

Comparative Study on the Differences in Climate Change Mitigation Between Systems with Different Sizes of the Winning Coalition: CO2 Emissions in Focus

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The scholarly opinion on how autocracies, democracies, and other factors within those systems affect environmental performance appears to be controversial but promising for future research. Applying the selectorate theory, we attempt to examine the difference in the provision of a clean environment as a public good in systems with larger and smaller sizes of the winning coalition. We found no significant empirical evidence to support the notion that systems with larger winning coalitions are less likely to adopt a policy, and we argue that they are associated with lower carbon dioxide emissions than those with smaller coalitions. This might be because in the former systems, the policy enforcement mechanisms and thus their implementation are expected to be more efficient. Also, we notice that the regime subtypes of democracy and autocracy can suggest other answers to the question of what specific institutional system is associated with a certain level of emissions. Though the results shown by autocracies generally support the theory, those of democracies show some deviance; specifically, liberal democracies do not show an expected reduction in CO2 emissions with increases in the winning coalition. However, in general, our findings align with the selectorate theory, meaning that the theory's underpinnings could be extended to another public good - clean air.

Keywords: CO2 emissions; selectorate theory; winning coalition; democracies; autocracies

Climate change is a significant challenge of this century, requiring global action and national policies to mitigate its impact. The reduction of greenhouse gas (GHG) emissions, specifically carbon dioxide (CO₂), has been a central mitigation effort to combat climate change. Along with other factors, political regime, institutional capabilities and government structure influence the effectiveness of mitigation policies.

An ongoing debate focuses on whether democracies have shown more promising results in addressing environmental challenges. While democracies are credited with a strong commitment to international policies and treaties as well as the provision of public goods, there is mixed evidence on whether democracies can achieve a substantial decrease in CO₂ emissions (Fredriksson & Wollscheid, 2007). Some studies name democracies as better performers of tackling climate change, but others simply state that the mere regime of the country cannot be a reliable factor in illustrating performance (Wurster, 2013; Fredriksson & Wollscheid, 2013; Iwinska et al., 2019; Chou et al., 2020). Some studies even stated that both democracies and autocracies show similar outcomes in mitigating climate change (Bättig & Bernauer, 2009). Notably, while the intersection of environmental politics and democracies is well studied, that of autocracies is not. The latter is predominantly researched in comparison to democracies, but not independently.

As the regime type is not the most reliable predictor for a clean environment, for this paper, we decided to take up a different approach based on the Selectorate theory created by Bueno de Mesquita et al. (2003) and investigate the relationship between the size of the winning coalition (W) and the CO₂ emission level. It is questionable that the regime type and the size of a winning coalition can be used interchangeably, but still, democracies are associated with larger winning coalitions, and autocracies with smaller ones. As Bueno de Mesquita and Smith (2022) state that W is not regarded as the best institutional measure, we do not intend to disregard the regime type in this paper, but test that minor differences in W can reveal important discrepancies in resource allocation.

Few studies similar to ours exist in academia concerning the effect of the winning coalition size in the polity on the distribution of various public goods (Deacon & Saha, 2005; Bueno de Mesquita & Smith, 2015; Cao & Ward, 2015; Choi, 2023; Choi & Heo, 2024). Focusing on sulphur dioxide and particulate pollution, Cao and Ward (2015) attempted to modify the selectorate theory to study the link between regime type and emissions. They concluded that democracies with better state capacity and regime stability perform better than autocracies in terms of long-term reduction

of the two pollutants. As an extension of this study with the most recent data available, we aim to examine and investigate the causation between winning coalition size and the level of CO₂ emissions. Hence, our research question is as follows: “How do political systems with different sizes of the winning coalitions differ in the implementation of climate change mitigation policy? Which systems are associated with lower CO₂ emissions?”

The implementation process of mitigation policies involves measures aimed at reducing greenhouse gas emissions, such as a carbon market and tax, voluntary agreements, transitioning to renewable energy, land use regulations, and more (IPCC, 2007, p. 17). While the ratification of relevant climate change treaties is not a necessary prerequisite for states to adopt these policies, it can symbolise the states’ intention to follow cooperative climate action, and be part of the implementation process, for these treaties impose certain obligations and provide a structured framework of potential actions and climate targets to achieve; for example, aimed at maintaining certain changes in the global temperature, legally binding Paris Agreement mandates states to submit and periodically update Nationally Determined Contributions (NDCs) (Paris Agreement, 2015). Depending on the sector, such as energy, economy, transport, etc., the mentioned measures’ ultimate mitigation goal is to reduce the level of emissions.

