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Comparative Politics of International Environmental Agreements and the EU

Abstract. *This paper considers the long-standing debate in the field of leaders and laggards of environmental policy in Europe. Although there exists a large body of literature on the subject, previous studies reveal mixed results due to methodological limitations and operationalisation issues, leading to a lack of empirical evidence. In this paper, we propose an empirical strategy to rank the environmental policy performance of EU Member States based on the 'commitment' to international environmental treaties and the 'difficulty' of their treaty collection. We use a multilevel partial credit model from the Rasch family of item response models. We compare the descriptive and explanatory models to examine the impact of country-specific characteristics on country ranking. The results suggest that well-known environmental leaders maintain consistent performance over time. However, some of the so-called laggards have fared better after considering country-specific factors, suggesting that the methodology used to assess performance is crucial in evaluating the progress achieved by the Member States. Our results provide a transparent ranking of the Member States which is necessary to develop sound policies and legal rules for environmental protection.*

Keywords: *item response models, multilateral environmental agreements, environmental policy, ranking, democracy.*

JEL Classification: F53, Q5, O57, P16.

1. Introduction

The post-World War II period was an era of economic expansion driven by increasing levels of economic activity and international trade. However, these economic activities have generated a wide range of global environmental problems, including greenhouse gas emissions resulting from the production and transportation of goods, overuse of energy, and depletion of natural resources. Due to the transboundary nature of environmental problems, countries must take integrated action at both national and international levels.

Multilateral environmental agreements (MEAs) are widely recognised instruments of international environmental law that facilitate collaboration on environmental issues and address global environmental problems. To date, approximately 1300 multilateral and 2200 bilateral agreements have been signed to protect the environment and address various environmental issues such as pollution,

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freshwater resources, habitat preservation, and species conservation (Mitchell 2002-2020).

One of the most influential global actors in international environmental politics is the European Union (EU). The EU has made significant contributions to the Convention on Biological Diversity and has played a pivotal role in the negotiations on the Cartagena and Nagoya Protocols. Additionally, the EU has played a crucial role in the development of the 2030 Agenda for Sustainable Development and has made significant progress toward achieving the Sustainable Development Goals. In 2019, the European Commission introduced the European Green Deal, which aims to transform the EU into the first climate-neutral continent. This initiative highlights the EU's commitment to addressing environmental challenges and pursuing sustainable development.

Environmental policy is an area of shared competence between the EU and its Member States. The EU itself is a party to many international environmental agreements at sub-regional, regional, and global levels. However, it is important to note that when the EU signs and ratifies an international environmental agreement, it also needs to be ratified by the Member States. One should remember that MEA membership is voluntary and supranational institutions cannot impose binding decisions on the participating states. In this context, there are variations among Member States regarding their interest and commitment to international collaboration in the field of the environment. Some governments are more proactive and enthusiastic about protecting the environment, while others may take advantage of the positive externalities created by other countries without bearing the associated costs. Some Member States adopt stricter environmental policies and participate in a larger number of international environmental agreements, while others do not.

There is a broad literature discussing why some countries are more willing to engage in international agreements. However, before examining the underlying reasons, it is essential to calculate the actual environmental policy performance of the countries. Once the environmental policy performances are calculated, it would be more appropriate to compare the performances of countries and investigate the factors underlying these differences. This paper aims to calculate and compare the environmental policy performances of countries, taking into account the international environmental agreements they have ratified.

Several attempts have been made in the environmental policy literature, including within the EU Member States, to measure environmental policy performance. One of the most comprehensive approaches is the Environmental Performance Index (EPI), which provides statistics on a comparable cross-country basis using several indicators that cover a wide range of policy targets (Emerson et al., 2010). Environmental Policy Stringency (EPS) is another well-known composite index based on various environmental policy instruments, specifically those related to climate change and air pollution (Botta and Koźluk, 2014). It is important to note that these indicators encompass a broader definition of environmental policy performance, including output and outcome variables such as emission levels, emission trends, national targets, and more. Although these indicators offer a useful overview of environmental performance, they provide limited information regarding a Member State's commitment to environmental agreements or its role in international environmental governance.

Recchia (2002) is a pioneering study that aims to measure the environmental policy performance of nation states, taking into consideration their participation in international environmental cooperation. The author presents a comparative analysis of the ratification of 15 environmental treaties by 19 democratic states and ranks countries based on their participation performance. The author assesses country performances by examining their signature and ratification statuses, placing greater emphasis on the latter.

