Cultural Diversity as a Driver for Environmental Action: Pollution Reduction Efforts in the EU Countries

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Abstract

Reducing greenhouse gas emissions is now a top priority on the global political agenda. In recent years, the European Union has adopted various policies to protect and enhance our ecosystem. However, policymakers should also take cultural values into account, as understanding cultural values can greatly influence how environmental policies are perceived and implemented locally. As there are few studies examining their impact on pollution abatement in the EU Member States, this paper attempts to fill this gap. Therefore, the objective of the paper is to investigate the relationship between cultural factors and greenhouse gas emissions at the level of the 27 EU member states for the period 1990 – 2019. Our results show that the role of cultural dimensions in reducing pollution in the EU member states can vary according to the specific cultural dimension measured according to Hofstede's methodology. In this context, the power distance index, masculinity, individualism, uncertainty avoidance index, and long-term orientation have a statistically significant and positive influence on the dependent variables used. Our study can be used as a starting point for researchers who want to deepen comprehensive analyses of individuals' behaviour to reduce pollution or for policymakers to develop effective environmental policies.

Keywords: *cultural factors, environmental concerns, pollution, European Union, envi-ronmental policies*

JEL Classification: H52, I25, Q50, Z10

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Introduction

Since the industrial era, the Earth's climate has been changing at a galloping pace, posing a significant challenge to current and especially future generations. In this context, climate change and air pollution have gained increased attention in recent years and have become the main concerns of governments around the world. According to reports published by the Intergovernmental Panel on Climate Change (IPCC), the average annual temperature has risen by 0.6°C causing a range of negative global impacts.

As early as 1995, it was concluded that fossil fuel burning, land use practices and increased livestock farming have greatly increased atmospheric concentrations of greenhouse gases (IPCC, 1995). The same source claims that the global average temperature could rise by 2°C by 2025 and 4°C by 2100 if human activities continue at the same rate. In line with this, environmental protection is high on the global agenda of the world's countries.

Although the anthropogenic nature of global warming is still being debated at the political level, there is scientific agreement that this phenomenon is a reality and needs to be properly addressed to mitigate its disastrous effects on the environment, humanity, and biodiversity.

According to them, natural variability and anthropogenic intervention are the main underlying causes of climate change. In this case, the negative effects generated by global warming can be easily felt and observed through heat waves, floods, increased seasonal variability of weather, and droughts that have occurred worldwide.

Today, the literature on climate change and what needs to be done to mitigate it is booming. In this regard, the Paris Agreement, adopted in 2015 under the United Nations Framework Convention on Climate Change (UNFCCC), which subsequently came into effect on 4 November 2016, represented a new attempt to mitigate climate change and the risks it generates. The Paris Agreement is the first legally binding multilateral instrument, and its main objective is to guide global action to keep the increase in global average temperature well below 2°C above pre-industrial levels. At the EU level, achieving these targets will contribute to the long-term achievement of the necessary process – the development of an efficient and low-emission economy.

The main objective of this paper is to analyse the impact of cultural values on greenhouse gas (GHG) emissions for EU member states. The relationship between these variables was tested with a panel data analysis for the period 1990 – 2019.

With this paper, we aim to highlight the importance of cultural factors in achieving environmental performance in the countries under review. Moral principles, behavior, beliefs and values, which are well ingrained in the national

culture, guide individuals as to what is acceptable and unacceptable behavior (Parboteeah et al., 2012). For example, in individualistically oriented societies, the emphasis is on maximizing personal and family benefits, which could lead to higher resource consumption and consequently CO_2 emissions. Cultural orientation also influences a society's economic priorities and approach to development. In those cultures that take a long-term view, there is a greater tendency to implement sustainable policies to preserve resources for future generations, thus being more receptive to environmental and technological solutions through initiatives to reduce pollution. On the other hand, crops with a short-term orientation may neglect the long-term consequences of their actions, contributing to increased CO_2 emissions and environmental degradation. From this it becomes clear that culture shapes attitudes towards the environment. We therefore believe that understanding how cultural dimensions influence environmental attitudes and behaviours can help policy makers and organizations develop more effective strategies to tackle pollution and promote sustainable practices.

Therefore, this research has three contributions. First, our study focuses on the 27 EU member states over 29 years to capture in a relevant way the environmental protection behaviours of individuals over several generations. At the same time, the study examines the impact of all cultural dimensions on GHG emissions, based on indices measured by Hofstede et al. (2010). A few studies (Park et al., 2007; Onel and Mukherjee, 2014) have examined the relationship between cultural factors and environmental performance with only the first four dimensions (power distance, individualism, masculinity, and uncertainty avoidance index). Another study (Dangelico et al., 2020) also focused on analysing the sixth cultural dimension, but the sample was different. Moreover, Hofstede has collected data from different countries, which allows us to make comparisons between different nations. Secondly, the study includes a detailed analysis of each type of greenhouse gas (carbon dioxide, methane, nitrous oxide and fluorinated gases) to understand their contribution to environmental problems. Third, from an academic point of view, this research helps to understand the cultural factors that have a shaping effect on individuals' behaviour to reduce pollution. Understanding and acknowledging the role that cultural factors play in individuals' behaviour concerning their actions on the environment helps to develop a sustainable environment and better inform public policy.

The paper is structured as follows: in section 1, we discuss cultural dimensions as a key element in reducing pollution and describe the six cultural dimensions we consider in this paper. Section 2 is devoted to the presentation of the data, the sample, and the econometric model. Section 3 presents the empirical results and discussion, and the last section concludes.

1. Literature Review and Hypothesis Development

Climate change and the severity of pollution are the main challenges of the 21st century, and huge efforts are being made to combat them. Collective global action is needed to make the changes necessary to build a sustainable future. As a result, cultural factors influence how individuals, communities and institutions respond to changes and opportunities (Dodor and Rana, 2007) by acting on the different levels at which individuals make decisions.

Studies such as Husted (2005), Park et al. (2007), and Onel and Mukherjee (2014) have analysed and demonstrated that the cultural dimensions made by Hofstede (1980) have a very different impact on environmental sustainability.

