 14001 certification. One such company was ABB Automation, who received an ISO 14001 certification at one of its plants; this implementation facilitated a reduction in the costs of energy and of hazardous waste handling and disposal. However, and arguably most importantly, ABB Automation also found that this implementation increased employee morale due to the company's commitment to environmental standards, which arguably could have had a positive effect on labour productivity. However, it is important for companies and governments to implement environmental management effectively. Ma et al. [4] note that strict environmental management may reduce efficiency, as it reduces the flexibility of companies in dealing with environmental issues. One example of this is that environmental management usually requires significant changes in production structures, thereby requiring companies to change their production processes and use environmentally friendly technologies and equipment.

Based on the above arguments, the following hypothesis is formulated:

H3. *Firms that do business with customers that require environmental certifications or adherence to certain environmental standards are more productive than firms that are not subject to these conditions.*

2.4. Renewable Energy and Firm Performance

The use of renewable energy and its impact on firm performance is an important issue, given the prioritisation of the green transition in both advanced and emerging economies. There are numerous macroeconomic studies that have examined the impact of renewable energy consumption on economic growth. A relatively smaller number of studies focus on firm performance. Clean production technologies can improve firm production efficiency [31]. Moreover, clean production technologies may be cheaper than polluting technologies, which contributes to firms' cost minimisation [32]. More recently, the traditional production function has been extended to include energy [33]. The inclusion of energy, in particular renewable energy, in the production function signifies a reduction in both greenhouse gas emissions and non-renewable energy dependency [33]. Consequently, the final hypothesis is formulated:

H4. *Using renewable energy sources has a positive effect on firm productivity.*

Figure 1 shows the conceptual framework based on formulated hypotheses and control variables in the model.

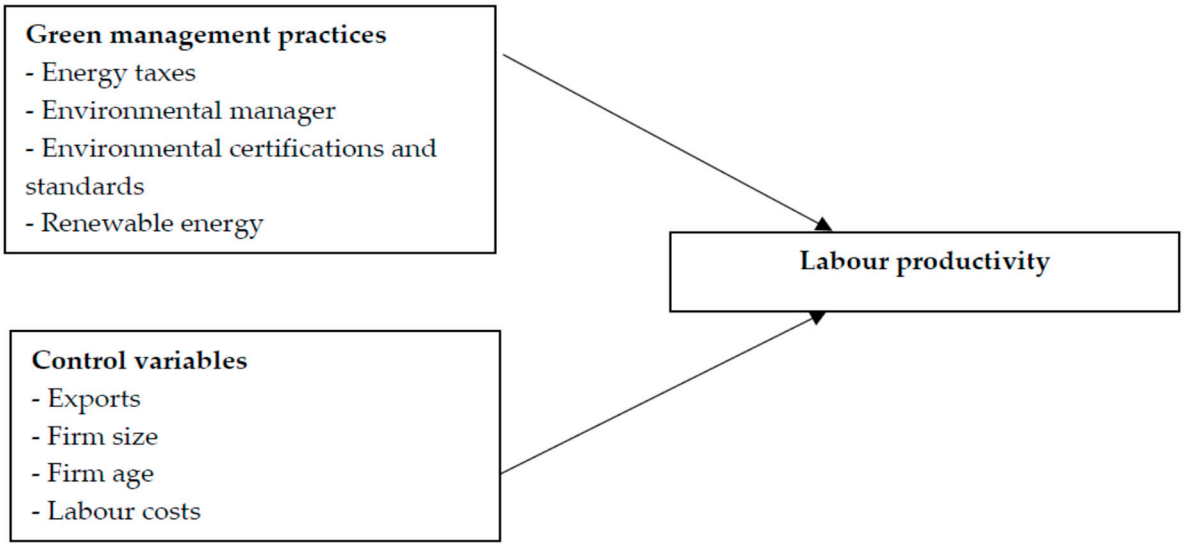

Figure 1. Conceptual framework (source: authors' illustration).