The concept of difficulty encompasses the diversity and comprehensiveness of the treaty portfolio. Thus, the methodology employed in this paper incorporates a ranking system that rewards countries for their sustained and diverse participation in a wide range of environmental agreements, which encompasses various environmental issues. The primary objective of this ranking system is to provide incentives and recognition to countries that actively address multiple environmental problems over an extended period. Furthermore, it is worth noting that our dataset is considerably larger and encompasses a wider range of environmental treaties. It is important to acknowledge the dynamic nature of treaty ratification, where a Member State may choose to ratify a treaty immediately or after several years, and may also withdraw from a previously ratified one. Hence, this paper adopts a panel setting that accounts for year-to-year fluctuations in ranks.

Lastly, nation states have diverse political legacies, economic conditions, economic and political institutions, and geographical characteristics. Neglecting these initial conditions while measuring the performance of countries in environmental agreements and international environmental cooperation undermines the reliability of the results and can lead to biased outcomes. In this study, the methodology considers the initial conditions when assessing countries' performance, resulting in more comparable, generalisable, and reliable findings. To the best of our knowledge, this study represents the first systematic examination and ranking of treaty ratification performances among EU Member States.

2. Methodology

2.1 Statistical Method and the Model

This section elucidates the rationale behind the utilisation of the Item Response Theory (IRT) in ranking EU Member States based on their participation in MEAs. IRT models have gained significant popularity in the social sciences, particularly in educational and psychological studies, where the measurement of latent traits such as the respondents' abilities, attitudes, or performances is crucial. Since a latent trait is not directly observable, IRT models provide statistical tools to measure the amount of ‘a latent trait’. In the context of assessing respondents' abilities using a set of questions or items, IRT models measure the interaction between the subject’s ability and the item-level difficulty (Lord, 1980). The probability of a true answer is an increasing function of the respondent's ability and a decreasing function of the item-level difficulty.

Among several IRT models, the choice of a particular model depends on several criteria. In general, IRT models can be categorised into two groups based on the number of item response categories: binary models and polytomous models. Binary models are used when there are only two response options, while polytomous models are suitable for situations with more than two response categories. The commonly used polytomous IRT models include the Rating Scale Model (RSM), the Partial Credit Model (PCM), and the Graded Response Model (GRM). The RSM assumes that all items share the same rating scale, where the distance between thresholds is constant across items, resembling Likert-style items. In contrast, the PCM allows each item to have its own rating scale, where the distances between thresholds may vary.

According to Galeotti et al. (2018), this study employs a multilevel PCM, which is a multilevel model with a hierarchical data structure. This particular model is also known as a three-level random intercept model and is formulated as described by Bacci and Caviezel (2011):

$$P(y_{ijh} = m \big| \theta_{0jh}, \theta_{00h}) = \frac{exp\left[\sum_{k=0}^{m} \lambda_i(\theta_{0jh} + \theta_{00h} - (\beta_i + \tau_{ik}))\right]}{1 + \sum_{l=1}^{M-1} exp\left[\sum_{k=0}^{l} \lambda_i(\theta_{0jh} + \theta_{00h} - (\beta_i + \tau_{ik}))\right]} \qquad (1)$$

where y_{ijh} represents the response to item $i(i = 1, \ldots\ldots, I)$ for person $j(j = 0, \ldots\ldots, n)$ from cluster $h(h = 0, \ldots\ldots, H)$. The item difficulties are denoted by β_i, while τ_{ik} indicates the threshold difficulties. The discriminant parameter λ_i reflects the discriminant power of the i^th item. Additionally, θ_{0jh} and 0_{00h} represent normally distributed random effects at the second and third levels, respectively.

Within the framework of Galeotti et al. (2018), the items in the model correspond to environmental agreements, and the subjects correspond to the EU Member States. Therefore, the structure of the multilevel PCM is as follows: environmental agreement as items (first level), years as the second level, and the EU Member States as subjects (three-level). Consequently, y_{ijh} represents the score on the ratification of environmental treaties $i(i = 1, \ldots\ldots, I)$ for year $j(j = 0, \ldots\ldots, n)$ and country $h(h = 0, \ldots\ldots, H)$. The second-level residual (θ_{0jh}) indicates the deviation of the latent variable θ for a given time and country from the average value of cluster h. Essentially, it allows us to assess the individual performance of a country over time. On the other side, the third level residual (θ_{00h}) enables the ranking of countries based on the mean level of the latent variable. Therefore, we will utilise the third-level residuals to compare the treaty ratification of EU Member States based on their commitment and the difficulty of treaty collection (Bacci and Caviezel, 2011; Galeotti et al. 2018).