Lately, the literature is booming with various issues being analysed on the factors influencing pollution growth and the different measures and policies that should be taken to reduce it. Mohr (1994) argues that scientists have felt the need to link cultural dimensions to ecological knowledge since human perceptions, cognitions, and values directly affect the environment, yet the relationship between human behaviour and the environment is not widely analysed. Peng and Lin (2009) examine the influence of cultural dimensions on environmental performance on a sample of 51 states. The multiple linear regression model was used to investigate these relationships and the empirical results demonstrate that the cultural dimensions (power distance, individualism, masculinity, and uncertainty avoidance index) developed by Hofstede can affect the environmental performance of the countries under analysis. After updating the cultural dimensions, Lahuerta-Otero and González-Bravo (2018) also integrated the impact of long-term orientation on the environmental performance indicator in their analysis. The research was based on 31 countries belonging to the European Environment Agency over the period 2007 – 2013. Using stepwise linear regression, the authors showed that cultural characteristics influence environmental behaviour in various ways.Disli et al. (2016) investigate the relationship between national culture, CO_2 emissions and economic growth in the Environmental Kuznets Curve (EKC). After applying the generalized method of moments (GMM) on a sample of 69 developed and developing countries, the empirical results show that masculinity, power distance and indulgence move the EKC upward and shift the income turning point to the left, while individualism, uncertainty and long-term orientation move the EKC downward and shift the income turning point to the right. More recent analysis by Zaher (2023) also shows that cultural dimensions influence environmental behaviour. Specifically, low power distance and high indulgence lead to stronger environmental sustainability practices, while individualism, masculinity, uncertainty avoidance, and long-term orientation do not significantly impact environmental sustainability practices. In the literature we find many studies that have investigated the direct

correlation between cultural dimensions and different greenhouse gases, but rarely have indirect effects been investigated, such as how these cultural dimensions, as defined by Hofstede, influence spending on education and environmental protection, renewable energy consumption and trade openness. In this context, by integrating such variables, the study can provide us with a deeper understanding of the impact of cultural factors on sustainable behaviors. Such research will not only improve our understanding of these complex relationships, but will also contribute to the development of more effective environmental policies that are aligned with the cultural specificity of each society. According to the results of the above-mentioned studies, it becomes very important to understand people's environmental attitudes and behaviours from a cross-cultural perspective to take personalised steps at the level of each country to reduce pollution. An important point to bear in mind is that although we live in a world that is very different culturally, we are first and foremost citizens of our planet Earth.

Cultural values shape the way society lives (Iorga et al., 2016), with huge potential to bring about the attitudinal changes needed to ensure a healthy and prosperous environment. In this paper, we focus on the definition given by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) which defines the concept of „culture" as „a distinctive set of spiritual, material, intellectual and emotional features that characterise a society, community or social group" (Council of Europe, 2018, p. 70). According to Grierson (2009), the environment urgently requires an improvement in environmental performance and this can only be achieved through cultural change.

This transition to a sustainable environment requires changes in human behaviour values, and attitudes, which will differ from country to country based on the characteristics of national culture. Of course, the different human cultures found globally have different impacts on the environment. As a result, urban and industrial societies have a significant effect on the environment due to the use of huge amounts of resources to fuel their daily activities. In some places, local culture and legislation have emphasized environmental protection, while in other places this has not been a concern. Of course, the results of these policies are often obvious, as statistics show that some areas have lower pollution levels despite industrial activity, while others have similar activity but higher pollution levels.

Our work builds on the six cultural dimensions that have been developed by Hofstede et al. (2010), providing a framework for understanding how cultural values and behaviours can contribute to creating the attitudes needed to ensure a 'green' environment. In 2001, Geert Hofstede conducted a study linking different cultural values to the prioritisation of environmental concerns over economic ones and people's willingness to pay higher prices for environmental protection.

He concluded that countries with lower power distance were more likely to prioritise environmental protection over economic growth, while countries with higher power distance and masculinity were less concerned about environmental issues, with individuals in these countries relying on decisions made by authorities to solve environmental problems.

To establish a direct link between the interaction between cultural dimensions, attitudes and environmental behaviours, Gammoh et al. (2019) conducted a study based on a survey of individual consumers in two societies with totally different cultural norms, namely the United States and India. To test the proposed hypotheses, the authors used SmartPLS. Following the analysis, the authors concluded that a sense of community and collectivism were significantly related to environmental consciousness in both India and the United States.

As there is a multitude of measures taken by governments to combat pollution, we believe that an important aspect to consider is cultural values, as they can be directly linked to a country's environmental efficiency, reducing practices that unnecessarily damage the environment. It should be noted that these six cultural dimensions proposed by Hofstede do not directly address the issue of reducing pollution, but model behaviours that contribute to a sustainable society, and are the key element in the concept of sustainable development.

Before moving on to the part we will present some aspects of each cultural dimension to understand their essence in shaping behaviours that contribute to the development of a sustainable environment.

1.1. Power Distance Index (PDI)

In Hofstede's view, this dimension has been defined as expressing „the extent to which less powerful members of organizations and institutions accept and expect power to be distributed unequally" (Hofstede et al., 2010, p. 94). This is how individuals in a society relate to each other on a hierarchical scale. In societies characterised by a high index of distance from power, the 'key pillars' come down to the centralisation of power and control. It is easy to understand that in these societies, leaders tend to have highly authoritarian attitudes and subordinate individuals are not involved in decision-making. Power distance scores correlate with student-teacher, child-parent, and employee-employer relationships.

On the other hand, when we talk about societies that are characterised by a low distance index, individuals are used to taking part in the decision-making process, feeling more involved in global issues (e.g. environmental issues). Consequently, we propose the following research hypothesis:

Hypothesis 1 (H1): There is a negative relationship between the power distance index and environmental pollution.