3. Methodology

3.1. Sample and Data

The data used within this model were collected using the sixth wave of the Business Environment and Enterprise Performance survey (BEEPS VI: 2018–2020). The database is available upon registration at https://www.ebrd.com/what-we-do/economic-research-and-data/data.html (accessed on 1 July 2023). This survey was carried out by the European Bank for Reconstruction and Development (EBRD) in partnership with the World Bank; this survey is at firm level and based on face-to-face interviews with managers used to assess the quality of the business environment. In the most recent surveys, conducted between 2018–2020, 28,000 enterprises were covered, across 41 economies of the EU, Eastern Europe, Central Asia, the Middle East, and North Africa. This survey used stratified random

sampling, with all population units grouped within homogenous groups. Then simple random samples were selected from these groups. The survey covers various firm sizes that depend on the number of employees, with 5–19 being small, 20–99 being medium, and over 100 representing a large-sized firm. Furthermore, the survey covers the manufacturing (without extraction) and service sectors. These recent enterprise surveys now include an additional Green Economy module that covers green management practices and green investments, thus allowing this research to assess the effects of such practices on a given firm's performance.

3.2. Model Specification

The dependent variable in this study is *labour productivity*, which is measured as the logarithm of total annual sales divided by the number of full-time employees [1,4]. Labour productivity has been used by Gogokhia and Berulava [34] and Lannelongue et al. [1] as an effective measure of firm performance; it is of crucial importance, as it indicates the degree to which the workforce is effectively producing.

Regarding variables of interest, we include the following. First, the variable *energy tax* is a dummy variable which is equal to 1 if the firm responded positively to the question "In the most recent fiscal year, was this establishment subject to any energy tax or levy?". This variable is used to test H1. Previous empirical studies [22,35,36] have explored how environmental taxes and energy taxes affect firm productivity.

Second, the variable *environmental manager* is equal to 1 if the firm responded positively to the question "In the most recent fiscal year, did this establishment have a manager responsible for environmental and climate change issues?". This is an interesting and important variable to include in the model, as Greenwood et al. [5] note that such managers have a major or supportive role in the company, regarding factors such as operating practices; these managers may work to reduce environmental impacts and improve the working experience for workers, allowing skill development, training, and opportunities for career advancement. The third variable of interest is *customers certification*, which is a dummy variable that is equal to 1 if the firm responded positively to the question "In the most recent fiscal year, did any of the establishment's customers require environmental certifications or adherence to certain environmental standards as a condition of doing business with this establishment?". As discussed in Section 2.3, environmental certification and adherence to environmental standards could improve a firm's efficiency, the production process, and rates of innovation, which, in turn, might lead to positive productivity effects.

The fourth variable of interest is *renewable energy*, which is a dummy variable that is equal to 1 if the firm responded positively to the question "Did this establishment use energy from its own renewable resources, such as power plants using solar, wind, hydro, biomass, or geothermal energy?". As noted in Section 2.4, most previous studies explore whether the use of energy affects firm productivity by including energy as an input in the production function. This study takes into the role of energy in the production function by focusing on the utilization of renewable energy.

Concerning control variables, the empirical model includes the following variables. The variable *labour costs* is measured as the logarithm of the total annual cost of wages. This is an interesting variable to include, as it is usually regarded as part of capital, and hence is of importance to productivity. However, in addition, it will be interesting to see if firms that spend more on wages have increased labour productivity. Nishitani et al. [37] also included the logarithm of wage expenses in their model when researching the effect of a firm's management of greenhouse gases emissions on firm performance. The variable *age* is measured as the natural logarithm of the age of the establishment in years [34]. The literature states that company age is an important factor in influencing productivity [4]. Therefore, similarly, this model includes an age variable, which is measured as the natural logarithm of the age of the establishment in years. The variable *firm size* is measured using the natural logarithm of the number of employees within the firm. It is important to control for this, as Singh et al. [38] report that firm size is positively related to environmental