Lastly, the multilevel PCM with a latent regression offers a convenient approach to analyse the effects of initial conditions on country performance. This is particularly important because these characteristics can potentially lead to significant changes in country rankings. Building on the work of De Boeck et al. (2004) and Galeotti et al. (2018), the descriptive multilevel PCM described above is augmented with two latent regressions at the second and third levels. For a vector of covariates $\boldsymbol{X}_{h,}$ the third level residual (θ_{00h}) is transformed as $\theta_{00h} = X'_h\,\gamma + \epsilon_{00h}$. Similarly, for a vector of covariates $\boldsymbol{Z}_{jh}$, the second level residual (θ_{0jh}) is transformed as $\theta_{0jh} = Z'_{jh}\,\gamma + \epsilon_{0jh}$ in equation (1). Therefore, the explanatory PCM with country covariates allows for the examination of the impact of country-specific characteristics on ranking.

2.2 Data and Descriptive Analysis of MEA Participation

In this study, multilateral environmental agreements (MEAs) are the focus, specifically those that involve the participation of at least three countries. The data set does not cover amendments and annexes to prevent inflation in the number of agreements, which are generally (but not always) minor modifications of original treaties. The data comprises EU Member States from 1995 to 2016 and is obtained from the IEA Database (Mitchell, 2002-2020).

To ensure compatibility with the model structure, only agreements that are open for signature by all Member States are included, while agreements linked to a limited number of countries are excluded. Consequently, a total of 94 agreements and protocols are considered. These agreements fall into various environmental target categories, namely, freshwater resources, ocean, habitat, nature, pollution, and species. Given the relatively low number of agreements in the freshwater resources and ocean categories, they are merged into a single category referred to as freshwater-ocean throughout the remainder of this paper.

The signature of an agreement represents the initial step taken by a country towards ratification, which is the legally binding act of committing to a treaty. In this paper, the focus is on the ratification status, as it indicates the level of commitment. To assess the ratification status of each country, a binary variable is created for each agreement, indicating whether the country has ratified it or not. Additionally, the score variables are generated by summing up the number of agreements ratified by a country for each target category in each year. As a result, there are five score variables corresponding to the five environmental targets for each country. To classify countries based on their ratification levels, quartiles are used, resulting in four groups: low, moderate, high, and very high. It is important to note that the total number of existing agreements has changed over time, leading to variations in the classification cut-off values. Therefore, to account for this, each score is compared to a benchmark value specific to the given year, allowing for a more accurate classification.

Figure 1 illustrates the distribution of MEAs via the choropleth map of EU Member States for each environmental target. The bottom left chart displays intervals based on quartiles, with darker colours indicating better performance in treaty ratification. The figure highlights the uneven performances across Member

States and the varying levels of engagement in different types of environmental agreements. Germany, Spain, Denmark, and the Netherlands exhibit strong involvement in freshwater-ocean treaties, performing better than other European countries in both 1995 and 2016. On the contrary, Belgium, France, Italy, and the United Kingdom rank in the top quartile for habitat agreements. Central and Eastern European (CEE) countries generally demonstrate weaker performance in most environmental subjects, but they exhibit relatively strong performance in nature protection. In 2016, Bulgaria, Croatia, the Czech Republic, Romania, Hungary, and the Slovak Republic belong to the two highest categories in the classification scheme. Some Member States exhibit minimal improvement over time, while others demonstrate consistent patterns. For instance, Germany, the Netherlands, Sweden, Finland, and Denmark consistently outperform other Member States in all environmental targets. Overall, Figure 1 underscores the disparities in treaty ratification performances across EU Member States and the variations in their engagement with different environmental agreement types.

The comparative analysis of country performances provides an initial understanding of their environmental policy performance over time. However, it does not present a comprehensive view of their commitment to ratified agreements, the duration between ratification and participation, or the influence of initial conditions on performance. Descriptive statistics offer valuable insights into certain aspects of country statistics. Nevertheless, using a method that fails to consider performance variations over years and the variability of performance in different environmental targets can lead to inaccurate empirical results.

The methodology used in this paper addresses these limitations and provides a comprehensive framework. Additionally, examining the treaty ratification process in isolation from economic and political factors would be incomplete. Therefore, the next chapter aims to present an empirical analysis and the main findings of a descriptive and explanatory model that incorporates economic and political factors.