1.2. Individualism versus Collectivism

Hofstede (2001) describes individualistic societies as those in which individuals take care of themselves and their families, taking less responsibility for the actions and outcomes of others. Although Lahuerta-Otero and Gonzáles-Bravo (2018) argue that individuals tend to be selfish, we can contradict this claim, as we consider that individualism does not mean being selfish, but it is expected various individual decisions and choices.

In collectivist societies, on the other hand, people are concerned with group members, so shared values prevail over individual opinions. A society's stance on this dimension is reflected in the fact that people's image is defined in terms such as 'we' (Hofstede, 2001). According to the literature, some authors (Parboteeah et al., 2012) believe that in collectivist societies individuals are expected to engage more in sustainable environmental actions and policies because they pursue a common interest. However, other authors (Dodor and Rana, 2007) argue that individualistic societies are more likely to protect the environment. Peng and Lin (2009), and Onel and Mukherjee (2014) empirically analysed the relationship between individualism and environmental performance and their results showed that individualism has a positive influence on environmental performance. Based on the mentioned studies, these aspects fit very well with a metaphor that is often used in physics, individuals in an individualistic society are more like atoms flying in gas, while individuals in collectivistic societies are more like atoms fixed in a crystal. Accordingly, we propose the following research hypothesis:

Hypothesis 2 (H2): There is a negative relationship between individualism and environmental pollution.

1.3. Masculinity versus Femininity

As the name of the dimension suggests, it refers to the distribution of roles between men and women, which is another fundamental characteristic in terms of finding solutions. This dimension is not about individuals, but about expected emotional gender roles. Success, ambition, achievement, and money are male values that prevail in this type of society. In this context, the higher the level of masculinity, the greater the importance individuals attach to these values. Therefore, societies with a low level of masculinity attach more importance to issues such as solidarity, discretion, and quality of life.

Hofstede (2001) argues that in countries with a high level of masculinity, companies are less likely to improve their environmental performance and may even damage the environment to maximise profits. Husted (2005) and Peng and Lin (2009) examined the relationship between masculinity and environmental actions.

They found a negative relationship between the two variables. Similar results were obtained by Parboteeah et al. (2012) on a sample of 33 states from 1999 – 2001 using hierarchical linear modeling. According to the results, we propose the following research hypothesis:

Hypothesis 3 (H3): There is a negative relationship between masculinity and environmental pollution.

1.4. Uncertainty Avoidance Index

This dimension refers to a society's tolerance of ambiguity and uncertainty. Uncertainty avoidance refers to the fear and distrust that individuals have of the unknown. Thus, in societies with a high level of uncertainty avoidance, individuals feel threatened by unknown situations and are constantly looking for solutions to reduce uncertainty and future risks. Considering the environmental problems facing humanity today, individuals are looking for different solutions to combat them and have a healthier environment. In societies with a low risk of uncertainty avoidance, they are more tolerant of risks, approaching uncertain situations with ease.

Based on these theoretical considerations, we believe that companies with higher levels of uncertainty avoidance will give higher priority to reducing environmental risks. Based on these results, we propose the following hypothesis:

Hypothesis 4 (H4): There is a positive relationship between the uncertainty avoidance index and environmental pollution.

1.5. Long-Term Orientation

Originally described as „Pragmatic versus Normative",[1] this cultural dimension deals with change, referring to the link between past actions and current and future challenges. Thrift, learning, perseverance, self-discipline, and honesty are values related to a long-term orientation.

Let's think about this dimension based on an example from the corporate world. A long-term-oriented company will focus on strategies, initiatives, and solutions that will bring long-term benefits, while short-term-oriented companies will focus on strategies that will bring limited-term benefits. Roy and Goll (2014) used the GLOBE study to exploit a country's culture, taking a long-term orientation into account when assessing environmentally sustainable practices. They found that all cultures that are long-term oriented are more willing to implement sustainable practices.

Hypothesis 5 (H5): There is a positive relationship between long-term orientation and environmental pollution.

[1] Pragmatic (long-term) and normative (short-term).

1.6. Indulgence

According to Hofstede et al. (2010), indulgence refers to the good things that happen throughout life. Therefore, in a society with a high level of indulgence, individuals focus on moments of enjoyment and fun, and actions for the environment are not a priority for them. Ismail and Lu (2014) state that in restrictive cultures, the opposite of indulgent ones, there will be more concern for reducing pollution because they control their actions very carefully, keeping a close eye on the long-term repercussions. Gallego-Álvarez and Pucheta-Martinez (2020) obtain similar results. As this dimension is relatively new, studies are limited. Based on these results, we propose the following hypothesis:

Hypothesis 6 (H6): There; is a positive relationship between indulgence and environmental pollution.

2. Data and Methodology

The study aims to analyse the impact of all cultural dimensions on GHG emissions, taking into account carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases (F-gas) at the level of the 27 EU Member States for the period 1990 – 2019. This sample was chosen because they share common lines of action for developing a prosperous and healthy environment. This study used the least squares regression (OLS) model for panel data.

The dependent variables in our models are greenhouse gas emissions (CO_2, CH_4, N_2O, F-gas, respectively total greenhouse gas emissions) from the 27 states, measured in metric tons per capita (see Table 1). The independent variables are cultural factors, namely the power distance index (CF_PDI), individualism-collectivism (CF_IDV), masculinity-femininity (CF_MAS), uncertainty avoidance index (CF_UAI), long-term orientation-short-term orientation (CF_LTOWVS) and indulgence-retention (CF_IVR). The score for each indicator ranges from 0 to 100. We also included a set of control variables in our models to highlight the impact of other economic determinants on pollution abatement. The variables used were selected according to other empirical studies (Lahuerta-Otero and González-Bravo, 2018).

Table 2 shows the descriptive statistics of the variables used in the analysis for the 27 EU countries.

The selected panel data have a total of 757 observations, covering the period 1990 – 2021. The values of the dependent variable (CO_2) range from a maximum of 30.37 metric tons per capita (Luxembourg, 1991) to a minimum of 2.93 metric tons per capita (Latvia, 2000). The mean of this variable is 7.92121 and the standard

deviation is equal to 3.835304. In this context, Figure 1 illustrates the evolution of CO_2 emissions over the period for some countries included in the analysis, reflecting trends and variations.