management practices, and the larger the company, the larger the business scale which could potentially have an important impact on labour productivity. Furthermore, Dangelico et al. [17] discussed that firm size may also be an important factor in explaining the environmental behaviour of employees. The variable *exports* is a dummy variable that is equal to 1 if the firm is an exporter, and zero otherwise. Research has shown that exports can increase the productivity of companies due to the international influence of learning and competition [4]. Additionally, export-oriented firms usually have higher labour productivity in order to compete internationally; moreover, empirical studies have shown the significant role played by exports in firms' decisions to introduce environmental standards [2]. Gogokhia and Berulava [34] also found direct exportation to be an important predictor of labour productivity.

The estimated model also includes country dummies. It is important to control for a firm's country, as there can be pressure elements that occur, depending on the development of the country in which the firm is established. Such elements include labour productivity, environmental management, and economic growth; therefore, one's country is a key factor that determines the actions of organised civil society, which is one of the main sources of pressure [1]. Additionally, Lannelongue et al. [1] report that a firm's size and location in certain countries (such as Finland, Sweden, Spain, France, and Germany) may lead to a higher level of labour productivity. Therefore, the estimated model includes ten EU countries that use the Euro as their official currency. These are Cyprus, Estonia, Greece, Italy, Latvia, Lithuania, Malta, Portugal, the Slovak Republic, and Slovenia.

Finally, it is important to include sector dummy variables in order to control for sector differences and fixed effects [2,34]. De Kok et al. [39] note that as different sectors of industry are in different phases of a product's life cycle, at a given point in time, productivity levels and productivity growth rates will vary between sectors. This sector effect has been found in various empirical studies. Therefore, this has been accounted for within the model using industry dummy variables.

Table 1 shows that a large proportion of the sample is subject to an energy tax or levy (*energy_tax*), with 27.9% of firms in the sample subject to this; meanwhile, 13% of firms within the sample employ an environmental manager (*env_management*). Some 15% of firms require establishments' customers to have environmental certifications, or to adhere to environmental standards as a condition of doing business with said establishments (*customer_reg*); 10% of firms use renewable energy, and finally, 34.7% of firms within the sample undertake direct exports (*exports*).

Table 1. Descriptive statistics (source: authors' calculation).

Variable	Mean	Std. dev.	Min	Max
Productivity (in log)	11.291	1.136	5.784	17.523
Energy_tax	0.279	0.448	0	1
Env_management	0.130	0.337	0	1
Customer_reg	0.150	0.357	0	1
Renewable energy	0.100	0.300	0	1
Firm_size (in log)	3.246	1.314	0	8.131
Exports	0.347	0.476	0	1
Age (in log)	2.909	0.809	0	5.303
Labour_cost (in log)	12.791	1.639	7.565	18.757
Food and beverages	0.115	0.318	0	1
Textiles	0.011	0.103	0	1
Garments	0.044	0.205	0	1
Leather	0.006	0.078	0	1
Wood production	0.027	0.163	0	1
Paper	0.005	0.071	0	1
Printing and publishing	0.017	0.132	0	1

Table 1. *Cont.*

Variable	Mean	Std. dev.	Min	Max
Refined petroleum	0.001	0.027	0	1
Chemical products	0.014	0.115	0	1
Plastics and rubber	0.021	0.142	0	1
Non-metallic mineral products	0.021	0.144	0	1
Basic metals	0.008	0.086	0	1
Fabricated metal	0.094	0.291	0	1
Machine equipment	0.070	0.255	0	1
Electric machines	0.016	0.127	0	1
Precision instruments	0.006	0.079	0	1
Motor vehicles	0.013	0.112	0	1
Furniture	0.024	0.152	0	1
Recycling	0.001	0.035	0	1
Construction	0.075	0.263	0	1
Motor sales	0.030	0.170	0	1
Wholesale trade	0.063	0.242	0	1
Retail trade	0.194	0.395	0	1
Hotels	0.058	0.235	0	1
Land transport	0.047	0.211	0	1
Computers	0.019	0.135	0	1
Cyprus	0.045	0.278	0	1
Estonia	0.081	0.272	0	1
Greece	0.131	0.337	0	1
Italy	0.156	0.363	0	1
Latvia	0.061	0.240	0	1
Lithuania	0.080	0.271	0	1
Malta	0.053	0.223	0	1
Portugal	0.215	0.410	0	1
Slovakia	0.102	0.302	0	1
Slovenia	0.076	0.265	0	1