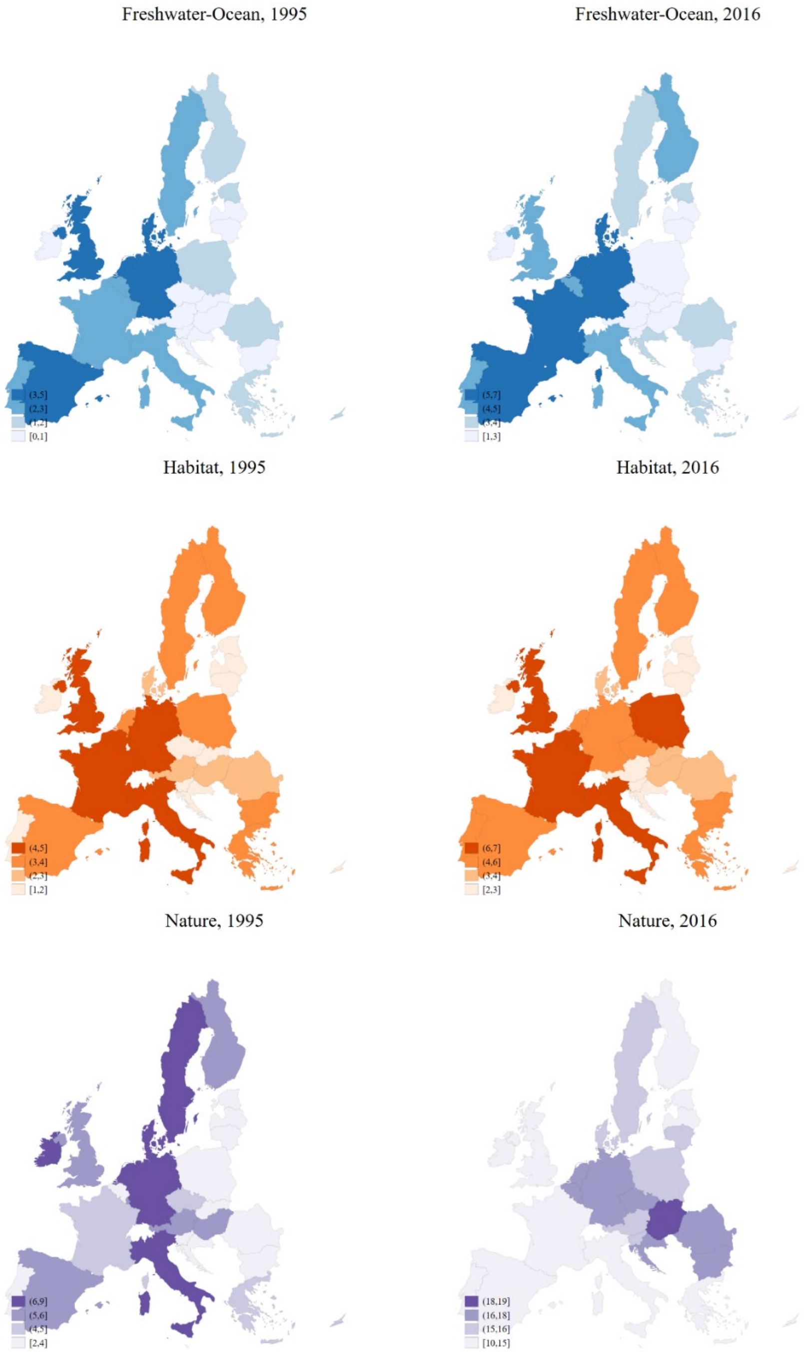

Figure 1. Number of Ratified Agreements for Each Categories, 1995 vs 2016
S*ource*: Authors' processing in STATA, based on IEA Database.

3. Empirical Results

This section presents and discusses the empirical results obtained from the descriptive and explanatory multilevel PCM analysis. Following Zheng and Rabe-Hesketh (2007) and Bacci and Caviezel (2011), this study applied the GLLAMM routine in STATA to rank the treaty ratification performances of EU Member States.

3.1 Descriptive Multilevel PCM

Table 1 presents the estimates of the item thresholds along with their standard errors. A threshold represents the point at which the probability of belonging to category $n-1$ becomes equal to the probability of belonging to category n. In other words, the threshold parameter indicates the level of the latent trait required to respond above a particular threshold (Hays, Morales and Reise, 2000). Since each item has four response categories, there are three thresholds associated with each item. The score of items should follow sequential ordering under the idea that countries with higher abilities are more likely to score higher. Table 1 shows that all item thresholds follow the expected ordering within each item, except for the thresholds in the habitat category. Specifically, the first difficulty threshold of habitat agreements is greater than the second threshold, indicating that it is relatively easier for countries to move from the 'low' category to the 'moderate' category compared to staying in the 'low' category.