According to the Selectorate Theory, systems with larger winning coalitions tend to prioritise public goods that include environmental sustainability over private goods, therefore leaving room for a potential advantage in tackling climate change. More specifically, Siebert (1998) stated that since private property rights cannot be determined for environmental goods, these cannot be distributed by the market, and thus the state regulation acts as a provider. Sekera (n.d.) also stated that, as the provision of clean air cannot create profit and be obtained within the market system, it is categorised as a public good. Thus, we define clean air as a public good that can be provided by either not harming the environment or, if harmed, then restored by targeted actions, including the establishment of policies and regulating mechanisms.

This research examines the relationship between the winning coalition size, regime type, and carbon dioxide emissions; it also considers other factors such as corruption, government effectiveness and institutional capacity. It draws on a merged panel dataset of 169 countries from 2011 to 2017 to investigate how regime characteristics and winning coalition sizes influence two key outcomes: participation in treaties on combating climate change and CO₂ emissions. The research

uses a two-way fixed-effects model to test two hypotheses: (1) when the size of the coalition increases, the likelihood of adopting the climate change mitigation policies decreases, and (2) greater winning coalitions enhance the effectiveness of these policies, leading to reduced CO₂ emissions.

Literature Review

The existing body of literature is mainly concerned with climate change mitigation policies rather than adaptation, focusing on the reduction of greenhouse gas (GHG) emissions or the enhancement of the sinks that remove those GHGs (United Nations Framework Convention on Climate Change, 1994). One of the possible explanations of policy effectiveness is informed by domestic institutions, regime type in particular. For example, Povitkina (2018) argues that some features of democratic institutions, such as freedom of the press, freedom of expression and fair elections, can facilitate climate change mitigation policies, which is explained by a higher level of commitment to address environmental issues. Similarly, Weiss and Jacobson (1999), and Battig and Bernauer (2009) argue that democracies tend to sign and ratify international agreements and treaties to cope with environmental problems and are more eager to comply with them because of adherence to the rule of law. Chou et al. (2020) concluded that the stronger the democratization effect, the lower the CO₂ emissions were observed.

However, there is a body of literature that argues that certain democratic institutions, in contrast, hamper the commitment to international environmental agreements. Mulligan et al. (2003) concluded that democracies and non-democracies do not show a significant difference in the variation of the adopted public policies in social and economic domains. According to Congleton (1992), political leaders in a highly competitive electoral environment tend to opt for short-sighted policies that could result in immediate outcomes rather than allocate funds to the implementation of long-term but effective policies that aim to mitigate environmental problems.

Furthermore, even though evidence from an extensive number of studies points to the positive correlation between democratic institutions and environmental outcomes, there are a few exceptions stating that the regime type alone cannot explain the effectiveness of mitigation policies and environmental outcomes (Midlarsky, 1998; Skocpol, 1985). Some studies found that a simple and broad difference in the regime type is insufficient in explaining the policy outcome, implying that the variation and the institutional context within those regimes can be more explanatory

(Wurster, 2013). Recognising this, Fredrikson and Wollshceid (2013) concluded that within democracies, proportional systems have designed stricter environmental policies than the majoritarian ones, and both are better than the policies in dictatorships; however, presidential-congressional democracies have not been that different from autocracies. Chou et al. (2020) also claimed that the explanations of why different democratic mechanisms had an impact on the environment were not determined but should be restudied in the future.

The institutional factors though may not be the only ones affecting the policy outcomes. Covering 153 countries, Lisciandra and Migliardo (2016) argued that corruption has a significant negative association with the environmental performance index. Lower levels of corruption and control of corruption were also associated with lower carbon dioxide emissions. (Povitkina, 2018; Wang et al., 2018). This conclusion, however, could not be fully supported by Læg Reid and Povitkina (2018), who stated that the relationship between democracies, low levels of corruption and the reduced level of CO₂ was weak. Iwinska et al. (2019) argued that control of corruption has little effect on the environmental performance of democracies. Their results also showed that the relationship between democracy and environmental performance is significant for high-income countries. This supports the Environmental Kuznets Curve theory within which Sinha et al. (2021) studied the effect of economic growth as well as the elections on carbon dioxide emissions and argued the level or the turning point of economic growth that was sufficient for economic benefits to be underweighted by the environmental quality was higher in closed autocracies compared to electoral ones; even lesser point was necessary for liberal democracies.