The mean of this variable is 7.92121 and the standard deviation is equal to 3.835304. For GHG emissions, the values range from a maximum of 32.77 metric tons per capita (Luxembourg, 1991) to a minimum of 4.14 metric tons per capita (Malta). For GHG emissions the average is 9.91379 and the standard deviation is equal to 4.202426.

T a b l e 1

Description of Variables

Variable	Notation	Specifications	Data source
Emissions of CO_2	CO_2	Carbon dioxide emissions (metric tonnes per capita)	Climate Watch
Emissions of CH_4	CH_4	Methane emissions (metric tonnes per capita)	Climate Watch
Emissions of N_2O	N_2O	Nitrous oxide emissions (metric tons per capita)	Climate Watch
Emissions of fluorinated gases	F-gas	Emissions of fluorinated gases (metric tonnes per capita)	Climate Watch
Greenhouse gas emissions	GHG	This indicator measures all greenhouse gas emissions that are generated by carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), including F-gas (F-gas) (metric tons per capita)	Climate Watch
Power Distance Index	CF_PDI	Reflects the distribution of power within a society and the extent to which individuals accept this unequal distribution	HOFSTEDE
Individualism	CF_IDV	It focuses on the degree to which a company individually or collectively consolidates	HOFSTEDE
Masculinity	CF_MAS	Describes the degree to which companies focus on achievement and assertiveness	HOFSTEDE
Uncertainty Avoidance Index	CF_UAI	Relates the extent to which individuals feel threatened by ambiguous situations	HOFSTEDE
Long-term orientation	CF_LTOWVS	Reflects the position of individuals in relation to time	HOFSTEDE
Indulgence	CF_IVR	Reflects how individuals in a society satisfy their desires for moments of joy	HOFSTEDE
Environmental protection expenditure	EPE	Current expenditure on environmental protection, % GDP	Eurostat
Expenditure on education	TGEE_GE	Public expenditure on education, total (% of GDP)	The World Bank
Foreign direct investment	FDI	Foreign direct investment, net inflows % of GDP	The World Bank
Renewable energy	REC	Renewable energy consumption (% of total final energy consumption)	The World Bank
Trade openness	TO	Trade openness (% exports and imports in GDP)	The World Bank
Population growth	GDP_PC	GDP per capita (%)	The World Bank
Urbanisation	U	Urban population (% of the total population)	The World Bank
Financial development	FD	Market capitalization of listed domestic companies (% of GDP)	The World Bank

Source: Author's representation.

T a b l e 2

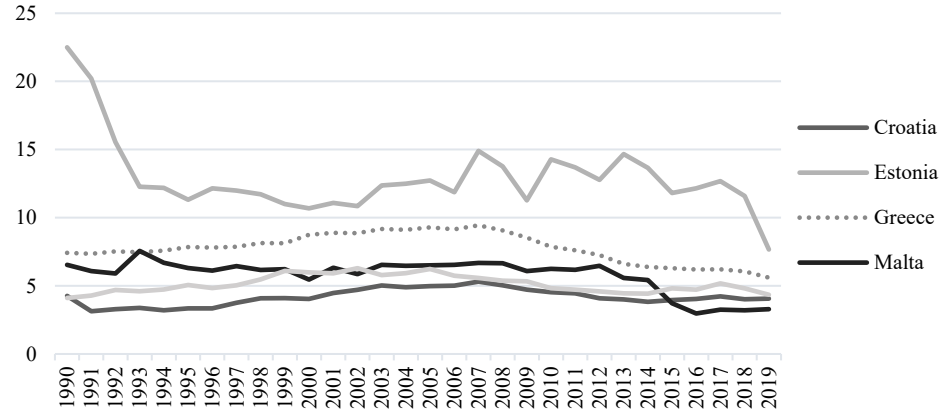
Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
CO_2	757	7.92121	3.835304	2.93	30.37
CH_4	757	1.146333	0.627335	0.43	4.46
N_2O	757	0.704148	0.435815	0.1	2.9
F-gas	757	0.147185	0.125667	0	0.85
GHG	757	9.91379	4.202426	4.14	32.77
CF_PDI	757	53.54487	20.80391	11	104
CF_IDV	757	58.68462	17.93249	27	89
CF_MAS	757	46.39615	24.89043	5	110
CF_UAI	757	72.40128	22.96879	23	112
CF_LTOWVS	757	57.50769	15.46543	24	82
CF_IVR	757	44.24568	19.83741	13	78
EPE	757	8.977778	4.906997	1	23
TGEE_GE	757	231.0679	201.8829	1	611
FDI	757	9.502977	33.28655	–57.5323	449.0809
REC	757	14.67446	11.57136	0	52.88
TO	757	108.9139	61.6353	32.97166	408.362
GDP_PC	757	2.341354	3.643442	–14.4643	23.20087
U	757	71.16734	12.38601	47.915	98.041
FD	757	182.225	180.6102	1	542

Source: Own calculations. See Table 1 for the variables' definitions.

F i g u r e 1

CO_2 Emission Trends, 1990 – 2019, Metric Tons per capita



Source: Author's representation.