Table 1. Descriptive Multilevel PCM: Item Difficulty Parameters

Item	Estimate		St. Error	P>z
Freshwater-Ocean				
Difficulty Threshold 1	-0,46	*	0,26	0,08
Difficulty Threshold 2	0,53	**	0,27	0,05
Difficulty Threshold 3	1,49	***	0,28	0,00
Habitat				
Difficulty Threshold 1	0,34		0,27	0,20
Difficulty Threshold 2	-0,30		0,28	0,28
Difficulty Threshold 3	1,24	***	0,27	0,00
Nature				
Difficulty Threshold 1	-0,33		0,27	0,22
Difficulty Threshold 2	0,42		0,27	0,11
Difficulty Threshold 3	1,45	***	0,28	0,00
Pollution				
Difficulty Threshold 1	-0,49	*	0,27	0,07
Difficulty Threshold 2	0,04		0,27	0,80
Difficulty Threshold 3	1,32	***	0,28	0,00
Species				
Difficulty Threshold 1	-0,50	*	0,27	0,06
Difficulty Threshold 2	0,27		0,27	0,30
Difficulty Threshold 3	1,30	***	0,28	0,00
Level 2 (year) Variance	1,19E-23		8,04E-12	
Level 3 (country) Variance	1,60		0,46	

* z-statistics at 10%, 5% and 1% level stated as *, ** and *** respectively.

Source: Authors' own calculations based on data from the sources mentioned.

After estimating the model parameters, we obtained empirical Bayes predictions to predict the latent trait. Figure 2 shows the EU Member States ranked in the ascending order of treaty ratification performance from left to right. Few country clusters stand out from the figure. In the ranking, Malta emerges as the lowest ranked EU country. This finding aligns with the criticism raised by Conrad and Cassar (2018) regarding the 2016 EPI report, which had ranked Malta in the top ten and positioned it ahead of countries such as France, the United Kingdom, and Germany. Conrad and Cassar argue that Malta, despite its relatively high population and urbanisation rate, performs poorly in terms of environmental indicators. They highlight factors such as Malta's heavy reliance on fossil fuels as the primary energy source and a relatively high rate of car ownership. Our findings support their perspective, indicating that Malta is one of the low performing countries among the EU Member States in terms of treaty ratification.

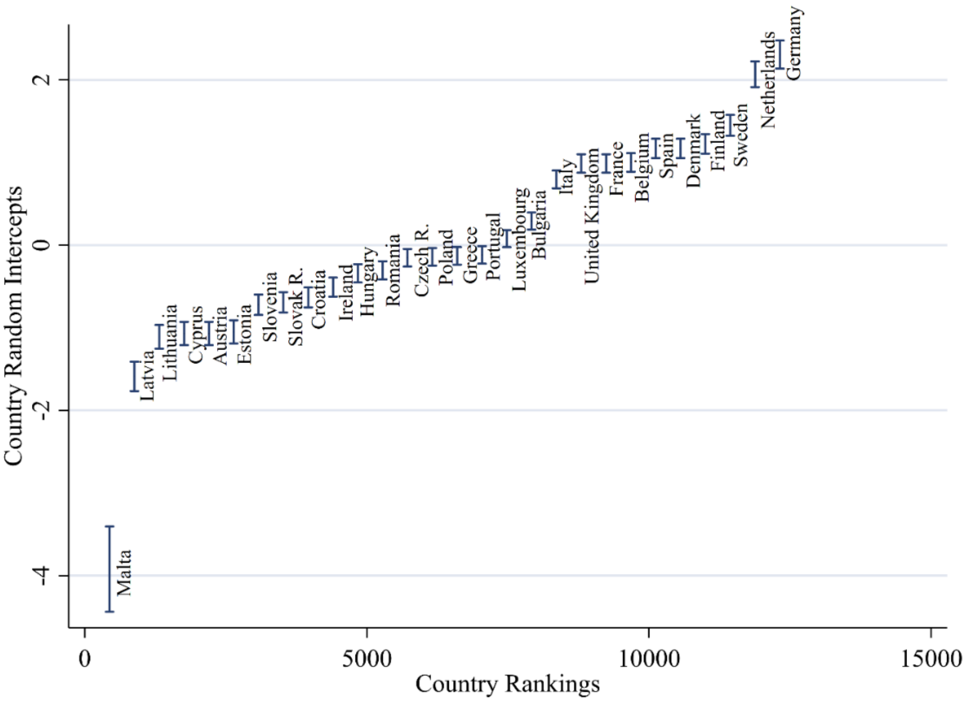

Figure 2. Rank of EU-28 Countries under Multilevel Partial Credit Model

Source: Authors' own construction.

The second cluster of countries, ranging from Latvia to Bulgaria, consists of relatively new EU Member States. These countries, particularly those in Central and Eastern Europe (CEE), such as the Czech Republic, Poland, and Bulgaria, had a high concentration of heavy industries and relied heavily on coal for production, resulting in substantial environmental damage to their territories (Andonova, 2003). Consequently, these countries are clustered towards the bottom of the graph, indicating relatively lower levels of treaty ratification performance.

