Exploring Determinants of Environmental Policy:

Instruments and Efficiency in Mitigating Climate Change

Private or public? The politics of public good provision.

Prof Silja Häusermann & Prof Francis Cheneval

Nathalie Guibert

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Introduction

Mitigating climate change through climate action is one of the most pressing issues of our time. As it poses a global threat, with an unprecedented impact on the Earth, climate's preservation is an integral part of the Sustainable Development Goals of the United Nations (UN a). Combatting climate change implies preserving "[…] a stable climate", which can be classified as a public good, since it is non-excludable, thus, nobody can be excluded from profiting from it, and non-rivalrous, as one's enjoyment of a healthy environment does not diminish the use of others (Kotchen 2012: 1).

At the Conference of the Parties (most recently COP 28 in Dubai), the central decision-making body of the United Nations Framework Convention on Climate Change (UNFCCC) engages in extensive discussions on which strategies to adopt in climate policy. This was also the case at COP 28 last December: The most critical agenda item was potential global phase-out bans of fossil fuels on which the members could not agree by the end of the meeting. Such bans and other instruments are part of diverse approaches for governments to attain "Target 13.2: Integrate climate change measures into national policies, strategies and planning" and its sub-indicator "Total greenhouse gas emissions per year" (UN b). In this study, I specifically focus on emission trading systems (ETS), carbon taxes, climate agreements, subsidies for the clean energy sector and bans on fossil fuels.

While the first environmental policies were based on command-and-control approaches, the current policy landscape has changed towards predominantly market-based mechanisms, often integrated into supranational regulatory frameworks such as the Paris Agreement and the EU's Green Deal, as climate change is a transnational problem. Apart from supranational policy schemes, most countries maintain also their own distinct climate policies that set them apart from other nations. However, that raises my research question: *What factors shape governments' choices of policy instruments and how do they relate to the countries' efficiency in stopping global warming?*

So far, only some research has been done to examine the selection of policy mechanisms to curb climate change. For instance, researchers of environmental science have only investigated the impact of interests of industrial groups, clean technology firms, aggregate welfare, and institutional capacity to explain the choice of policy instruments (Hughes & Urpelainen 2015). However, political factors such as the government's position on the left-right ideological spectrum, the impact of public perception of the seriousness of the climate crisis, and the source of energy consumption have not been taken into account in previous and current research on environmental politics. Furthermore, attempts to measure the efficiency of climate change mitigation approaches have used proxies such as the "ambitiousness" of policies and relied on determinants such as public preference for climate preservation. Independent environmental organisations, on the other hand, measure the nation's capability to reach certain climate goals based on current policies, emission levels, as well as sources and sustainability of energy consumption.

Using a quantitative approach, I first examined whether political and socioeconomic factors influence the choice of policy instruments aimed at mitigating climate change. However, I did not find conclusive evidence suggesting any significant impact of my chosen covariates. Next, I investigated whether these policy instruments significantly affect the effectiveness of countries' overall mitigation strategies. Although some socioeconomic and political

variables were significant in this analysis, there was no evidence that a specific policy resulted in higher or lower efficiency. These inconclusive results on the choice of policy mechanisms and their efficiency suggest that further determinants have to be evaluated. Future research should also consider the influence of environmental organisations in shaping climate policy and how they contribute to effective environmental strategies.

Literature Review

In scientific literature, the environment and, thus its resources and its biological spheres are often regarded as public goods. This classification implies that these resources are non-rivalrous, meaning one person's use does not diminish the availability or benefit to others. For example, the usage of clean air by one individual does not reduce the quality of air available to others. Additionally, public goods are non-excludable, so no one can be prevented from accessing these resources. However, not all natural resources can be strictly classified as "purely" public goods. For instance, a public park can become crowded, limiting access for everyone at the same time. While it does not exclude particular people from using it, an element of rivalry to gain access to the greenery could, thus, appear (Kotchen 2012: 1).

While there has been discussion about the purely public character of environmental goods, I argue that reducing carbon emissions may similarly qualify for non-rivalry and non-excludability to my first example. Public goods are mostly provided by governments, as they result from a market failure which stems from the free-rider problem (Kotchen 2012: 1ff.): The private sector lacks incentives to provide goods that anyone can access without paying, leading to no rivalry among users.

Thus, the responsibility to provide such goods may be transferred to the government Environmental issues, which often transcend national borders, necessitate a transnational consensus within the public goods framework (Kotchen 2012: 2ff.): On the one hand, international agreements, such as the Paris Agreement, serve as regulatory mechanisms to address these issues, despite criticisms of their sufficiency, as the discussions surrounding COP28 has shown (Carrington & Stockton, 2023). On the other hand, more and more – partly multinational – market solutions have been established, such as for example the Emission Trading System (ETS) of the EU (OECD 2024).

Until the 1990s, economists and market-based ideas had minimal influence on environmental policy-making (Portney 2020). Some argue that this limited impact persisted until the turn of the century (Hahn 2000: 375). In the United States, national climate governance began in 1970 with the “Clean Air Act amendments”, followed by the “Federal Water Pollution Control Act Amendments” in 1972 (Portney 2020). A parallel evolution occurred in Europe, marked by the “[…] 1972 Stockholm Conference […]”, which led to the establishment of the “[…] United Nations Environment Programme (UNEP) […]” (Sjöstedt 1998: 233), and the “[…] First World Climate Conference […]” (Pallemaerts & Williams 2006: 22). As a result of these events, climate protection became a global issue for the first time (Jordan & Rayner 2010: 52).

Initially, climate policies were predominantly based on command-and-control approaches. However, by the 1980s in the US, it became evident that these methods provided little incentive for innovation and reduced market adaptability. These policies became too costly, thus, alternative solutions such as cap-and-trade systems and pollution taxes were developed. For instance, in a cap-and-trade system, the government sets a limit on the total

emissions allowed from businesses, which must purchase permits to emit a specific amount of such. These permits can be traded amongst the system's participants, creating a market that incentivises emission reductions.

Today, various measures to mitigate climate change exist. These include the aforementioned emission trading systems, pollution taxes (which tax emissions per ton) (Portney 2020), as well as subsidies (for the green energy sector) and definite bans – such as the phasing out of fossil fuels, which is currently planned in many countries but often not yet implemented (Young 2023). However, this raises the question of which socio-economic and political factors influence the choice of certain policy approaches to mitigating climate change.

How (strongly) do these determinants in turn relate to the efficiency of policy output? So far, the effectiveness of climate policies has been difficult to "fix" due to the long-term nature of many ongoing policies such as those aimed at reducing greenhouse gas emissions within specific timeframes. As a result, drawing absolute conclusions about climate change mitigation efficiency is challenging, as I argue. Various attempts have been made to measure the efficacy of countries' climate change mitigation strategies (Climate Change Performance Index 2023; Climate Action Tracker 2024). However, similar factors like "ambitiousness" are often used as proxies for efficiency, equating these terms in oftentimes normative-ridden discussions.

For instance, using strong objectives as a substitute for efficiency, Tobin found that wealthy nations with leftist governments have higher aspirations for climate action. Ambitiousness may also be accounted for by a country's ties to the EU, as well as less "[…] political constraints" (Tobin 2017: 28). Following the narrative of efficacy and ambitiousness being equal, Anderson et al. argue that strong public preference for natural resource conservation leads to more environmental policies (2017: 1).