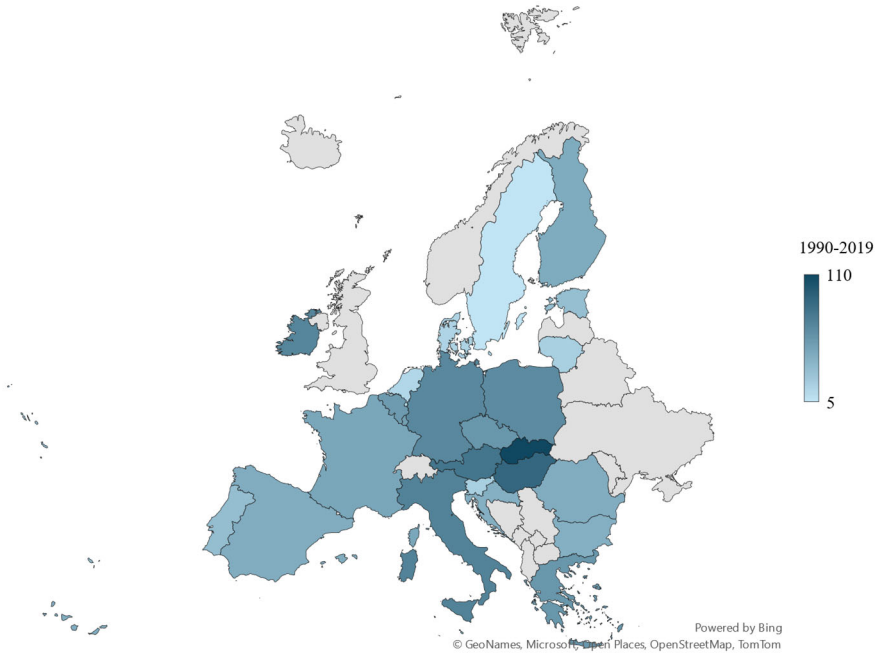
The mean of this variable is 7.92121 and the standard deviation is equal to 3.835304. For GHG emissions, the values range from a maximum of 32.77 metric tons per capita (Luxembourg, 1991) to a minimum of 4.14 metric tons per capita (Malta). For GHG emissions the average is 9.91379 and the standard deviation is equal to 4.202426.

As regards the independent variables, the core of our analysis, we note that they differ significantly between the countries analysed. In this case, a significant

difference is indicated by the variable CF_MAS, which reaches a maximum score of 110 in Slovakia over the whole period analysed and a minimum score of 5 in Sweden over the same period. At the opposite end of the scale is the CF_LTOWVS indicator, where score ranges from a high of 82 for both Belgium and Lithuania over the whole period to a low of 24 for Ireland.

Variations in masculinity, an index that emphasizes the acquisition of wealth, ambition can be analysed in the adjacent figure.

F i g u r e 2
Variations in the Masculinity Index



Source: Author's representation.

First, we conducted a correlation analysis (see Table 3) between GHG emissions, taking into account each gas that generates negative environmental effects (CO_2, CH_4, N_2O, and F-gas), cultural factors, and economic variables (not reported here to save space, but available upon request). It should be noted that there is a positive and significant correlation between the dependent variables (CO_2, CH_4, N_2O, F-gas, and GHG), which is to be expected, but they will be used sequentially in our models. We also find the same situation for cultural factors, but as in the other circumstances, they are used sequentially in the models. Since none of the pairwise correlation values in the sample under analysis exceed the critical value of 0.7, and the correlation between them is moderate, we judge that multicollinearity is unlikely to be a problem in our models.

Table 3

Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
CO_2 (1)	1.00																		
CH_4 (2)	0.25	1.00																	
N_2O (3)	0.21	0.88	1.00																
F-gas (4)	0.00	0.00	–0.04	1.00															
GHG (5)	0.95	0.50	0.46	0.03	1.00														
CF_PDI (6)	–0.25	–0.31	–0.36	–0.07	–0.32	1.00													
CF_IDV (7)	0.27	0.12	0.26	–0.01	0.30	–0.51	1.00												
CF_MAS (8)	0.10	0.04	–0.08	–0.01	0.09	0.22	0.09	1.00											
CF_UAI (9)	–0.19	–0.38	–0.44	0.17	–0.28	0.56	–0.55	0.13	1.00										
CF_LTOWVS (10)	0.10	–0.36	–0.20	–0.13	0.00	0.19	0.16	0.02	0.02	1.00									
CF_IVR (11)	0.30	0.19	0.12	0.29	0.33	–0.52	0.42	–0.08	–0.40	–0.37	1.00								
EPE (12)	0.03	–0.14	–0.23	0.34	–0.00	0.12	–0.00	0.05	0.09	0.16	0.03	1.00							
TGEE_GE (13)	–0.07	0.00	0.01	0.14	–0.06	0.00	0.07	0.05	–0.15	0.11	–0.11	0.20	1.00						
FDI (14)	0.04	–0.01	–0.05	0.04	0.03	–0.02	0.04	–0.00	0.05	–0.03	0.13	0.24	–0.03	1.00					
REC (15)	–0.35	–0.22	–0.03	–0.04	–0.35	–0.15	–0.14	–0.41	–0.12	0.04	–0.09	–0.21	0.10	–0.17	1.00				
TO (16)	0.35	0.05	0.04	0.04	0.33	–0.09	0.08	0.07	–0.06	0.13	0.15	0.34	0.08	0.31	–0.21	1.00			
GDP_PC (17)	–0.07	0.08	0.15	–0.13	–0.03	0.03	–0.02	–0.01	–0.05	0.05	–0.17	–0.00	0.02	0.05	0.00	0.12	1.00		
U (18)	0.33	–0.15	–0.08	0.18	0.26	–0.27	0.51	–0.25	–0.09	0.18	0.51	0.19	–0.00	0.20	–0.14	0.30	–0.14	1.00	
FD (19)	0.11	0.04	–0.05	0.25	0.10	0.03	0.11	0.13	0.01	–0.15	0.32	0.27	–0.02	0.15	–0.30	0.02	–0.03	0.16	1.00

Source: Own calculations. See Table 1 for the variables' definitions.

3. Empirical Results and Discussion

Using the Ordinary Least Squares (OLS) regression method, the following section presents the empirical results obtained, which highlight the relevance of investigating the correlation between cultural values and GHG emissions. In this context, Table 4 presents the empirical results using the level of CO_2 emissions as the dependent variable.