On the other hand, the founding members of the EU and early member countries demonstrate significantly better performances compared to other groupings of nations. Germany and the Netherlands rank at the top and are clustered at the highest position on the graph. Sweden holds the third position in the ranking, followed by Finland (4th), Denmark (5th), Spain (6th), Belgium (7th), France (8th), the United Kingdom (9th), and Italy (10th). These findings align with the notion of these top-ranking countries being considered environmental pioneers in the literature on environmental policy making (Knill et al., 2012; McCauley et al., 2023).

Germany has indeed played a significant role in shaping strict environmental policies, both within the European Union (EU) and at the international level, since the 1960s. Germany's leading position stems from its early-developed environmental protection industry (Jörgens and Saerbeck, 2017). The country has an unusual comparative advantage in environmental industries and has sought to promote its environmental principles among EU member states to maximise future economic gains. In addition to economic interests, cross-border pollution is a serious environmental problem in Germany. The country is in central Europe and shares borders and rivers with other European countries. It is at risk of serious damage from cross-border environmental problems. Germany has taken a leading role in developing measures and initiatives to prevent cross-border pollution and mitigate environmental risks, solidifying its position as a frontrunner in this field.

In summary, the analysis conducted in this paper highlights that founding members and early members of the EU show relatively better performances compared to countries that joined the EU at a later stage. One possible explanation can be attributed to the fact that the early members had more time and resources to align their legislation and regulations with EU environmental standards. Compliance with these standards often requires the adoption of the EU environmental acquis, a process that can be costly and time-consuming, particularly for new member states. To obtain more accurate ranking outcomes, it is crucial to take into account country-specific economic and political indicators, as well as the initial conditions of the countries. By employing an explanatory multilevel PCM model, this paper aims to address the limitations of the descriptive model and provide a more comprehensive understanding of the factors influencing country performances in terms of treaty ratification.

3.2 Explanatory Multilevel PCM

This subsection presents the results of the explanatory multilevel PCM, which builds upon the descriptive multilevel PCM by augmenting two latent regressions at the second and third levels. The explanatory model allows for the consideration of country-specific indicators, thereby providing unbiased and reliable outcomes. As for the economic indicators, this paper uses log-transformed real gross domestic product per capita *(LGDP*) from the time-series data of the Maddison Project Database (2020). Under the assumption that environmental quality is a normal good, one can expect that an increase in income leads to an increase in demand for a cleaner environment. This, in turn, could lead to increased participation in international environmental agreements (Murdoch et al., 2003). Therefore, it is expected that countries with higher incomes will be more likely to participate in MEAs.

LCO2 represents log-transformed CO_2 emissions (metric tons per capita) sourced from the World Bank. Lastly, the *EU* is a dummy variable that takes the value of one if the country is a member of the EU at a given time t and zero otherwise.

The ratification and implementation of environmental treaties are political processes influenced by the actions and behaviours of various agents driven by domestic political institutions. Improving environmental quality and performance through environmental policymaking (like other policy areas) relies on the quality of governance. The strength of the judiciary and a commitment to the rule of law are essential for effectively implementing stringent environmental policies. Congleton (1992) suggested that democratic states tend to outperform authoritarian regimes in pollution control because the marginal cost of environmental protection is relatively higher for authoritarian regimes, which often have shorter time horizons. Carbonell & Allison (2015) also prove that democratic governments are more likely to comply with international environmental treaties compared to authoritarian governments. In democratic states, citizens have easier access to environmental information and can demand government action through lobbying. In contrast, citizens of non-democratic states may face restrictions in gathering full information about environmental problems. Also, in non-democratic states, the government may deliberately choose not to address environmental degradation if it conflicts with their policy agenda (Neumayer, 2002). While the relationship between democracy and environmental policy is rather complex, a growing body of literature shows that the democracy-environment relationship holds.

In this paper, the quality of democratic governance and political institutions is measured using indicators such as control of corruption *(CORRUPT)*, voice and accountability (*VOICE)*, and the rule of law *(RULEOFLAW)* from the World Bank. The rule of law captures the perceptions of how the rule of law is experienced, while control of corruption is a perception-based of the extent to which public power is exercised for private gain. *VOICE* assesses the extent to which citizens raise their voices to hold their government accountable (Kaufmann et. al., 2011). These indicators range from -2.5 to 2.5 with higher values indicating better government capacity and higher quality political institutions. We use the mean values of these political indicators (1996-2016) because the covariates of the third-level residuals are time-independent, reflecting the deviation of the latent variable from population average.