In order to explain the choice of policy instruments, Hughes and Urpelainen examined the "[…] interests of industrial groups and clean technology firms," as well as "[…] aggregate welfare […]" and "[…] the importance of institutional capacity". Their research builds on previous work that measures the influence of local institutions and interest organisations (2015: 61). They also suggest that their model can be adapted to include factors from earlier studies, such as "[d]ifferences in political institutions […]", government and party constellations, and the supranationalisation of policies by governing bodies, political organisations, and the public through agenda setting and advocacy for environmental protection (Hughes & Urpelainen 2015: 61 ff.). Hughes and Urpelainen argue that identifying the significance of these factors for the choice of policy instruments can provide researchers with a more comprehensive understanding of the establishment and adoption of existing policies (2015: 62).

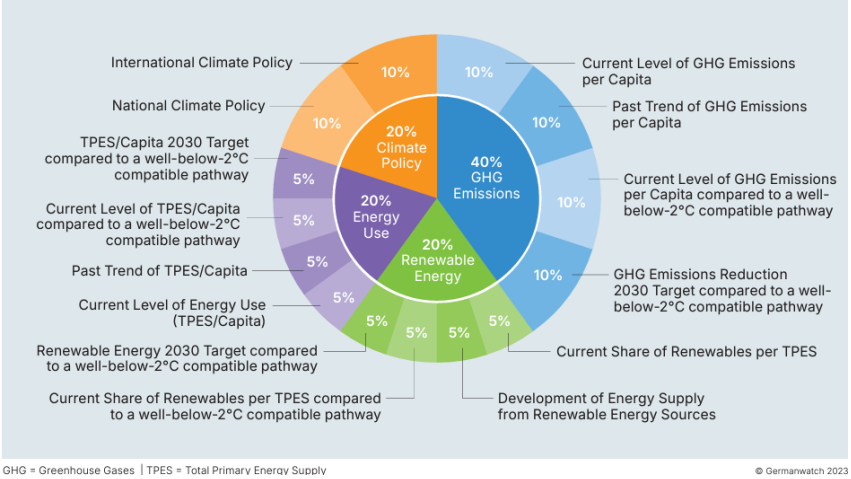
As previously noted, as to whether a nation's strategy for combatting climate change is considered effective has been extensively tackled by climate protection organisations like the Climate Action Tracker, as well as independent monitoring tools such as the Climate Change Performance Index (CCPI) (Climate Change Performance Index 2023; Climate Action Tracker 2024). For the choice between regulatory and market-based policy instruments to address climate-related issues, political factors, such as the availability of information on policy implications, have been considered as well (Jacobsen 2020: 5; Hahn & Stavins 1991: 26). There has not been, however, any comparisons of the explanatory power of socio-economic and political factors in relation to both policy efficiency and the choice of policy instruments. Additionally to this research aim, I hope to contribute to the discussion by including previously unexamined variables – as far as to my knowledge – such as the consumption of renewable energies and fossil fuels per capita, as a proxy for the sectors' importance.

Theory

In summarising the previous literature, I have established that environmental protection, specifically in the context of reducing carbon emissions, functions as a public good typically provided by the government due to market failure. As nations strive for efficiency, there are various policy measures they can take to achieve less or more ambitious environmental protectionist objectives.

In my analysis, I focus on the following solutions for climate change mitigation: a country's participation in an Emission Trading System, provision of subsidies for green energy, implementation of a carbon tax paid per ton of emitted carbon dioxide, and the enforcement of fossil fuel bans. These policy mechanisms serve as the outcome variables in the models of the first part of the analyses. On the other hand, I determine the efficiency of climate policies considering the main ranking of the Climate Change Performance Index, which is a score ranging from 0 – which is equivalent to a "Very Low" rating – to 100 – symbolising a "Very High" rating (Climate Change Performance Index 2023). The CCPI is an index composed of the results from the following sub-indicators: GHG-Emissions with a 40% weighting, Renewable Energy with a 20% weighting, Climate Policy with a 20% weighting, and Energy Use with also a 20% weighting. Figure 2 depicts how the components of the CCPI are structured in detail. How the countries perform in the sub-ranking GHG-Emissions and Climate Policy, as these two categories seem the most relevant to answer my research question, can be seen in Appendices A2 and A3.

Figure 1: Components of the CCPI (Burck et al. 2023: 4)



To answer my research question "What factors shape governments' choices of policy instruments and how do they relate to the countries' efficiency in stopping global warming?", I use the following explanatory factors: The economic orientation of the currently elected government, the establishedness of different energy sectors—using per capita consumption of renewable energy and fossil fuels as proxies — the perception of the seriousness of climate issues, and a dummy variable indicating EU membership. Initially, I also considered political dummies, such as whether a Green or Conservative Party is represented in government. However, based on preliminary analysis results, I decided to retain only the economic stance of the government as the political confounder.

Firstly, I consider the "government's economic orientation" as a crucial factor. This variable examines whether a governing body leans more towards economic libertarianism or socialism. Liberal economic policies have gained prominence due to the impact of globalisation, resulting in instruments such as "lower trade barriers, […] [and]

limit[s] [on] government spending […]", which are characteristic of market-based approaches like emission trading systems (Dorn 2004). *I posit that economically liberal governments are more inclined to adopt market-based instruments like Emission Trading Systems while avoiding regulatory bans (H1a)***.** Given the reluctance of libertarian governments to enforce strict environmental policies, which could harm the market, such as the complete prohibition of the consumption of fossil fuels, *I argue that opting for market-friendly measures, such as ETS and subsidies for the renewable energy sector, leads to lower efficiency in climate change mitigation (H1b).*

Next, I am interested in examining the relationship between a nation's consumption of renewable energy and fossil fuels and its choice of specific policy measures, as well as a country's effectiveness in satisfying the different aspects of the Climate Change Performance Index, such as having effective measures in place, transitioning towards not only renewable energy sources in general but also its pathway to sustainable energy usage and efficaciously reducing greenhouse gas emissions (GHG) (see Figure 1). In researching this matter, Peterson (2021) discovered that countries with a significant carbon-heavy industry tend to allocate less funding to environmental initiatives. I assume this leads to negative consequences for efficiency, as limited funding likely results in fewer environmental initiatives and, thus, less attention to environmental issues. Furthermore, Lazarus and van Asselt argue that the fossil fuel industry possesses "[...] geopolitical influence powerful enough to stymie energy and climate policies not to their liking" (2018: 9). I would assume that this applies reversely to countries with higher consumption of renewable energy, such that these countries profit from more funding opportunities for the green energy sector. Thus, I would expect that a country with a significant renewable industry would seek to protect it by implementing market-conforming policies, such as providing subsidies. Therefore, my *second hypothesis states that as renewable energy consumption increases, a country's environmental protection strategy will rely more heavily on market-based instruments like subsidies for the renewables sector and ETS (H2a1)*.