T a b l e 4

Regression Results – Dependent Variable CO_2

	I	II	III	IV	V	VI
CF_PDI	–0.0333*** (0.0052)					
CF_IDV		0.0239*** (0.0068)				
CF_MAS			0.0046 (0.0050)			
CF_UAI				–0.0267*** (0.0044)		
CF_LTOWVS					0.0163** (0.0070)	
CF_IVR						0.0166*** (0.0062)
EPE	–0.0779*** (0.0249)	–0.0926*** (0.0253)	–0.1044*** (0.0252)	–0.0829*** (0.0249)	–0.1157*** (0.0255)	–0.0727*** (0.0245)
TGEE_GE	–0.0008 (0.0005)	–0.0010* (0.0005)	–0.0008 (0.0005)	–0.0013** (0.0005)	–0.0008 (0.0005)	–0.0006 (0.0005)
FDI	–0.0131*** (0.0038)	–0.0124*** (0.0039)	–0.0128*** (0.0039)	–0.0117*** (0.0038)	–0.0120*** (0.0039)	–0.0132*** (0.0031)
REC	–0.0909*** (0.0096)	–0.0755*** (0.0097)	–0.0753*** (0.0108)	–0.0866*** (0.0095)	–0.0806*** (0.0096)	–0.0728*** (0.0093)
TO	0.0156*** (0.0019)	0.0173*** (0.0019)	0.0165*** (0.0019)	0.0156*** (0.0019)	0.0166*** (0.0019)	0.0154*** (0.0019)
GDP_PC	–0.0623** (0.0283)	–0.0713** (0.0289)	–0.0613** (0.0292)	–0.0732** (0.0285)	–0.0690** (0.0291)	–0.0540* (0.0283)
U	0.0424*** (0.0090)	0.0400*** (0.0104)	0.0626*** (0.0095)	0.0534*** (0.0087)	0.0550*** (0.0090)	0.0494*** (0.0096)
FD	0.0005 (0.0006)	0.0005 (0.0006)	0.0006 (0.0006)	0.0004 (0.0006)	0.0009 (0.0006)	0.0004 (0.0006)
R-squared	0.3299	0.3031	0.2919	0.3250	0.2963	0.2862
N. of observations	727	727	727	727	727	757

Notes: * p < .10; ** p < .05; *** p < .01. Values in parentheses represent standard errors. See Table 1 for the variables' definitions.

Source: Own calculations.

For the power distance index (CF_PDI), used as an independent variable (model I) we can observe that the coefficient β is statistically significant at 1%, having a negative value. This indicates that there is an inverse relationship between the two variables, which means that increasing the power distance index by one unit leads to a decrease of 0.0333 units in carbon dioxide emissions. The result

obtained was not in line with our hypothesis as it is in contrast to previous studies. For example, Husted (2005) states that companies with higher power distance will be less able to address environmental issues, thus leading to environmental neglect. Moreover, Gallego-Álvarez and Pucheta-Martinez (2020) examine how cultural factors affect environmental disclosure by firms. The analysis was based on companies in 28 countries with 2004 – 2015 as the period of analysis. The authors found that companies operating in a society with a high distance index disclose less information about environmental issues.

In the case of the individualism variable (model II) a positive and significant result is observed indicating that an increase in individualism by one unit leads to an increase of 0.0084 units in CO_2 emissions. The result obtained is in line with our hypothesis, given that individualistic societies are oriented on the welfare of oneself and one's family, which leads to a lack of collective action to address various issues. On the contrary, in collectivist societies Hofstede et al. (2010) argue that individuals think at the group level, thus having much stronger ties to society. As individualistic societies place a high priority on profit and promote the purchase of goods in large quantities, they contribute to environmental degradation precisely through this pattern of overconsumption. There is also a positive relationship between masculinity (model III) and CO_2 emissions. Hofstede (2001) and Husted (2005) argue that masculine societies focus on career development and material success, and are rather harsh cultures that do not emphasise environmental quality. At the same time, Lahuerta-Otero and González-Bravo (2018) mention in their work that these cultures have a lower perception of future risks (e.g., environmental risks) because they are very much oriented towards achieving their own goals. Our results are also consistent with other studies in the literature, such as Roy and Goll (2014).

The uncertainty avoidance index (model IV) has an inverse and negative relationship with carbon dioxide emissions. A one-unit increase in the uncertainty avoidance index leads to a 0.0276 unit decrease in carbon dioxide. This is justified by the fact that companies with a higher uncertainty avoidance index score will be more likely to take measures to minimise the negative effects of pollution. Societies with a high index will be more likely to protect the environment to provide themselves with the best possible living conditions (e.g. health care), thus avoiding the unknown effects that climate change may cause. Peng and Lin (2009), and Onel and Mukherjee (2014) obtained similar results. Analysing the interdependence between long-term orientation (model V) and CO_2, respectively between indulgence (model VI) and CO_2, our results show a positive and significant relationship. In the case of long-term oriented crops, our result is not in line with the literature, because according to some studies (Hofstede, 2001) these crops will develop

different strategies, goals, and initiatives that will bring them long-term benefits, as they attach significant importance to future events. Long-term-oriented societies also attach significant importance to education. Therefore, they understand the seriousness of environmental problems, promote responsible behaviour and encourage individuals to take action to reduce environmental pollution. As for indulgence, the result is justified by the fact that individuals place a very high value on leisure time, personal well-being, entertainment, and indulgence, thus ignoring environmental concerns. At the opposite pole (i.e. restrictive cultures), individuals will be more likely to undertake environmental activities that lead to carbon dioxide emission reductions. Ismail and Lu (2014), and Gallego-Álvarez and Pucheta-Martinez (2020), respectively, have found similar results.

At the same time, we can see that foreign direct investment (FDI) leads to reduced CO_2 emissions, resulting in a cleaner and more prosperous environment. In a world where environmental challenges are becoming more and more acute, FDI is emerging as an essential tool to promote sustainable development. A fundamental aspect of FDI's positive environmental impact is its ability to transfer green technologies (Ren et al., 2024). Many foreign companies are investing in innovative solutions that significantly reduce GHG emissions. These less material-intensive technologies offer effective solutions to reduce negative impacts on local ecosystems. For example, investments in renewable energy, such as solar and wind, not only support the transition to a cleaner energy mix but also promote energy independence in host countries. In addition, FDI can stimulate increased energy efficiency and the use of renewable energy sources. Infrastructure and urban development projects financed by foreign investors can lead to improvements in public transportation systems and waste management, reducing reliance on polluting solutions. Leitão (2024), Ren et al. (2024), and Uddin et al. (2023) have obtained similar results. At the same time, these issues can be observed in terms of the negative relationship between renewable energy consumption and CO_2 emissions. Replacing traditional energy sources with renewable ones can significantly reduce the amount of CO_2 emissions emitted into the atmosphere (EIA, 2024).