Table 2 presents the results of the explanatory PCM. The regression results of the second- and third-level covariates include estimated coefficients and standard errors. The t-ratio is calculated using these statistics and compared to a threshold (1.645) to test for statistical significance. The empirical results indicate that all predictors are statistically significant, except for *LGDP* and *VOICE*. The results show that MEA ratification is positively correlated with per capita CO_2 emissions. This suggests that environmental pressure, coupled with domestic pressure for a cleaner environment, motivates governments to address environmental challenges. Countries that exhibit higher CO_2 emissions per capita are more likely to ratify MEAs in order to align with EU standards and catch up with environmental policy leaders.

Table 2. Explanatory Multilevel Partial Credit Models

Regressions of latent variables on covariates	Coefficient	t-ratio
Second-level covariates:		
LGDP	-0.14 (0.38)	0.37
LCO2	1.88 (0.40)	4.70
EU	0.49 (0.10)	4.90
Third-level covariates:		
RULEOFLAW	-2.14 (0.58)	3.69
CORRUPT	1.96 (0.39)	5.03
VOICE	0.26 (0.39)	0.67

Source: Authors' own calculations based on data from the sources mentioned.

The EU membership is also found to be positively correlated with the environmental treaty ratification. When a country becomes an EU member, it is required to adopt a set of regulations and rules known as the Acquis Communautaire in order to align its policies with the EU standards. This alignment with the environmental acquis leads to increased stringency in environmental policy, which in turn can result in a higher participation in environmental agreements. Other than that, the EU can transfer its norms and policies, as well as create an environment for the Member States to exchange ideas (Bradford, 2020). Previous studies suggest that countries often adopt policy innovations by mimicking or emulating the successful policy experiences of other countries with whom they interact in the international arena (Busch & Jörgens, 2005). This process of policy convergence across nations can lead to a catch-up effect, particularly for CEE countries, as they benefit from the policy convergence within the EU.

According to Welsch (2004), corruption has a twofold impact on pollution. Firstly, it reduces the effectiveness and stringency of environmental laws and regulations through manipulating policies and weakening their enforcement. Secondly, corruption has an indirect effect on pollution by decreasing per capita income. Damania et al. (2003) found similar results to Welsch (2004) and demonstrate that corruption and rent-seeking behaviour reduce the stringency of environmental regulations. In line with previous literature, our study also finds a significant relationship between corruption and treaty ratification performance.

Specifically, countries with lower levels of corruption tend to have higher performances in terms of ratifying environmental agreements.

Furthermore, the rule of law is statistically significant and negatively related to the treaty ratification performance. One possible explanation is that countries with weaker rule of law may indeed ratify a higher number of agreements during the analysis period. However, their performance in terms of meeting the objectives and requirements of these agreements may be relatively lower compared to countries with stronger rule of law. In other words, their performance may be better in relative terms when compared to their own previous levels, but it may still fall short in absolute terms.

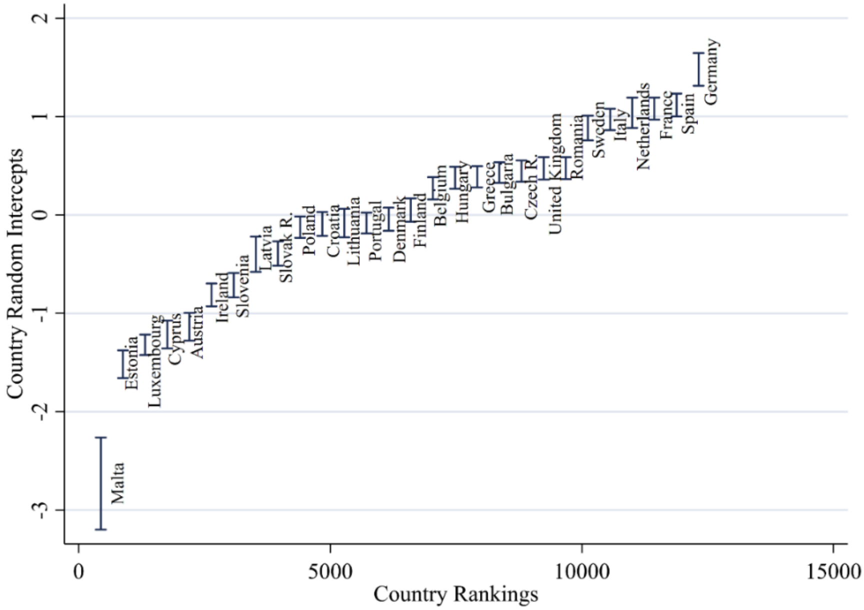

Figure 3. Rank of EU-28 Countries under Explanatory Multilevel Partial Credit Model

Source: Authors′ own construction.