On the other hand, as the consumption of renewable energy rises, I assume that this usage is sustainable, and, thus, results in higher efficiency in country's mitigation of climate change (H2a2). As a result, I argue that this effect is reversed for countries with high fossil fuel usage, resulting in unsustainable energy use and large greenhouse gas emissions. It has been suggested that the fossil fuel sector may be strong enough to fight any policies aiming to abolish this industry, which may impede policies that aim to mitigate climate change more efficiently. *Therefore, I hypothesise that more fossil fuel consumption leads to less efficacy concerning the Climate Change Performance Index (H2b).*

As a third explanatory factor, I examine how public perception of the severity of climate issues influences policy selection. With the increasing impact of climate change on people's lives, the perceived importance of the issue has risen significantly. The International Science Survey from 2019-20 indicates that "[a]bout half or more consider climate change to be a very serious problem [...]" (Funk et al. 2020). In order to determine whether citizens prefer market-friendly policies over regulatory ones for mitigating climate change, I draw on conclusions from Jacobsen, who notes that in the absence of "[...] any policy analysis, individuals tend to oppose a market-based approach to policy" (2020: 1). I argue that such analyses presumably would not be accessible to the public and even if so, Stadelmann-Steffen and Dermont argue that "[...] citizens are reluctant to accept incentive-based energy policies even though such instruments are widely acknowledged by economists and policy-makers to be the most effective means of attaining the goals of environmental policy" (2018: 51). Therefore, my third

hypothesis is that *if public concern of climate-related issues is high, it is more likely that a government will favour regulatory solutions over market-based for mitigating environmental change (H3a)*. Furthermore, I expect *the efficiency of such policies to be high since the pressure for more far-reaching measures is driven by public demand, compelling governments to respond to this preference (H3b)*.

I also incorporate European Union (EU) membership as a control variable to constrain the influence of EU countries adopting supranational policy mechanisms imposed by the EU. Given that a substantial portion of my sample comprises EU member states, which are inherently part of initiatives such as the EU's Emission Trading Systems (ETS), this control variable helps to isolate the effects of EU membership.

This chapter establishes the theoretical framework and hypotheses for understanding how governments select policy instruments to address climate change and how these choices relate to policy efficiency. Subsequently, I introduce the data and methodology intended to provide insights into my research question and hypotheses.

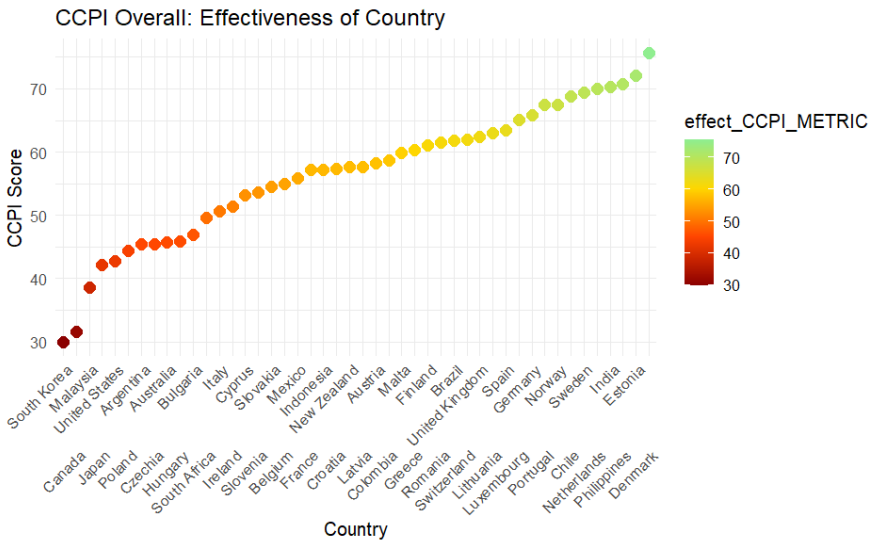
Data

In this section, I present my data selection and variable definition. Given the comparative nature of my research proposal, I have tried to gather data from all the continents to provide a comprehensive global analysis of potential factors for the choice of instruments, as well as "[…] to compare the climate performance of 63 countries and the EU, which together account for over 90% of global greenhouse gas emissions" (CCPI 2024). Shortcomings such as the scarcity of data for countries outside of Europe, as well as other potential confounders in other domains, such as inter alia public perception, industry, and environmental advocacy, shall be addressed in the discussion section later.

First, concerning the data selection process, the CCPI yields the results of 63 countries globally. This includes both democratic and autocratic states. However, in light of my explaining variables, which entail also political factors which imply that, for example, a people's representation in the form of a parliament can be (relatively) freely elected, a further downsizing of the sample has been done. Given the Freedom House Country reports, I then also remove countries that are considered "Not Free", and "Partially Free" if they receive less than 3 points for the questions in the categories "Electoral Process" and "Political Pluralism and Participation" (Freedom House). These criteria for removal are further validated by past research, suggesting that autocratic governance structures struggle to address the climate crisis effectively and that public perceptions of climate change are significantly shaped by political institutions (Levi & Goldberg 2021).

Excluding the countries which do not match my criteria as well as eliminating an aggregated score for the entire EU (since I am interested in country-level explanations), I am left with a sample of 46 countries overall. A better overview of the selected countries can be found in Appendix A, A1. The figure (Figure 1) below shows how well the countries performed according to the Climate Change Performance Index, whereas South Korea has performed the worst ("Very Low") and Denmark the best ("High"). It should be noted that in the ordinal version of the ranking, no country has been able to achieve a "Very High" CCPI Rating, implying that, thus, de facto, the ranking only ranges from "Very Low" to "High".

Figure 2: Countries' performance in CCPI Overall



Next, the instruments emission trading systems (ETS), subsidies for clean energy and renewable energy, respectively, as well as the existence of a carbon tax are yielded by the OECD PINE dataset. The data can be explored by examining the "Data" panel, filtering the information using the specified criteria, and utilising the search function (OECD 2024). Furthermore, 31 countries in my sample have implemented a ban or phase-out of fossil fuel vehicles (Wikipedia 2024).