Among other factors examined that could potentially affect the environmental outcomes, the rate of CO₂ emissions, in particular, is the level of economic growth of a country. The findings of the research by Onofrei et al. (2022) argue that there is a cointegrating relationship between economic growth and the level of CO₂ emissions. Using the reduced-form regression models, Grossman and Krueger (1994) found that while an increase in GDP may result in the worsening of the environment in poor economies, the overall level of air and water quality tends to increase with the growth of GDP after exceeding a certain threshold of income level. Finally, the level of energy consumption may hold a clue to explaining the variation in CO₂ emissions across countries. According to Tiwari (2011), energy consumption facilitates an increase in CO₂ emissions. Another research findings by Reema (2024) state that there is a strong causation between energy

consumption and the level of carbon dioxide emissions, indicating that every increase in energy consumption results in an increase in CO₂ emissions.

Main Arguments and Hypotheses

1) Theoretical Framework

Our hypotheses for this study would be mainly based on Bueno de Mesquita et al.'s (2003) selectorate theory. According to the authors, what all leaders aim to achieve, the extension of their political survival, depends on the states' winning coalition (W) and selectorate (S) sizes or the W/S proportion; W and S are the subsets of a larger polity with W being the subset of the selectorate whose support for the incumbent is essential, and S representing those eligible for voting within a state. W and S are continuous reflections of traditional nominal classification of regime types; that is, systems with larger winning coalitions are categorised as democracies and those with smaller winning coalitions as autocracies. As the size of W and S affects leaders' behaviour, the selectorate theory states that systems with larger W and S or a larger proportion of W/S are better at public good provision, and systems with smaller W and S or a smaller proportion of W/S are better at private good provision. This is because leaders in small W systems have to maintain the loyalty and favour only of a small group of people, and thus an efficient way of doing so is the provision of private goods. Meanwhile, leaders in large W systems are accountable to a greater number of essential population than those in small W systems, and thus an efficient way to support that population's loyalty and favour is the provision of public goods. The core public goods, such as education, health, etc., examined by Bueno de Mesquita et al. (2003) do not include clean air or environmental quality. That is why we can extend the selectorate theory by testing its applicability to another public good - clean air.

2) Selectorate Theory and Climate Change Policy

Based on the selectorate theory, we argue that systems with larger winning coalitions tend to be better at providing clean air as a public good. First, being accountable to a larger group of people, leaders of these systems are subject to greater pressure or impediment to their incumbency. Second, once they adopt a certain policy, there is a need to be committed to its efficient enforcement. Third, having had such enforcement, it is expected to achieve policy outcomes. In our case, we focus on

policies targeting greenhouse gas emissions, particularly carbon dioxide; the expected successful policy outcome is to have lower CO₂ emissions.

Based on literature, we develop our main hypotheses as follows:

H1. As the size of the winning coalition (W) increases, the likelihood of adopting a climate change policy decreases.

Policy adoption and implementation are interdependent but distinct components of the policy development process (Fowler, 2019, 2022), and thus confidently stating that our expectation of systems with a larger winning coalition being more prone to policy adoption might be misleading. We argue that, as democracies are expected to have large winning coalitions, in these W systems, it is hard to achieve either a majoritarian or common consensus necessary for policy adoption or treaty ratification. That is why it would require more effort and time to initiate the policy adoption processes.

H2. As the size of the winning coalition (W) increases, the performance of climate change policy improves. Thus, we expect fewer CO₂ emissions in countries with a larger winning coalition.

We argue that though it is harder to adopt a policy in systems with larger winning coalitions, once adopted, it has to be implemented. That is, the pressure of the winning coalition would make that system achieve the policy outcomes. In particular, as democracies generally have larger winning coalitions, they are expected to have lower emissions than autocracies.

Research Design

1) Data Description

The dataset employed in the study is a longitudinal panel dataset that covers observations from 169 countries from 2011 to 2017; this dataset was merged based on the variables' availability in different datasets, as further outlined for each variable. The data illustrates a diverse set of political, economic, and geographic contexts. Overall, the data consists of 1182 observations, with each observation having the value of a specific country for each year. For testing our hypotheses, we use two dependent variables: the volume of CO₂ emissions by a country in a given year, and whether a country participates in international climate treaties in a given year. Among the independent variables, there are the winning coalition size and regime type. We also control the level of

corruption, population and GDP size, state capacity, energy consumption, and law transparency based on Cao and Ward's (2015) recommendation to include more control variables.