Moreover, the models presented highlight that trade openness (TO) contributes to increased CO_2 emissions. Trade liberalization fosters faster growth of the global economy through increased trade volumes and income, but this upward trend comes with its own set of environmental repercussions (Wang and Zhang, 2021).

Protecting the environment is a defining public policy concern of the modern era (Beeson, 2010) and for this reason, researchers have widely investigated the ways in which TO influences the environment. In this context, empirical results support the Pollution Haven Hypothesis (PHH), according to which polluting industries will move their operations to jurisdictions with less stringent environmental regulations.

Table 5 presents the results of the second model, where CH_4 emissions are used as the dependent variable.

T a b l e 5

Regression Results – Dependent Variable CH_4

	I	II	III	IV	V	VI
CF_PDI	–0.0133*** (0.0010)					
CF_IDV		0.0084*** (0.0015)				
CF_MAS			–0.0047*** (0.0011)			
CF_UAI				–0.0116*** (0.0009)		
CF_LTOWVS					–0.0140*** (0.0014)	
CF_IVR						0.0091*** (0.0013)
EPE	–0.0212*** (0.0050)	–0.0277*** (0.0054)	–0.0334*** (0.0054)	–0.0224*** (0.0050)	–0.0236*** (0.0052)	–0.0147*** (0.0053)
TGEE_GE	0.0002** (0.0001)	0.0001 (0.0001)	0.0003** (0.0001)	–0.0000 (0.0001)	0.0003*** (0.0001)	0.0002* (0.0001)
FDI	–0.0005 (0.0008)	–0.0002 (0.0008)	–0.0005 (0.0008)	0.0002 (0.0008)	–0.0011 (0.0008)	–0.0021*** (0.0007)
REC	–0.0190*** (0.0019)	–0.0130*** (0.0021)	–0.0190*** (0.0023)	–0.0175*** (0.0019)	–0.0139*** (0.0020)	–0.0116*** (0.0020)
TO	0.0008** (0.0004)	0.0015*** (0.0004)	0.0015*** (0.0004)	0.0008** (0.0004)	0.0014*** (0.0004)	0.0008** (0.0004)
GDP_PC	0.0090 (0.0057)	0.0057 (0.0062)	0.0059 (0.0063)	0.0043 (0.0057)	0.0129** (0.0060)	0.0154** (0.0061)
U	–0.0165*** (0.0018)	–0.0166*** (0.0022)	–0.0131*** (0.0020)	–0.0123*** (0.0017)	–0.0061*** (0.0019)	–0.0149*** (0.0021)
FD	0.0002* (0.0001)	0.0002 (0.0001)	0.0003** (0.0001)	0.0002 (0.0001)	–0.0000 (0.0001)	0.0001 (0.0001)
R-squared	0.2969	0.1754	0.1596	0.3026	0.2367	0.1563
N. of observations	727	727	727	727	727	757

Notes: * p < .10; ** p < .05; *** p < .01. Values in parentheses represent standard errors. See Table 1 for the variables' definitions.

Source: Own calculations.

In the case of the power distance index (model I), individualism (model II), uncertainty avoidance index (model IV), and indulgence (model VI) the results maintain their trend. The two variables generate a decrease in the degree of pollution. The results are consistent with other studies in the literature (Husted, 2005; Peng and Lin, 2009; Roy and Goll, 2014). The novelty of this model is revealed in the variables masculinity (model III) and long-term orientation (model V) concerning methane emissions as the results reveal an inverse and significant relationship. Although it is the contract of studies in the literature, the masculinity index (model III), according to our results, generates a reduction in pollution levels. Hollensen and Arteaga (2010), Gupta and McIver (2016), and Pelau and Pop (2018), respectively, demonstrate that a society with a high masculinity score leads to

environmentally harmful behaviours. A possible explanation, in this case, would be due to behaviours that prioritize their desires. Given the defining characteristics of this cultural value, even within societies with a high masculinity score, individuals may adopt responsible attitudes towards the environment and take various initiatives to help reduce pollution. However, we believe that engaging in pollution reduction are tasks that should only be undertaken by societies with lower masculinity scores. Behaviours, as well as attitudes of males and females, may vary depending on education and awareness of the seriousness of pollution problems.

However, there are also studies showing that societies with a high degree of masculinity can have attitudes and behaviours that lead to environmental improvement (Chwialkowska et al., 2020). The results of these studies differ because different samples were used, including different variables, and the results from one sample cannot be generalised to other countries that were not analysed.

Between long-term orientation (model V) and CH_4, there is a negative relationship with an influence on methane emission reduction. Societies that move more towards long-term orientation are more pragmatic, which leads to higher environmental performance, as individuals encourage various educational efforts as a way of preparing for the future. A long-term perspective is needed to find effective and sustainable solutions to environmental problems. Roy and Goll (2014) and Pelau and Pop (2018) argue that societies with a long-term orientation sacrifice present benefits for the sake of their future goals.

The results obtained for the robustness checks (dependent variables nitrous oxide emissions and fluorinated gases) are not reported here to save space, but they are available upon request. They provide additional evidence for the results presented in Table 1.

Table 6 shows the results of the last model, applying as a dependent variable the total GHG emissions of the sample chosen for analysis. We can see that throughout the analyses performed, for the power distance index (model I) and the indulgence index (model VI), the results maintained their trend.