Figure 1: Distribution of different mechanisms to mitigate climate change

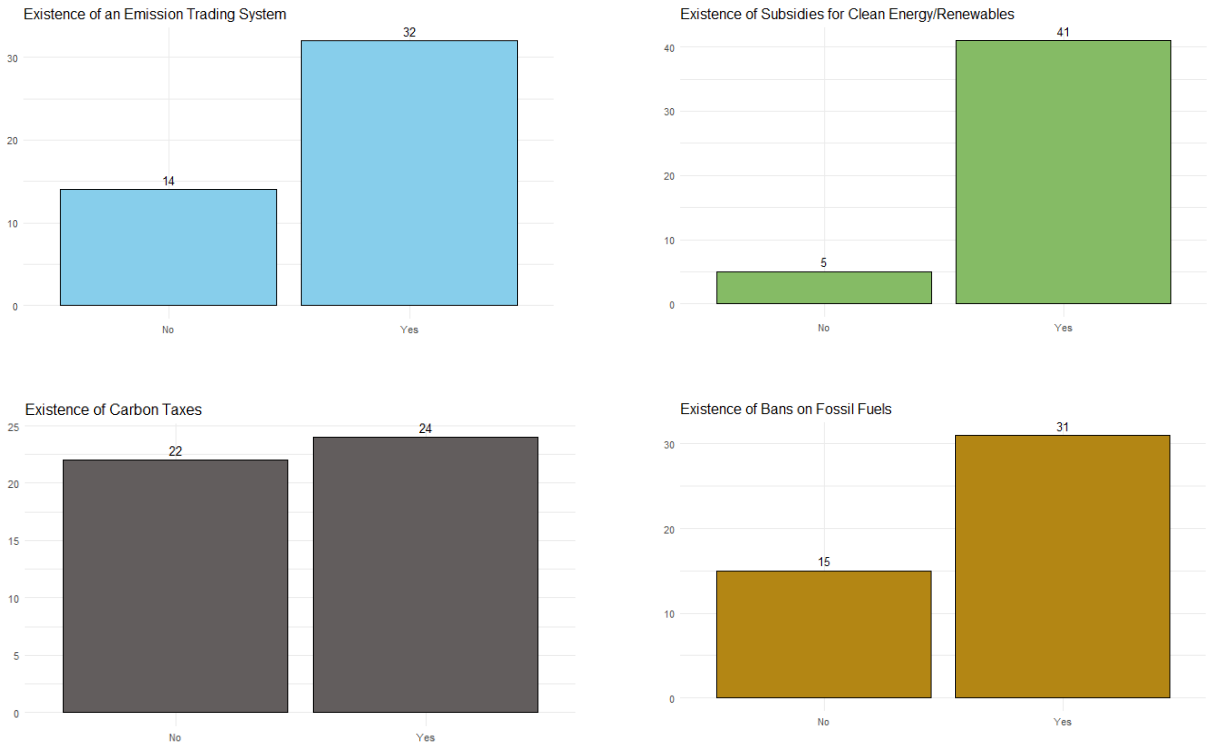


Figure 3 describes the distribution of each mechanism in the refined sample. Apart from the case of carbon taxes, the balance between the existence and non-existence of other measures seems to be unequal, particularly drastic

in the case of subsidies for clean energy and renewables, which will be addressed in the discussion. As the history of climate policies has demonstrated – as elaborated in the Literature review– market-based instruments have only risen in popularity in the 1990s. Nowadays, these are increasingly widespread, especially in the case of ETS and bans on fossil fuels. The prevalence of such instruments might be explained by the existence of supranational treaties and common strategies such as in the case of the EU's "Green Deal" or the UN's "Paris Agreement", which aim at unifying national environmental preservation goals and strategies to mitigating climate change on a supranational and international level (European Council Council of the European Union; United Nations Climate Action), as I argue.

So what exactly connects these countries, such that they adapt different or similar climate policies? In order to answer this question, which is part of the research question "What factors shape governments' choices of policy instruments and how do they relate to the efficiency of the government's policy outcome?", I have previously elucidated in the theory section the factors that I deem relevant to this paper's research aim.

First, a government's economic direction shall be named as an influential parameter. In particular, given the increasing prevalence of market-based policies, it is crucial to examine how market-based policies interact with different fiscal positions of governments to their nations' economies, specifically in the context of environmental policies. Therefore, I use the variable left_right from the parlgov dataset and calculate a government's positioning on the economic left-right scale by taking the average of the governing parties' market stances. However, as this dataset is limited to the countries covered in the parlgov dataset (see Appendix A4) – 34 of the 46 countries covered in this paper – other sources and, also proxies needed to be found to establish a complete variable for quantitative analysis (Döring et al. 2022). For both the Latin American countries which remain (Argentina, Brazil and Mexico) (The AmericasBarometer by the LAPOP Lab) and the other left-over countries (Indonesia, Malaysia, Philippines, South Korea, United States) (Haerpfer et al. 2022), the mean self-placement of survey respondents on a left-right scale (LAPOP: Ideology (Left/Right) l1, WVS: Q240) serves as proxy for economic stance of governments. This introduces a bias, which I will elaborate on in the discussion section. Still, this leaves missingness for South Africa and India, whereas in the latter case, this might be due to a different cultural understanding of ideology (Puthillam et al. 2021: 2). I have chosen this variable over the ones mentioned next, as the fit of each of my models was often then enhanced.

Previously, I have also considered the percentage of Greens and Conservatives in a country's parliament (lower house) as an additional confounder for the political perspective, however, on the one hand, many countries do not have Green parties within their parliaments, thus, limiting the variable's variation, as well as the definitions of what counts as a Green and Conservative party varies strongly from source to source. On the other hand, I decided to reduce potential confounders, and, thus, have chosen the left-right placement of governments as the political (establishment) factor (although I am aware of the partially problematic proxies).

Changing the perspectives, the public perception of the seriousness of climate change is another confounder. Again, this question cannot be answered by selecting one dataset only: I make use of different surveys, which all include similar questions regarding the public's perception of the significance of the environment's importance (Appendix A5 shows the full wording of each source) (ISSP Research Group 2023; European Social Survey European Research Infrastructure 2016 & 2023; The AmericasBarometer by the LAPOP Lab; Vlasceanu et al.

2024; Wood 2021; Parisse 2021; European Investment Bank 2022; Kardooni 2018; Leiserowitz 2023). The scores are then standardised on a scale from zero to 100. If there exist multiple data sources that cover one country, I average the score and then subsequently adapt it to the normalised scale, such as in the case of France.

Penultimately, to examine how consumer behaviour influences the choice and effectiveness of policy mechanisms, I incorporate the nations' fossil fuel and renewable energy consumption as indicators of whether a country is progressing towards prevalently utilising energy sources that effectively reduce greenhouse gas emissions. For this, I calculate how many kilowatt hours per capita are consumed in a given country by taking the countries' consumption (or assessing the quantities per country relative to their use of different energy sources) of either fossil fuels or renewables and dividing them by the population count. Again, for this, I use different sources (Energy Institute 2023; U.S. Energy Information Administration 2023 a & b; European Commission 2021).

Lastly, I use an "EU dummy" which indicates whether a given country is part of the European Union or not to account for the effect of this confederation of European states. I do this due to the fact that over half of my remaining sample are EU countries and that many mechanisms that exist supranationally are, therefore, regulated on an EU level.

Method

In order to demonstrate which factors play a role in the choice of environmental policy instruments, as well as which instrument leads to the most effectiveness of a state in combatting climate change, I make use of statistical techniques. First, for the models using the various instrument dummies as dependent variables, I choose to perform a binomial logistic regression; for the models using effectiveness as defined by the CCPI as dependent variable, I use linear regression.

The first model using the ETS dummy as a dependent variable can be constructed as follows:

$$P(Y_1 = 1) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x_{govLR} + \beta_2 x_{fosfuelCons} + \beta_3 x_{renewCons} + \beta_4 x_{pubpercImport} + \beta_5 x_{euDummy}}}$$

where $P(Y_1=1)$ is the probability of the country having an emission trading system (ets_dummy), β_0 is the intercept representing the baseline model, and then follow the predictor variables and their coefficients:

- $\beta_1 x_{govLR}$: The government's stance on the left-right axis.
- $\beta_2 x_{fosfuelCons}$: The fossil fuel consumption of a given country.
- $\beta_3 x_{renewCons}$: The renewable energy consumption of a given country.
- $\beta_4 x_{pubpercImport}$: The public perception of the importance of climate issues in a given country.
- $\beta_5 x_{euDummy}$: A binary indicator of whether a country is in the EU or not.