2) Dependent Variables

CO₂ Emissions. The variable displays the total annual carbon dioxide emissions measured in metric tons and produced by each country, encompassing emissions from energy generation, industrial processes, and fossil fuel combustion. The data is sourced from the Our World in Data database, a widely recognised and authoritative repository for global environmental and socio-economic indicators.

Treaty participation. It represents the proportion of international climate treaties a country has ratified relative to the total number of treaties available in a given year. The values for the data range from 0 to 1, with 0 implying the absence of ratified treaties and 1 indicating countries that have ratified or signed all key treaties under consideration. To calculate the ratio, data were sourced from Bellelli et al.'s (2023) Ratification Data, a comprehensive dataset tracking whether a country has ratified specific international environmental treaties. First, the dataset is sorted by treaties that are related to climate change. After finding out the number of total treaties each country ratified for each year, the number is divided by the number of total existing climate change treaties available for that specific year.

3) Independent Variables

Winning Coalition Size. It is a continuous variable that ranges from 0 to 1, illustrating the estimated proportion of the winning coalition whose support is essential for a leader's survival in power. The values for the variables were derived from De Mesquita and Smith's (2022) paper, which represents the results of the winning coalition size according to institutional dimensions and governance characteristics.

Regime. This is a categorical variable that illustrates the country's belonging to one of the four different regime types (0 Closed Autocracy, 1 Electoral Autocracy, 2 Electoral Democracy, 3 Liberal Democracy). The values for the VD are sourced from Our World in Data.

4) Analytical Framework

The analysis is divided into two models, relying on a panel regression model. Panel data was structured for the given study because it permits detailed and comprehensive information on the data by considering both cross-sectional and temporal variations. Given the structure of the data, which includes time-variant variables such as winning coalition size, corruption, energy use, and others, the two-way fixed effects model is a more appropriate method of analysis, as it accounts for both unobservable country-specific effects and time-specific shocks. This way, we only focus on how our main variables influence the outcome. The general model specification for the models in the study is as follows:

$$y_{it} = \beta + \beta_1 X_{it} + \alpha_i + \lambda_t + \epsilon_{it},$$

where y_{it} is the dependent variable, β is the coefficients of interest, X_{it} is the independent variables and controls, α_i is an individual fixed effect, λ_t is a time fixed effect, and ϵ_{it} is an error term. Model variants are as follows:

Model 1

The first model analyses the relationship between participation in the treaty ratio and winning coalition size. To capture more accurate results and isolate the effect of the IV on DV, several controls are included: GDP per capita, law transparency index, population size, state capacity, energy consumption, and political corruption. The following equation controls unobserved differences between countries (country-level heterogeneity) and time-specific effects that may result from global trends:

$$\text{treaty}_{it} = \beta_1 W4_{it} + \beta_2 X_{it} + \alpha_i + \lambda_t + \epsilon_{it}$$

The model considers the independent variable of winning coalition size (W4) as a key predictor. Based on the model, we aimed to find whether there is a possible relationship between these two variables. If H1 is supported, the expected results should be a negative value for W4. It will demonstrate that the higher the value of the winning coalition, the lower the chances for the ratification or adoption of treaties that cope with climate change.

Model 2

The second model shifts its focus to the carbon dioxide emission level by investigating the influence of two independent variables, regime type (regime) and winning coalition size (W4), on the dependent variable of CO₂ emissions (emiss). It aims to extend the selectorate theory by using clean air as a public good. According to the model, there are two hypotheses:

H2a: As the size of the winning coalition (W) increases, the performance of climate change policy improves. Thus, we expect to see fewer CO₂ emissions in countries with a larger winning coalition. The following equation reflects the conditions outlined in H2.

$$\text{emiss}_{it} = \beta_1 W4_{it} + \beta_2 X_{it} + \alpha_i + \lambda_t + \epsilon_{it}$$

H2b: democracies are expected to have fewer CO₂ emissions. This hypothesis is similar to the previous one, but as we do not treat the regime and winning coalition as the same, we include it as a separate, related hypothesis.

The second model, covering its first hypothesis, investigates the relationship between the level of emission caused by carbon dioxide and the winning coalition size. The analysis covers panel data that contain variables of emiss, W4, energy_use, pol_cor, trnslw, popsize, gdp and capacity. Similarly to the first model, the second accounts for country-level heterogeneity and time-specific effects.