4. Results

Given that the data are self-reported, common method variance could bias the estimates due to systematic measurement errors [40]. To check the internal validity of the data, we conducted a Harmon's one-factor test [40]. The test encompasses an explanatory factor analysis of all independent variables by using an unrotated principle component factor analysis. When common method bias is unlikely to occur, the first unrotated factor (i.e., the factor with the largest share of variance) should account for less than 50% of the total variation in other explanatory variables in the model. In our model, the first factor accounts for 6.53% of total variation, which suggests that common method bias raises no great concern in our model. In addition, the Harmon's one-factor test resulted in 26 factors with an eigenvalue greater than 1, which also suggests that common method bias is unlikely to arise in this study, because no single factor emerged during the analysis [41]. The mean variance inflation factor (VIF) is 1.92, which suggests that multicollinearity is unlikely to occur. Econometric results were obtained using Stata statistical software. Most empirical studies that examine various sustainability practices are macroeconomic studies that either use analyse panel data or time series data (e.g., [42–44]. Few microeconomic studies that explore the impact of green management practices on firms' performances apply either a panel data analysis (when a longitudinal data are available [35,45]) or the OLS estimator [1,4] (when a cross-sectional data are available). As our data are cross-sectional, similar to that in Lannelongue et al. [1] and Ma et al. [4], we used the OLS estimator.

The estimated model is shown in Table 2. We can firstly look at the R^2 value, which has reasonably high explanatory influence at 0.504; therefore, over 50.4% of the outcome data can be explained by the model's variables. From Table 2, we can see that the first green management variable, *energy_tax*, representing whether the establishment was subject

to an energy tax or levy, on average will increase labour productivity by 13%, and this is significant at the 1% level of significance ($p < 0.01$). This finding provides support to Hypothesis H1. The next green management indicator in the model is *env_management*, representing if the establishment had an environmental manager in the most recent fiscal year. This is statistically significant at the 1% level ($p < 0.01$), and shows that firms with environmental managers had 11.9% higher labour productivity than establishments without environmental managers. This finding provides support to Hypothesis H2. The variable *customer_reg* shows if any of an establishment's customers are required to have environmental certifications or to adhere to environmental standards as a condition of doing business with said establishment. This variable is not statistically significant at any conventional level, which means that it does not affect labour productivity. This finding does not provide support to H3. The variable *renewable energy* is statistically significant at the 5% level, and shows that firms that use renewable energy have 9.3% higher labour productivity than those who do not. This finding provides support to H4.

Table 2. Regression results.

	Coefficient
Variables	
Energy tax	0.130 ***
	(0.033)
Env. management	0.119 ***
	(0.043)
Customer reg.	0.055
	(0.041)
Renewable energy	0.093 **
	(0.043)
Firm size	−0.724 ***
	(0.031)
Exports	0.261 ***
	(0.033)
Age	0.038 **
	(0.018)
Labour costs	0.766 ***
	(0.025)
Constant	3.357 ***
	(0.254)
Industry and country dummies	Included
Number of obs.	4071
R-squared	0.504

Notes: Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, (source: authors' calculation).

Regarding control variables, Table 2 shows that firm size (*firm_size*) has a negative and significant relationship with labour productivity. Namely, a 1% increase in firm size leads to a 0.72% decrease in labour productivity, and this is statistically significant at the 1% level ($p < 0.01$). Firms that export have 26.1% higher labour productivity than those that do not export. This is highly significant at the 1% level. Furthermore, a 1% increase in firm age is shown to increase labour productivity by 0.038%, and this is statistically significant at the 5% level. Labour costs were also included within the model as a control variable, resulting in a positive significant relationship with labour productivity. Table 2 shows that if labour costs increase by 1%, labour productivity will increase by 0.77%.