The second model utilises the subsidies dummy variable as the dependent variable and has again the same confounders as before. Its equation can be constructed as follows:

$$P(Y_2 = 1) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x_{govLR} + \beta_2 x_{fosfuelCons} + \beta_3 x_{renewCons} + \beta_4 x_{pubpercImport} + \beta_5 x_{euDummy}}}$$

where $P(Y_2 = 1)$ is the probability of the country having subsidies for renewable energy (subsidies_dummy) and β_0 is the intercept representing the baseline model.

The third model has the carbon tax dummy variable as the dependent variable and follows the other models in terms of explanatory variables. The model's equation is presented below

$$P(Y_3 = 1) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x_{govLR} + \beta_2 x_{fosfuelCons} + \beta_3 x_{renewCons} + \beta_4 x_{pubpercImport} + \beta_5 x_{euDummy}}}$$

where $P(Y_3 = 1)$ is the probability of the country having a carbon tax and the baseline model is expressed by the intercept β_0.

The last instrument model describes the instance, in which the ban on fossil fuels dummy variable serves as the dependent variable and has the same confounders as the other policy models. The model's equation can be expressed as follows:

$$P(Y_4 = 1) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x_{govLR} + \beta_2 x_{fosfuelCons} + \beta_3 x_{renewCons} + \beta_4 x_{pubpercImport} + \beta_5 x_{euDummy}}}$$

where $P(Y_4 = 1)$ is the probability of the country having a (planned) ban on fossil fuels and the baseline model is expressed by the intercept β_0.

Now, I turn over to the effectiveness models, which measure how different policy instruments and other confounders contribute to the effectiveness of combatting climate change. Based on the four policy mechanisms, four linear regression models can be created based on the same predictor variables as before, as well as the mechanisms each per model:

$$Y_5 = \beta_0 + \beta_1 x_{ets\_dummy} + \beta_2 x_{govLR} + \beta_3 x_{fosfuelCons} + \beta_4 x_{renewCons} + \beta_5 x_{pubpercImport} + \beta_6 x_{euDummy} + \epsilon$$

$$Y_5 = \beta_0 + \beta_1 x_{subsid\_dummy} + \beta_2 x_{govLR} + \beta_3 x_{fosfuelCons} + \beta_4 x_{renewCons} + \beta_5 x_{pubpercImport} + \beta_6 x_{euDummy} + \epsilon$$

$$Y_5 = \beta_0 + \beta_1 x_{ctax\_dummy} + \beta_2 x_{govLR} + \beta_3 x_{fosfuelCons} + \beta_4 x_{renewCons} + \beta_5 x_{pubpercImport} + \beta_6 x_{euDummy} + \epsilon$$

$$Y_5 = \beta_0 + \beta_1 x_{FFban\_dummy} + \beta_2 x_{govLR} + \beta_3 x_{fosfuelCons} + \beta_4 x_{renewCons} + \beta_5 x_{pubpercImport} + \beta_6 x_{euDummy} + \epsilon$$

where Y_5 is the response variable effectiveness or climate performance, β_0 represents the intercept of each baseline model and ϵ is the random error term in each design. Furthermore, the following mechanisms and their coefficients shall be listed:

- x_{ets_dummy} is a dummy variable, where 1 represents the existence of an ETS and 0 the nonexistence of said mechanism,
- x_{subsid_dummy} is a dummy variable, where 1 represents the presence of subsidies for renewable energy and 0 the inexistence of this mechanism,
- x_{ctax_dummy} is a dummy variable, where 1 represents the existence of a carbon tax and 0 the nonexistence of this tax,
- x_{FFban_dummy} is a dummy variable, where 1 represents the existence of fossil fuel bans and 0 the inexistence of such bans.

Results

Following the establishing of the regression equations for the different models, I present the results in this section. First, I focus on the models which present each mechanism as the dependent variable and the political, public, and industry confounders (Table 1-4). After this, I analyse the effectiveness models based on each of the policy mechanisms (Table 5-8).

First of all, it should be mentioned that apart from the first model, none of the other first four models has statistically significant coefficients. Despite this, the consumption covariates do not indicate large effects anyway. Also, due to the fact of missingness in the variable government's positioning on the left-right scale for the cases of India and South Korea, the regressions are only executed with 44 of the 46 countries in total.

In the *ETS model*, the confounders government's stance on the left-right scale, fossil fuel and renewable energy consumption per capita in 2022, the public's perception of the criticalness of climate change, as well as an indicator of membership in the EU try to predict the existence of an ETS. The fact that the variable *eu_dummy* is highly significant, is not surprising, as the EU has introduced an EU-wide emission trading system, and the countries of the European Union constitute the majority of the sample. Thus, if a country is part of the EU, it has 576% more odds of having an ETS than a non-EU country.

The subsequent *Subsidies model* includes again the same predictor variables, which are, however, all insignificant. Potentially due to the weakly balanced distribution of the existence of subsidies (see Figure 3), the predictors of the regression model have problems contributing significantly to the explanation of the presence of subsidies. This notion might also be reinforced by the large standard errors of the intercept, as well as the variable public perception of climate change's importance. Contrary to this assumption, the second model fit is allegedly better than the first model. This issue shall be addressed in the discussion.

Again, the third model "*Carbon Tax model*" is using the same independent variables to determine the likelihood of the presence of a carbon tax and yields completely insignificant results. In contrast to the *Subsidies model*, the standard errors are not as high, however, different criteria, such as the AIC, BIC, and Log Likelihood suggest the worst model fit so far.

Also, the last model "*Fossil Fuel Ban model*" with the same predictors seems to not be able to explain the variance in the outcome variable, which indicates the existence and the planned introduction of bans on fossil fuels, significantly.

These results indicate that I cannot confirm any of my hypotheses (H1a, H2a1, H3a) regarding the impact of socioeconomic and political factors on the choice of policy instruments to mitigate climate change. A comparable situation exists with the other models addressing policy efficiency: I only have evidence to confirm my hypothesis H2b regarding the negative impact of fossil fuel consumption on efficiency.

Table 1: ETS Model

	ETS Dummy
(Intercept)	1.06276
	(6.69208)
gov_lr_econ	−.18598
	(.53891)
fos_fuel_consump_pc_2022	−.00001
	(.00003)
renew_consump_pc_2022	.00005
	(.00005)
pub_perc_clim_stand_fin	−.93695
	(5.78045)
eu_dummy	4.07065***
	(1.21165)
AIC	40.33153
BIC	51.03667
Log Likelihood	−14.16576
Deviance	28.33153
Num. obs.	44

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 1: ETS model

Table 2: Subsidies Model

	Subsidies Dummy
(Intercept)	180.39875
	(221.73661)
gov_lr_econ	−4.34455
	(5.21997)
fos_fuel_consump_pc_2022	.00175
	(.00199)
renew_consump_pc_2022	−.00084
	(.00094)
pub_perc_clim_stand_fin	−187.32467
	(231.79120)
eu_dummy	−12.78322
	(15.46116)
AIC	19.28861
BIC	29.99375
Log Likelihood	−3.64431
Deviance	7.28861
Num. obs.	44