If H2a is supported, we expect to see a negative trend in the coefficient of β_1 , representing that the larger size of the winning coalition is associated with lower emissions due to their emphasis on public goods. The second hypothesis (H2b) relies on the following equation that also uses two-way fixed effects to control for α_i and λ_t , which in turn reduces the risk of omitted variable bias:

$\text{emiss}_{it} = \beta_1 \text{regime}_{it} + \beta_2 X_{it} + \alpha_i + \lambda_t + \epsilon_{it}$, where emiss_{it} : the level of CO₂ emissions for country at time it ; regime: Regime type, with 4 categories; X_{it} : Vector of control variables; α_i : individual fixed effect; λ_t : time fixed effect; ϵ_{it} : Error term.

By using the function of relevel, we change the reference of the regime variable across the four categories discussed above. For example, by setting the re-leveling to closed autocracy, which is the category of 0 (regime = 0), the rest of the coefficients, electoral autocracy (regime = 1), electoral democracy (regime = 2) and liberal democracy (regime = 3), are measured. It helps to compare the relative effects of each regime type on CO₂ emissions. As a result, this will provide detailed information on how each regime type influences DV.

If H2b is supported, we expect to observe the negative and significant trends for electoral democracy (regime = 2) and/or liberal democracy (regime = 3), while a positive or less negative one should be noticed for closed autocracy (regime = 0) and/or electoral autocracy (regime = 1).

Results

Model 1

Regarding Model 1, our results indicate that the size of the winning coalition (W4) has no statistically significant relationship with the probability of adopting a climate change policy. As shown in the table, the coefficient for W4 is -0.0648 with a standard error of 0.1293, a t-value of -0.5015, and a p-value of 0.61616. Since the p-value is far above the conventional significance thresholds (e.g., 0.05), this result is not statistically significant, and thus our first hypothesis (H1) is not supported.

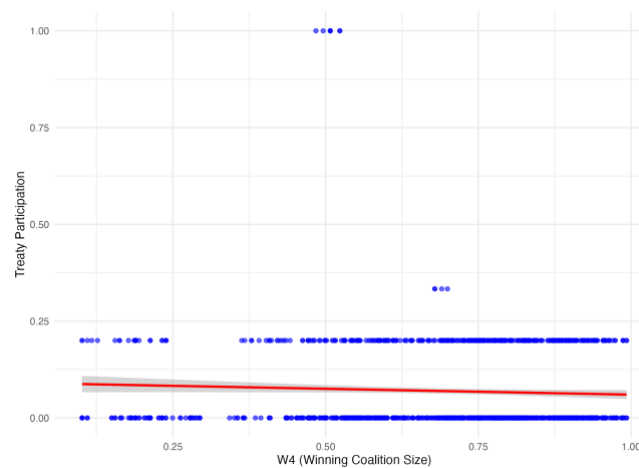


Figure 1. Illustrates the relationship between Winning Coalition Size (W4) and Treaty Participation.

Previous studies have not directly tested this hypothesis, so our finding neither supports nor contradicts existing literature. However, studies such as Neumayer (2002) have found that democratic regimes are more likely to ratify and commit to environmental treaties. If regime type is proxied by the size of the winning coalition, then our results challenge those conclusions. Although the coefficient is not significant, the negative value suggests a slightly downward trend: as the size of the winning coalition increases, the likelihood of adopting climate change policy appears to decrease.

Model 2

The results of the study provide empirical evidence that aligns with the selectorate theory. Below, we discuss the findings of Model 2 with the visualisation of the two main variables.

As discussed earlier, the first hypothesis (H2a) of Model 2 states that since the size of the winning coalition (W) increases, the performance of climate change policy improves. Thus, we expect to see less CO₂ emissions in countries with a larger winning coalition. The results of the two-way fixed effects model confirm the statement by showing significant negative coefficients. In other words, the significant negative association in the two main variables of winning coalition size (W₄) and the carbon dioxide emissions (emiss) matches strongly with the theory.