5. Discussion

Empirical findings from this study add to the current body of literature on the relationship between green management and firm performance. Empirical results show that three out of four hypotheses find support in the current empirical analysis. With regard to the variable *energy_tax*, which is associated with Hypothesis H1, empirical findings suggest

that establishments that are subject to energy taxes or levies will have higher productivity than those that are not. This could be somewhat due to the fact that firms who are subject to these taxes analyse their production processes, as Delmas and Pekovic [2] discuss. Firms subject to environmental standards do this in order to monitor environmental performance, and this leads to improved innovation, firm efficiency, and therefore productivity. This is an interesting result, as Nishitani et al. [37] argue that if there was to be a positive relationship between a firm's environmental management (in reducing emissions of greenhouse gases) and their economic performance, it would be reasonable to encourage firms to conduct environmental management voluntarily. However, with this result, it appears that indirect regulation could be one of the most effective ways for a firm to improve its productivity, through using environmental management rather than voluntary methods.

Concerning Hypothesis H2, the results also show that those establishments with an environmental manager, employed to address climate change and environmental issues, had increased labour productivity compared to those without an environmental manager. Greenwood et al. [5] argue that within many firms, environmental managers have several roles to fulfil or support, including pollution prevention, sustainable resource use, climate change mitigation and adaptation, and promoting social responsibility. Within such roles, these managers analyse and adapt the operating practices of the firm by trying to eliminate or minimise potential adverse impacts on ecosystems and biodiversity [5]. Furthermore, Greenwood et al. [5] also found that such managers either had a major role or supportive role in providing all workers at all stages of the work experience with access to skill development, training, and opportunities for career advancement. Therefore, bearing these roles in mind, this could be the reason that firms with environmental managers have higher labour productivity than those without, as such managers analyse and change firms' production processes, and they could also enhance employee training and thus their prospects. This result is of particular importance to stakeholders and firm managers, as employing an environmental manager may improve the production process, improve labour productivity for the firm, and may also have some appeal to consumers who care about environmental practices.

With respect to Hypothesis H3, firms that adhere to certain environmental standards as a condition of doing business with the establishment were shown to have higher labour productivity than those that do not do this; however, this result was not statistically significant. With that said, 15% of the sample did require customer certification, therefore the random variation may be too large to have a significant effect. Finally, in relation to Hypothesis H4, firms that use renewable energy have higher productivity than their counterparts. This result suggests two implications. First, the production function in the context of green transition and green economic growth should include energy as an input, as it has a significant effect on productivity. Second, empirical results suggest that firms that reduce their non-renewable energy dependence reap the benefits of higher productivity.

Concerning control variables, the estimated model showed similar results to existing pieces of research. Interestingly, firm size showed a negative relationship with labour productivity, which is similar to the results of Delmas and Pekovic [2]. Although there is a common assumption that larger firms will have higher productivity [1,4], Sohag et al. [43] note that in general, smaller firms will organise their production processes differently than larger firms; therefore, an increase in firm size is initially expected to have a positive effect on productivity levels due to economies of scale. However, when a grows beyond a certain size, diseconomy of scale may have an effect, and could negatively affect productivity within the firm [43]. Upender [46] reports similar results to this; the author showed that the Indian manufacturing sector is capital-intensive and is characterised by decreasing returns to scale. Darnall et al. [47] discuss that there is more flexibility in smaller organisations because they are less committed to existing products and processes that could be hindering productivity. Furthermore, Darnall et al. [47] posit that larger firms can offset stakeholder pressure due to their ability to allocate greater resources to resisting stakeholder pressures through lobbying and litigation. This could provide some justification for firm size having

a negative relationship with productivity, as these larger firms may be more resistant to change and environmental regulation.