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 2: Subsidies Model

Table 3: Carbon Tax Model

	Carbon Tax Dummy
(Intercept)	2.19131
	(3.98094)
gov_lr_econ	−.22146
	(.29512)
fos_fuel_consump_pc_2022	−.00002
	(.00002)
renew_consump_pc_2022	.00009
	(.00007)
pub_perc_clim_stand_fin	−1.07079
	(3.77197)
eu_dummy	−.00103
	(.70447)
AIC	66.34025
BIC	77.04539
Log Likelihood	−27.17013
Deviance	54.34025
Num. obs.	44

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 3: Carbon Tax Model

Table 4: Fossil Fuel Ban Model

	Fossil Fuel Ban Dummy
(Intercept)	5.41826
	(4.84792)
gov_lr_econ	−.17287
	(.33172)
fos_fuel_consump_pc_2022	.00005
	(.00003)
renew_consump_pc_2022	.00010
	(.00010)
pub_perc_clim_stand_fin	−6.58992
	(4.71270)
eu_dummy	−.04612
	(.78056)
AIC	56.51818
BIC	67.22332
Log Likelihood	−22.25909
Deviance	44.51818
Num. obs.	44

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 4: Fossil Fuel Ban Model

Table 5: Effectiveness - ETS

	Effectiveness
(Intercept)	69.80251***
	(16.25425)
ets_dummy	4.01886
	(4.09863)
gov_lr_econ	−2.55498*
	(1.12880)
fos_fuel_consump_pc_2022	−.00033***
	(.00009)
renew_consump_pc_2022	.00010
	(.00013)
pub_perc_clim_stand_fin	4.59540
	(15.56914)
eu_dummy	3.59445
	(3.89211)
R^2	.42396
Adj. R^2	.33055
Num. obs.	44

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 5: Effectiveness - ETS

Table 6: Effectiveness - Subsidies

	Effectiveness
(Intercept)	80.22163***
	(17.66250)
subsid_dummy	−6.75334
	(5.31045)
gov_lr_econ	−2.68346*
	(1.12455)
fos_fuel_consump_pc_2022	−.00029**
	(.00009)
renew_consump_pc_2022	.00007
	(.00014)
pub_perc_clim_stand_fin	.57975
	(15.74825)
eu_dummy	6.67966*
	(2.88368)
R^2	.43374
Adj. R^2	.34192
Num. obs.	44

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 6: Effectiveness - Subsidies

Table 7: Effectiveness - Carbon Tax

	Effectiveness
(Intercept)	67.28964***
	(16.35067)
carb_tax_dummy	3.43691
	(2.75756)
gov_lr_econ	−2.31211*
	(1.13523)
fos_fuel_consump_pc_2022	−.00032***
	(.00009)
renew_consump_pc_2022	.00010
	(.00013)
pub_perc_clim_stand_fin	5.05547
	(15.45448)
eu_dummy	6.14023*
	(2.85724)
R^2	.43280
Adj. R^2	.34083
Num. obs.	44

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 7: Effectiveness - Carbon Tax

Table 8: Effectiveness: Fossil Fuel Ban

	Effectiveness
(Intercept)	68.87018***
	(17.23313)
ban_fos_fuel	1.21641
	(3.16098)
gov_lr_econ	−2.47313*
	(1.15532)
fos_fuel_consump_pc_2022	−.00035***
	(.00009)
renew_consump_pc_2022	.00013
	(.00013)
pub_perc_clim_stand_fin	5.95663
	(16.15973)
eu_dummy	6.14426*
	(2.91110)
R^2	.41135
Adj. R^2	.31589
Num. obs.	44

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 8: Effectiveness - Fossil Fuel

Taking a look at the results of the effectiveness models, the situation in terms of significance looks slightly better. Generally, the chosen political variable "*government placement on the left-right axis*" proves to be significant to some degree, as well as the fossil fuel consumption, however, only with marginal effects. The consumption of renewables and the perceived urgency of climate change are in all models only insignificant predictors. The adjusted explained variance of the dependent variable "*Effectiveness*" by the independent variables in each model lies within a range of 31.6% and 34.2% - thus, all models have quite similar relatively low scores. As to why this is the case, is part of the discussion. Overall, the main variables, thus, the policy instruments, cannot significantly predict the effectiveness of countries in fighting climate change.

The first model predicts the relative effectiveness of an existing emission trading system compared to countries without one. However, as mentioned before, the existence of an ETS is not a significant predictor of effectiveness. Despite this, the government's placing on the left-right axis is slightly significant and is negatively associated with the effectiveness. This can be interpreted as such that economically more right-wing governments are less efficient than left-wing governments in combatting climate change. The odds of having more effectiveness decrease by approximately 92.22% the more right-wing the government is. Interestingly, just as in the other models, fossil fuel consumption as a predictor is highly significant. Higher fuel consumption decreases the odds of a country reaching higher efficiency in preventing climate change by 0.033%, which indicates only a small effect.

In the second model in which I try to calculate the effect of the existence of subsidies for renewable energy on the effectiveness in preventing climate change to progress, the results look similar compared to the first model. The variable "*government's economic leaning on the left-right scale*" is mildly significant and indicates a decrease in odds of having a more efficient outlook in tackling climate change by 93.17% the more right-wing the government is. Here, the impact of higher fossil fuel consumption is significant, albeit its effect is relatively small: The odds of reaching more efficiency decrease only by 0.02%. In this model, as well as in the remaining ones, the effect of membership in the EU on effectiveness is marginally significant but implies a dramatic impact on the odds of having higher efficiency by 79505%. Furthermore, the explained variance in the dependent variable is here the highest of all efficiency models at 34.19%.

The third model looks at the impact of a carbon tax on reaching higher efficiency levels. The coefficient for the variable "*government's stance on the economic left-right* axis" aligns with the results from the other models, indicating a slightly significant impact. Specifically, it suggests that for each step rightward on the ideological axis, the odds of achieving greater efficiency decrease by approximately 90.1%. The highly significant confounder fossil fuel consumption indicates a decrease in the odds of reaching higher efficiency by again only 0.032%. In the case of a country being a member of the European Union, the odds of obtaining higher efficiency levels increase again substantially by 46316%, although, again, this coefficient is only lightly significant.

The last model measuring the impact of an implemented or planned fossil fuel phase-out on the efficacy of a nation's governance indicates again that the main variable, thus, the policy instrument, has no significant effect on the dependent variable. Similarly to the previous model, the ideological positioning of a government on the left-right spectrum has a modestly significant impact, correlating with a 91.57% decrease in the likelihood of achieving higher efficiency. Akin results can be also found for the strongly significant impact of fossil fuel

consumption, decreasing the odds of attaining higher efficiency by 0.035%. Lastly, the membership of the EU has also a minorly significant but large impact on the odds of an increase in efficacy by 46503%.

In summary, the variables in which I am particularly interested, such as the political, consumeristic, and public confounders in the case of instrument models, as well as each policy mechanism in the efficiency models, have no significant impact. Compared to the regression design for the different policies, the government's positioning along the left-right ideological spectrum, along with fossil fuel consumption and EU membership, emerge as significant factors in the efficiency models. However, their significance varies, ranging from marginal significance with substantial impact to high significance with minor effects. Overall, the explained variance in the outcome variable is relatively low.