Figure 3 presents the ranking of the EU Member States based on the explanatory multilevel PCM. As in the descriptive model, the EU Member States ranked in ascending order of treaty ratification performance, from left to right. Although the country clusters have changed from the previous model, Germany once again emerges as the best-performing country. The next three countries in the ranking are Spain (2), France (3), and the Netherlands (4). These countries appear to have achieved far better treaty ratification performances than the other Member States. In other words, they exhibit significantly higher levels of commitment to MEAs and demonstrate a greater willingness to adopt stringent and complex measures.

Some CEE countries have shown remarkable progress when economic and political indicators are considered. Contrary to the previous model, the explanatory model ranks three CEE countries, namely Romania, Bulgaria, and the Czech Republic, among the top ten in terms of treaty ratification performance. As in the case of macroeconomic performance, the CEE countries have been making efforts to catch up with their western neighbours in terms of environmental policy, as the EU accession has required them to adopt necessary regulations that align with the EU environmental standards. Moreover, the EU has provided assistance in terms of administrative and environmental capacity building, as well as investment support, to help accession countries fulfil their obligations concerning the EU environmental acquis.

Although the adoption of EU standards is complex and costly, most CEE countries have experienced rapid developments in their environmental conditions by implementing a new set of strict regulations (Andonova, 2003). Consequently, when controlling for initial conditions, several CEE countries have climbed up the ladder and have shown significant progress in the rankings compared to the previous model. On the contrary, Nordic countries (particularly Finland and Denmark) have dropped in the rankings, moving from 4^{th} and 5^{th} place to 14^{th} and 15^{th} place, respectively. One should remember that the explanatory PCM, which takes into account initial conditions, considers the improvements in performance over the sample period. In contrast, the descriptive model provides more general results (Galeotti et al., 2018). It is worth mentioning that Austria, one of the EU's environmental policy leaders, should not be labelled as low performing. This country has just not made enough progress given its initial conditions.

4. Results and discussions

This paper introduces a novel approach to rank environmental agreement participation performances of EU Member States. The method employed considers the level of commitment to treaties and the complexity of the treaty collection. The proposed approach extends the descriptive PCM by augmenting two latent regressions, resulting in an explanatory model that examines the impact of country-specific economic and political factors on the rankings of Member States. The novelty of the explanatory model lies in its ability to rank while considering their national characteristics and idiosyncrasies.

The results of the study indicate a positive correlation between higher CO_2 emissions per capita and the treaty ratification performance of the EU Member States. This suggests that countries with higher levels of CO_2 emissions are more likely to participate in environmental agreements because of their environmental vulnerability. Furthermore, EU membership has a positive impact on the treaty ratification performance of Member States. As mentioned earlier, EU membership requires the implementation and enforcement of the *Acquis Communautaire*. The harmonization of environmental policies through EU membership leads to increased policy stringency among candidate countries. Additionally, the study reveals that less corrupt governments are more likely to ratify environmental agreements. Transparent and accountable local governments are more responsive to the demands of citizens and environmental organisations, prioritising their interests over those of companies or lobbyists.

The descriptive PCM shows that the founding members of the EU, well-known environmental leaders of the environmental policy literature, ranked higher compared to most of the CEE countries, which were perceived as having lower or moderate performance. Conventional leaders such as Germany, the Netherlands, and Sweden maintained their high relative rankings in both descriptive and explanatory models. However, the explanatory model presented a completely different picture. Some CEE countries have climbed up the ladder and made significant progress in the rankings after controlling for initial conditions. These countries, commonly regarded as environmental policy laggards, performed better than many of the policy leaders (at least relatively during the sample period). This suggests that the methodology used to assess environmental performance is crucial in evaluating the progress achieved by the Member States.

It is important to note that the social and environmental policy agendas of countries have evolved over time since the introduction of the leaders-laggards classification. Therefore, the methodology employed to assess performance should allow for the consideration of the dynamic and evolutionary performances of the countries in the field of environmental policy.

It is important to clarify that the treaty ratification performance reflects the commitment to treaties and the complexity of the treaty portfolio. In other words, it is an indicator of environmental policy stringency. Therefore, the results obtained from this study can indeed contribute to further develop European environmental policy in the future and to promote policy measures at the international level. However, it is crucial to acknowledge that the translation of obligations from ratified agreements into domestic legislation takes time to come into full effect. Therefore, a low-performing country may still have better environmental outcomes at a given time. The ranking itself does not directly reflect the current environmental conditions and/or quality of the environment, but rather the level of improvement in environmental policy stringency. The relationship between treaty ratification performance and environmental outcomes remains the subject of future analyses.

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