Regarding the control variables, we observe a negative relationship between environmental protection expenditure and the six independent variables. Environmental spending is crucial to addressing environmental problems, promoting sustainable development, and protecting the planet for future generations. By investing in renewable energy, sustainable infrastructure, and sustainable transport countries can contribute to reducing GHG emissions. While spending on environmental protection plays a significant role in reducing pollution, we believe it needs to be accompanied by various measures (effective regulation, education on climate change, and public awareness of the seriousness of the current situation) to be more effective. We also see the same situation with renewable energy consumption,

which leads to a reduction in GHG emissions. This is justified by the fact that renewable energy is a key strategy to reduce pollution. Thus, by increasing the share of renewable energy in the global energy mix, all countries can significantly reduce their dependence on fossil fuels, contributing to a healthier environment and a prosperous future.

T a b l e 6

Regression Results – Dependent Variable GHG

	I	II	III	IV	V	VI
CF_PDI	–0.0560*** (0.0057)					
CF_IDV		0.0422*** (0.0077)				
CF_MAS			–0.0032 (0.0057)			
CF_UAI				–0.0462*** (0.0049)		
CF_LTOWVS					–0.0040 (0.0081)	
CF_IVR						0.0312*** (0.0071)
EPE	–0.1105*** (0.0276)	–0.1342*** (0.0287)	–0.1579*** (0.0290)	–0.1178*** (0.0277)	–0.1546*** (0.0294)	–0.0964*** (0.0282)
TGEE_GE	–0.0004 (0.0006)	–0.0008 (0.0006)	–0.0003 (0.0006)	–0.0012** (0.0006)	–0.0003 (0.0006)	–0.0002 (0.0006)
FDI	–0.0143*** (0.0042)	–0.0131*** (0.0044)	–0.0141*** (0.0045)	–0.0119*** (0.0043)	–0.0142*** (0.0045)	–0.0167*** (0.0036)
REC	–0.1163*** (0.0106)	–0.0900*** (0.0110)	–0.1006*** (0.0124)	–0.1094*** (0.0106)	–0.0974*** (0.0111)	–0.0857*** (0.0107)
TO	0.0169*** (0.0021)	0.0197*** (0.0022)	0.0189*** (0.0022)	0.0168*** (0.0021)	0.0188*** (0.0022)	0.0167*** (0.0022)
GDP_PC	–0.0378 (0.0314)	–0.0536 (0.0328)	–0.0419 (0.0336)	–0.0565* (0.0316)	–0.0389 (0.0335)	–0.0199 (0.0325)
U	0.0211** (0.0100)	0.0155 (0.0118)	0.0472*** (0.0110)	0.0393*** (0.0097)	0.0505*** (0.0104)	0.0312*** (0.0111)
FD	0.0009 (0.0007)	0.0008 (0.0007)	0.0010 (0.0007)	0.0006 (0.0007)	0.0009 (0.0007)	0.0005 (0.0007)
R-squared	0.3523	0.2952	0.2661	0.3458	0.2660	0.2646
N. of observations	727	727	727	727	727	757

Notes: * p < .10; ** p < .05; *** p < .01. Values in parentheses represent standard errors. See Table 1 for the variables' definitions.

Source: Own calculations.

Conclusions

In this study we examined the impact of cultural factors on pollution abatement in European Union countries. Using panel data estimation, we empirically explored how cultural values contribute to shaping attitudes and behaviours on environmental issues. Empirical results show that cultural values significantly influence individuals' behaviour and attitudes toward the environment.

The most important and influential factor in our analyses was the power distance index (CF_PDI) which had a statistically significant effect on all dependent variables. The result is in contrast with Gupta and McIver (2016). In this context, we demonstrate that even companies with a high power distance index can contribute to environmental improvement by implementing different measures. Individuals in these societies can more easily collaborate with members of certain sectors, thus helping to develop effective solutions to reduce the negative effects of climate change. Moreover, in these societies, policymakers play a key role in implementing stricter emission reduction regulations, especially in critical sectors such as energy, transportation and construction. At the same time, policymakers can provide fiscal incentives for companies to adopt green technologies, thereby contributing to improving the environment. Looking at the countries in our sample, this is observed in countries such as the Slovak Republic, Romania and Bulgaria.

Long-term orientation was found to be the second most influential variable in the analyses. In societies with a high level of long-term orientation, individuals are particularly concerned about the environment and prioritize sustainable practices. Long-term orientation is a fundamental element of the concept of sustainable development (European Commission, 2019). Empirical results linking cultural factors to pollution reduction also point to two other cultural values that influence behaviours and attitudes towards environmental issues, namely masculinity and uncertainty avoidance index. Societies with a higher degree of masculinity, as characterised by Hofstede, can stimulate the development of ecological solutions that help improve environmental quality. In parallel, high uncertainty avoidance leads communities to adopt more stringent environmental regulations supporting the transition towards a sustainable society. In the case of the result for the individualism variable, it shows a significant influence on fluorinated gases. We justify this result by the fact that when individuals become more aware that they can make a difference, they adopt attitudes that lead to reduced pollution. In these societies, citizens tend to be more environmentally conscious, which motivates them to adopt sustainable behaviors. Studies suggest that in societies with a higher level of individualism, they are more creative and often rely on quality (Nayeen and Casigy, 2012). Therefore, citizens are more likely to invest in green technologies and participate in conservation initiatives.

Throughout the analyses, our results highlight the presence of five cultural values (power distance index, individualism, masculinity, uncertainty avoidance index, and long-term orientation) that influence pollution reduction. According to them, national cultural values play a significant role in determining behaviours and attitudes toward environmental issues. A society based on values such as caring for nature and environmental responsibility can make a significant difference in reducing pollution and protecting the planet for future generations.

Limits and Future Research

Our study has some limitations that need to be acknowledged. One drawback of the research results from the limitation of the investigation to the level of EU Member States only and the lack of complete data for some countries and relatively short periods. By limiting the sample to this one, there is a possibility that the results we obtained may not be attributable to other countries that were not included in the analysis. Therefore, as future research directions, we propose to extend the analysis with data for non-EU countries.

In this context, our study was based on Hofstede's cultural factors, but nine other cultural factors in the literature could lead to a study that explores all these dimensions. Besides that, the addition of new variables such as prosocial behaviour provided by Gallup would make a valuable contribution to the literature.

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