Discussion

Considering the inconsistent findings from both the logistic and linear regressions applied to various factors and policy mechanisms, I aim to initially address potential data deficiencies, which may account for these outcomes and is followed by the discussion of the results.

Data

Firstly, it is important to highlight that while the data for the variables is primarily coming from the last five years, it also includes some "outliers" from previous years. This is particularly true for the data on election results, including the government's placement on the left-right axis, as well as the Green and Conservative seat percentages in the parliament, which were not used in the main analysis. In the parlgov dataset, there are some elections which date back to before 2019, for instance, in the case of France, Luxembourg, Sweden, and other European countries, as well as Malaysia. However, in the meantime, there have been more recent elections taking place. As a consequence, when using Green and Conservative seat percentages in a given parliament as a confounder, this must be taken into account, or, rather, data, such as the parlgov dataset, should be supplemented with information from more recent elections or generally be updated. I consider this drawback crucial, as calls for green policies and climate protection have increasingly become widespread, especially through movements such as "Fridays for Future", which became popular in 2019, thus, after some election results in the parlgov dataset (Döring et al. 2022).

Despite this, looking then at the Climate Change Performance Index's results from 2024 makes sense in that aspect that for example climate policies as a subcategory of the performance index may only have their (full) effect unfolded after a certain time frame (Ellerman et al. 2015; Portney 2020; Price et al. 2020). At the same time, policies may influence other sub-elements of the indicator as certain policies may lead to a decrease in GHG emissions (which account for 40% of the countries' scores) and impact both energy use and the expansion of renewable energy sources (each comprising 20% of the performance index), as I argue.

Furthermore, the imbalance between the existence and the non-existence of certain policy instruments is particularly dire in the case of subsidies for clean energy and renewables. This has also played a crucial role in statistical significance, as well as more generally the convergence of certain models, as can be seen in the results. In future analyses using this data, imbalanced outcomes of both dependent and independent variables may be

addressed by resampling techniques, which are also used for Machine Learning approaches, such as classification (Welvaars et al. 2023; Lee 2014).

Lastly, for some countries, I assume the government's placement is based on the self-placement of survey respondents from these particular nations. This is the case for countries and regions from the American continents, such as Latin America as well as the US, Asian nations, like inter alia Malaysia and South Korea, and South Africa. In doing so, I follow the strong assumption that democratic leadership generally follows the public's volonté concerning economic issues (Neumann 1977: 113 ff.). Therefore, I potentially create a bias, which might be criticised as naïve. Surveys from Latin America for instance have shown that in 2023 only 43.3% of respondents of Latin American countries believe that "[…] [t]hose who govern this country are interested in what people like [them] think", as well as 78.8% in 2018 thought that "[t]he government must spend more on helping the poor" (The AmericasBarometer by the LAPOP Lab). This clearly suggests a divergence between the interests of the government and the population. By integrating expert interviews into the evaluation of governments' and parties' economic positions, it may be possible to prevent the formation of a biased representation of the left-right positioning of the government variable.

Results

Some of the data issues are also relevant for discussing the results, such as the disproportionality of the countries that have subsidies versus the countries which do not have these in place. This might imply that the regression model potentially does not converge and lead to the model's instability, as well as designs without any significant coefficients, and, thus, in my case, to less informative value of the explaining variables. On the one hand, this might be due to the general lack of comparable data on public opinion towards climate change and the government's response. This is particularly true for non-European countries and more generally, for global south continents, as I argue. In my analysis, I have focussed on democratic countries, and have chosen the confounders accordingly. However, this leaves out roughly half of the countries worldwide in my analysis (Freedom House), such that I cannot claim to explain the choice of instruments, as well as the countries' efficiency, globally.

In the efficiency models, the adjusted R squared drops by nearly 25% compared to the R squared. As the adjusted R squared takes into account the count and influence of the independent variables, this indicates that supplementary independent variables in the model only contribute minimally to explaining the variance of the effectiveness of governments in combatting climate change. This decline underscores the need for other confounders, which may account more strongly for variability in the dependent variables. Such factors may be potentially found in the realm of environmental NGOs and their leverage on policy-making. So far, only exemplary studies on specific countries have been carried out (Haley & Clayton 2003; Ben Youssef 2021), as well as more general overviews of the "[p]articipation of NGOs in international environmental governance" (Oberthür et al. 2002: 5), which are, however, over 20 years old, therefore, one could question the general applicability of such studies to the current situation of NGOs.

Next to the missing data, the efficiency models have only shown R squared values between circa 30% and 35%, indicating relatively low scores, thus, only have a limited ability to explain the variance in efficacy. None of the

policy mechanisms were significantly indicating levels of efficiency, thus, leaving a question mark behind most of my main hypotheses (H1b, H3b). This insignificance of the "protagonist" independent variables, thus socioeconomic and political factors, applies also to the mechanism models so I am unable to confirm any of the hypotheses that regard the policy mechanism models (H1a, H2a1, H3a).

Furthermore, it is interesting to acknowledge that while fossil fuel consumption is a significant predictor of efficiency – compared to the consumption of renewable energy (thus, confirming hypothesis H2b but not H2a2) – the coefficients only suggest a small reduction in the odds of achieving higher efficiency when it comes to preventing climate change. This may come not too much of a surprise, as most countries in my sample consume significantly more energy from fossil fuels than from renewable sources. Additionally, the public of each country seems to acknowledge the general importance of the climate. As a functioning environment as well as a good climate, and, thus, the preservation of nature and climate change mitigation, can be seen as a public good – as outlined in the literature review – I assume that the public is generally not against pursuing the provision of this good. However, if the importance of climate policies and their stringency is juxtaposed with the relevance of economic growth, this might introduce more variability in the responses, potentially explaining more of the variance in efficiency. Using such a question item has already been done in the Americas Barometer, as well as more globally by the World Values Survey for instance (The AmericasBarometer by the LAPOP Lab; Haerpfer et al. 2022). Interestingly, despite potential bias in the variable representing the government's placement on the left-right ideological axis, this variable shows a slightly significant negative effect on efficiency in the model, decreasing the odds of achieving higher efficiency by roughly 90%. Finally, it's noteworthy that the control variable "*eu_dummy*", signifying a country's EU membership status, exhibits high significance within the ETS model. This finding is not unexpected, given that the EU, encompassing the majority of the countries in my sample, has implemented a Europe-wide emission trading system. For the efficiency models, this significant effect is not reciprocated in the Effectiveness – ETS model, however, in the case of the other effectiveness models it is. These results suggest that it might be sensible to generally include controls for supranational policy regimes in analyses concerning policy instruments.

Conclusion

Climate change is one of the most pressing challenges of our time, necessitating efficient policy instruments to mitigate its adverse effects. This paper aimed to identify the determinants affecting the choice of environmental policy instruments – including emission trading systems (ETS), subsidies for renewable energy, carbon taxes, and bans on fossil fuels – and assess which instruments are most efficient in mitigating climate change in order to answer my research question. To investigate how socioeconomic and political variables, such as the government's stance on the left-right axis, consumption of fossil fuel and renewable energy, public perception of the seriousness of climate issues, and EU membership, contribute to shaping climate policies and their effectiveness, I employed statistical techniques, including binomial logistic regression and linear regression.