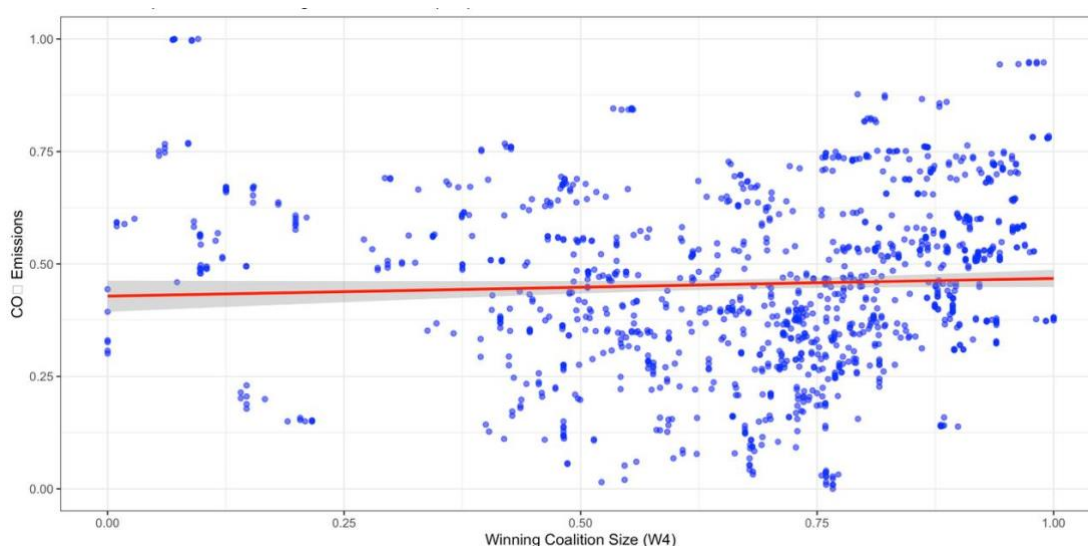


Figure 2. Illustrates the relationship Between Winning Coalition Size (W₄) and CO₂ Emissions.

Table 2 illustrates the negative relationship between W₄ and emiss variables with a slope line of - 90 392 889. This coefficient of the slope, along with the standard error of 40 628 497 and p-value of 0.0263, which shows the significance of the variable, implies that as the size of the winning coalition rises, the level of emission declines. Specifically, the coefficient of the W₄ suggests that its one-unit increase leads to the reduction of carbon dioxide emission by approximately 90.39 million metric tons. The negative trend confirms Bueno de Mesquita et al.'s (2003) assertion that larger winning coalitions will prompt the leader to worry more about public goods, such as clean air, than about private goods. In such a framework, since the leader is held responsible for a large number of people, the individual has to prioritise the policies and actions that will benefit the masses.

Regarding the second hypothesis (H2b), which states that democracies are expected to have lower emissions than autocracies. According to the selectorate theory, democratic countries characterised by a large winning coalition size are better prepared to provide public goods. However, the winning coalition size does not influence policy outcomes in the same way for all regime types. Even though the theory assumes democracy with a larger winning coalition and vice versa for autocracy, the importance of the regime shaping the relationship between W-size and environmental performance is one of the major issues raised by the difference. By investigating these regime-specific dynamics, we will be able to understand the reason behind democracies outperforming autocracies in achieving long-term environmental goals.

As mentioned earlier, the larger the winning coalition, the stronger the incentive for leaders to focus on public goods, such as clean air in this study. The empirical results support the second hypothesis of the second model by illustrating the significant negative findings between electoral democracy and emission level variables. Compared to closed autocracy, according to the coefficients of electoral democracy regime type, -25,642,710, being significant at the p-value of 0.013, and liberal democracy regime type, -21,194,333, with the p-value of 0.09 being marginally significant at the 10% level, they show considerably lower emissions. For example, electoral democracies have 25.64 million metric tons less CO₂ emissions than closed autocracies produce. Similar to the first analysis, when the results of closed autocracy were used as the reference for the analysis, the outcome of electoral democracy still represents lower emissions of carbon dioxide and vice versa. Generally, the closed autocracy (regime = 0) illustrates a higher number of emissions compared to the other 3 regimes. For example, when the electoral democracy and liberal democracy were there references one for each analysis, the results for closed autocracy illustrated higher emission.

According to the results above, we see that only electoral democracy aligns with the predictions of the theory when compared to the autocratic countries. This is shown in relatively lower levels of carbon dioxide emissions of these electoral democracies as opposed to electoral autocracy and closed autocracy. However, when comparing liberal democracy with an electoral one, we can observe the negative trend, with the former increasing its emission amount. Figure 3 represents the overall positive upward trend, as the winning coalition size rises or the regime switches from electoral to liberal. These results suggest the importance of the structure and strength of the

institutional consideration that goes beyond identifying the winning coalition size. Thus, considering the variables of institutional characteristics is important for further studies.