As discussed in the results section, exports have a positive and significant effect on labour productivity. This is in line with De Loecker [48] and Delmas and Pekovic [2], with De Loecker [48] also finding that beginning exports causes productivity to be significantly higher than pre-export productivity levels. This relationship is to be expected, with studies showing that exports can further increase the productivity of companies due to the concurrent encouragement of learning and competition [4,48].

Some scholars believe a company's age is an important factor in determining labour productivity [4]. Empirical results from this study appear to have similar results to Ma et al. [4], with firm age having a positive significant effect on labour productivity. This may largely be due to those who have been manufacturing for longer having more efficient processes. These production processes may be subject to fundamental changes thanks to new insights with regard to the production process, or fundamental changes in the production technologies that are used [43].

Additionally, labour costs also have a positive effect on labour productivity. Previous studies have found similar results regarding this, including that of Nishitani et al. [37], which found a positive relationship between the log of wages and firm performance. Lannelongue et al. [1] discussed that the study they carried out did not provide empirical evidence that variation in labour costs is associated with lower pollution, and that this is of great interest to the business world. Therefore, this result is somewhat interesting, as it provides some insight into the relationship between labour costs and productivity, which we found had a positive relationship with green management practices.

6. Conclusions

This study reports the effects of several environmental management practices on labour productivity. As discussed within the literature review and introduction, there is still great debate as to whether such practices have a positive or negative effect on firm performance. However, this model, which used labour productivity as a measure of firm performance and a range of independent and control variables, found there to be a largely positive effect on firm performance that results from using such environmental practices.

Therefore, from the results found within this research there appears to be implications from both a policy point of view and a managerial standpoint. As such, these results yield a lot of significance for future research, as they show that environmental government interventions may actually improve firm performance; this may become an important consideration for governments, particularly in countries with high emissions. Regarding energy taxes, governments should consider either continuing with current energy taxes or levies, or increasing them, as this could increase productivity in companies and reduce the negative effects of companies on the environment. Additionally, a faster switch to the utilization of renewable energy should be encouraged, as firms will not only reduce their non-renewable energy dependency, but also enhance their productivity. Moreover, it could be argued that there was a voluntarily positive relationship between labour productivity and firm performance, as some firms within the sample employed an environmental manager. This could have implications for government interventions, as Nishitani et al. [37] note that if there were benefits, it would be reasonable to expect firms to conduct environmental management voluntarily; thus, government regulation may not be needed in the long run.

Concerning managerial implications, firms should consider the employment of an environmental manager. Such an employee would both reduce the environmental impact of the firm but also improve the firm's performance [5]. Furthermore, as discussed previously in the methodology and discussion sections, there may be several benefits to employees from such managers such as access to skill development, training, and opportunities for career advancement. Furthermore, managers should consider ways to increase the use of renewable energy to speed up firms' green transition and reap the benefits of increased productivity.

Limitations and Suggestions for Future Research

Although this study offers relevant findings, it has some limitations that may serve as suggestions for future research. Firstly, this study analyses cross-sectional data, and thus the reported empirical results are limited in their explanation of the complex relationships and impacts of environmental management on labour productivity. Future studies would benefit from a panel data analysis including controls for unobserved heterogeneity. Secondly, future studies could investigate the impact of green management on environmentally relevant productivity measures, such as output per unit of emissions, output per unit of energy input, emissions-adjusted labour productivity, and environmental protection-adjusted labour productivity [49]. Thirdly, the environmental management measures employed in the current study are binary indicators that are unable to measure the intensity of environmental management and practices in firms. Future studies could use other measures of environmental management, such as ISO14001 certification and the environmental responsibility score [4]. Fourthly, this study does not take into account that some firms may belong to an enterprise group. As the organizational grouping of businesses may have a positive effect on their environmental management as well as their productivity and firm efficiency, future studies could focus on this relevant topic. Finally, our sample is limited to EU countries. Future research could focus on emerging and less-developed economies, and could thus provide comparable empirical evidence on the effects of green management practices on firm performance in these countries.

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