The results of the study revealed very limited compelling findings. Firstly, none of the socioeconomic and political confounders seemed to exert a significant influence on the choice of policy instruments (apart from the control dummy variable of EU membership, which was not a control factor for my hypotheses). Secondly, none of the instruments were able to significantly predict countries' efficiency levels in mitigating climate change.

Interestingly, in the efficacy models, some of the main confounders from the environmental policies model had an impact on efficiency. For instance, the government's left-right positioning suggested that right-wing governments might be less effective in climate change mitigation compared to more left-wing ones. Additionally, there was evidence to suggest that increased fossil fuel consumption marginally diminishes a country's efficacy in addressing climate change. Furthermore, EU membership had a substantial but barely significant impact on effectiveness, highlighting the potential influence of supranational policy regimes on national climate performance. In light of these results, I was only able to confirm hypothesis H2b, which states that higher fossil fuel consumption is assumed to be associated with lower levels of efficacy in regards to the Climate Change Performance Index.

I believe that these findings underline the complexity of the understanding of climate policy adoption and effectiveness. Continuing to explore determinants of policy choice and the efficiency of these measures remains imperative for effectively addressing climate change, and, thus, ensuring the provision of a healthy environment as a public good for all.

This paper attempts to contribute to the explanation of the choice of policy instruments by examining the importance of political and socioeconomic variables in the process, in contrast to previous literature that has focused on explanatory factors, such as industrial groups, clean technology firms, aggregate welfare, and institutional capacity.

Furthermore, while some have suggested using ambitiousness as a metric of efficiency in addressing climate change, I followed the established perspective of independent environmental organisations, which view efficiency as a multifaceted factor based on current policies, emission levels, as well as sources and sustainability of energy consumption.

Future research should primarily address the data deficiencies and limitations in this study. Moreover, as discussed earlier, additional research is needed to determine how environmental groups affect policy decisions and the government's efficiency in addressing climate change.

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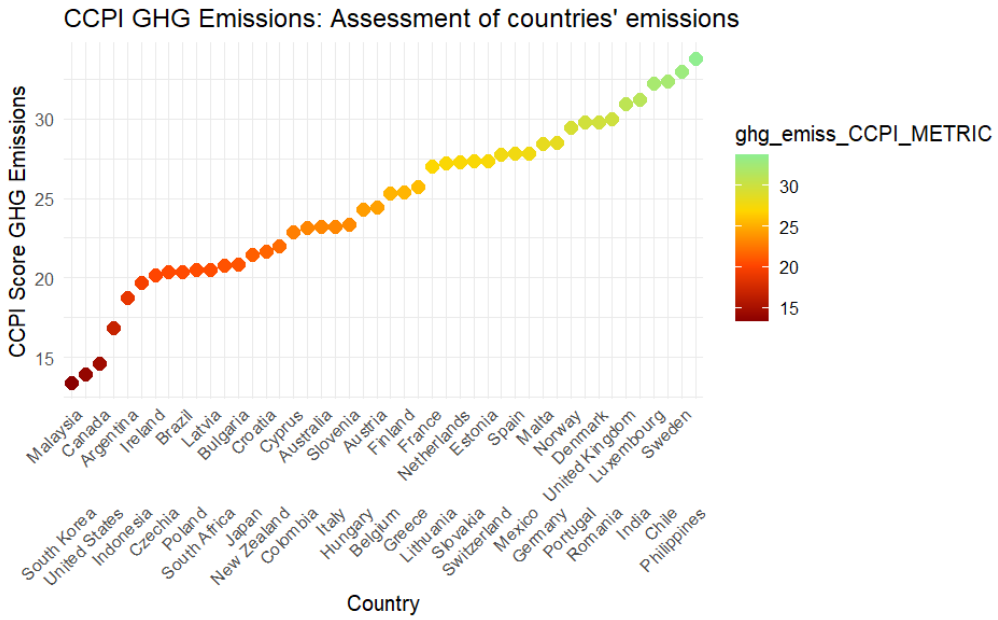
Appendix A: Country Data

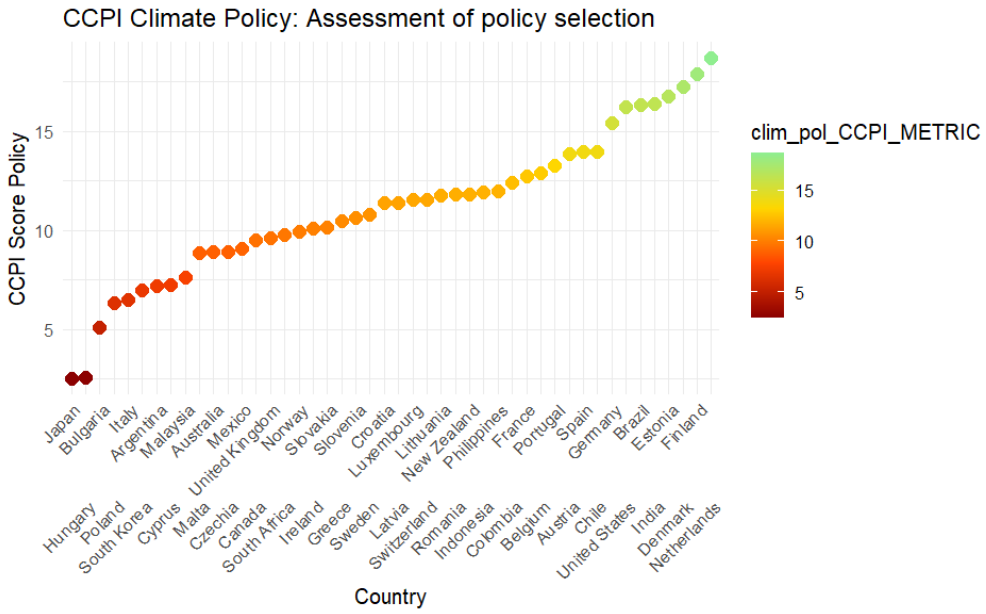
A1: List of countries included in the sample:

Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, Colombia, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, India, Indonesia, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malaysia, Malta, Mexico, Netherlands, New Zealand, Norway, Philippines, Poland, Portugal, Romania, Slovakia, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, United Kingdom, United States

A2: Countries' performance in reducing GHG emissions (CCPI)



A3: Countries' performance in implementing greenhouse gas reducing policies



A4: List of countries included in the parlgov dataset and used for my analysis:

Australia, Austria, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom

A5: Exact wording of the different datasets' questions.

ESS: H1/H2 [Now I will briefly describe some people. Please listen to each description and tell me how much each person is or is not like you. Use this card for your answer.] She/he strongly believes that people should care for nature. Looking after the environment is important to her/him.

ISSP: Q6 Generally speaking, how concerned are you about environmental issues?

LAPOP: env2b Seriousness of Climate Change. If nothing is done to reduce climate change in the future, how serious of a problem do you think it will be for [country]?

Vlasceanu: Share of people who believe in climate change and think it's a serious threat to humanity.

European Investment Bank: Q2 Do you think climate change and its consequences are the biggest challenges for humanity in the 21st century?