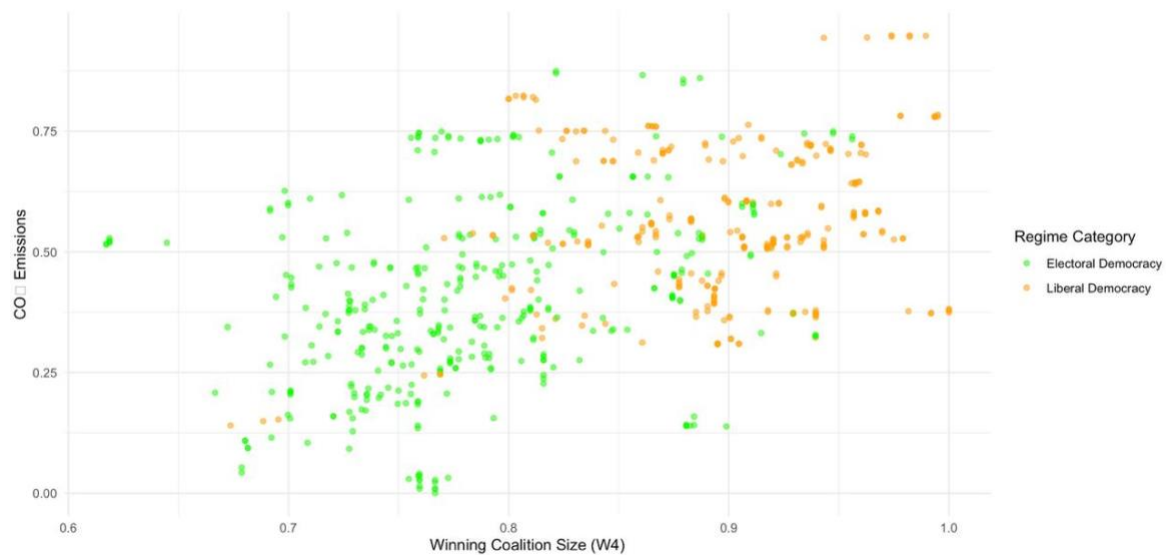


Figure 3. Relationship Between Winning Coalition Size and CO₂ Emissions in Democracy.

An interesting variation was observed within the autocratic regime subtypes regarding their environmental provision. One of the explanations is the regime's durability, which makes the pursuit of long-term goods more likely. Royal dictatorships were found to positively contribute to achieving environmental outcomes (Eichhorn & Linhart, 2022). This might explain the tendency for "Closed autocracies" to have a negative relationship between W and emissions, illustrated in Figure 4 above. The results for "Electoral autocracies" show that there is almost no association between emission levels and changes in the size of W. This might be because the size of the winning coalition in an electoral autocracy overestimates the actual number of voices considered in decision-making. Within this coalition, there is a leader whose preference has a large effect on the whole group's vote. That is, an increase in the coalition size does not necessarily mean having more decision-makers and changes in certain outcomes (Bueno de Mesquita et al., 2003). This imitation of an increase in the W size and thus continuous small W makes the provision and pursuit of short-term goals more attractive than climate goals which require long-term action.

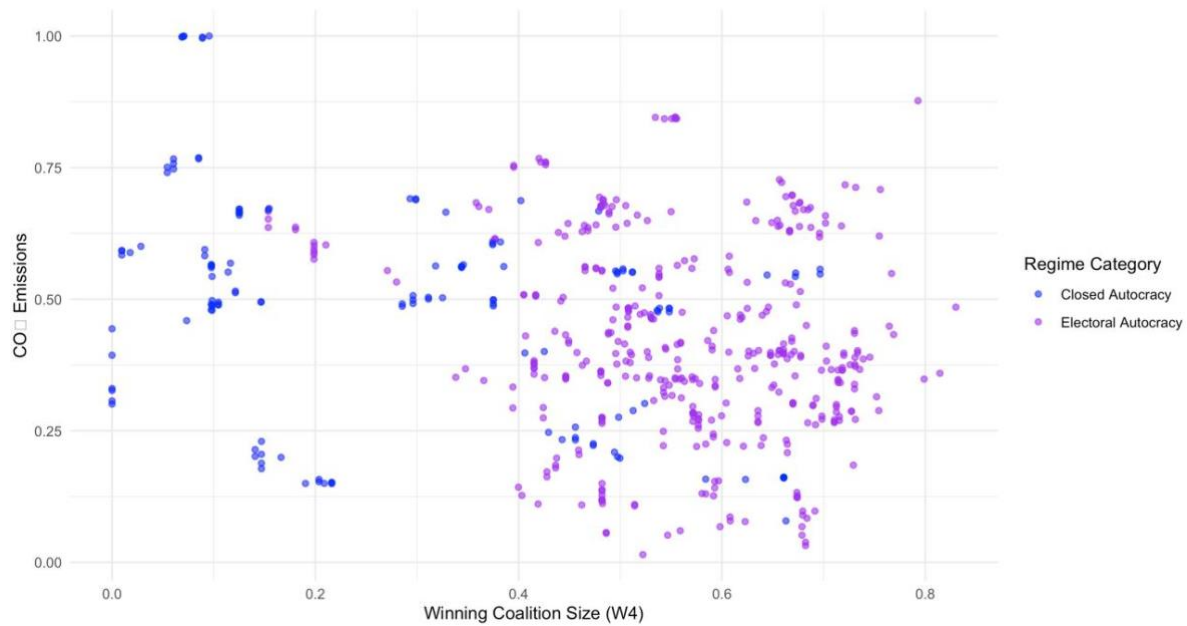


Figure 4. Relationship Between Winning Coalition Size and CO₂ Emissions in Autocracies.

Conclusion

Our analysis applies the selectorate theory to investigate the relationship between the sizes of the Winning coalitions of democracies and autocracies, climate change policy adoption, and the amount of CO₂ emissions. Previously, the theory was tested to explain the provision of general public goods, such as education, health, etc. Meanwhile, our study applies the theory by considering the environmental provision as a public good to test the causation between climate change policy adoption, along with CO₂ emission level and the Winning coalition size. Our statistical results show that the size of the winning coalition does not affect the likelihood of adopting a climate change policy, though we expected a negative relationship. In general, the increase in the size of the winning coalition had a statistically significant negative relationship with the levels of CO₂ emissions. From a policy perspective, these results reflect that enriching political inclusion and accountability will promote desired outcomes even in an environment, which implies that for international climate agreements, democratic nations support large coalitions because that would scale up the contribution of collective actions towards mitigating global emissions. However, this was not true for one democratic regime's subtype - liberal democracy - which showed a deviant tendency between the changes in the size of the winning coalition and the emission level. We also observed the different tendencies in autocratic regime subtypes, specifically closed and electoral autocracies.

In conclusion, by providing empirical data on the correlation between the winning coalition sizes, political regimes, and climate change mitigation results, this study adds to the knowledge on environmental governance. It reveals the new domain of the selectorate theory and calls for further exploration of factors such as corruption, governance quality and institutions to shape policies regarding climate change. Policymakers attempting to strike a balance between environmental sustainability and accountability in politics may find these findings useful in furthering the global effort to prevent climate change.

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Bibliography

- Alajmi, R. G. (2024). Energy consumption and carbon emissions: An empirical study of Saudi Arabia. *Sustainability*, 16(13), 5496. <https://doi.org/10.3390/su16135496>
- Bättig, B. M., & Bernauer, T. (2009). National institutions and global public goods: Are democracies more cooperative in climate change policy? *International Organization*, 63(2). <https://www.jstor.org/stable/40345935>
- Bellelli, F.S., Scarpa, R. and Aftab, A. (2023). An empirical analysis of participation in environmental agreements. *Journal of Environmental Economics and Management*, 118, 102783.
- Bueno de Mesquita, B., Smith, A., Siverson, R. M., & Morrow, J. D. (2003). *The Logic of Political Survival*. The MIT Press: London, England.
- Bueno de Mesquita, B., & Smith, A. (2015). Tanzania's economic and political performance: a district-level test of selectorate theory. In: Wolf, S., et al. *Politics in South Asia*. Springer, Cham. https://doi.org/10.1007/978-3-319-09087-0_3
- Bueno de Mesquita, B., & Smith, A. (2022). A new indicator of coalition size: tests against standard regime-type indicators. *Social Science Quarterly*. <https://doi.org/10.1111/ssqu.13123>

- Cao, H., & Ward, H. (2015). Winning coalition size, state capacity, and time horizons: an application of modified selectorate theory to environmental public goods provision. *International Studies Quarterly*, 59(2). <https://doi.org/10.1111/isqu.12163>
- Choi, Y. (2023). Foreign aid, winning coalitions, and economic growth: an empirical analysis of Asia, 1990–2010. *Asian Survey*, 63(5). <https://online.ucpress.edu/as/article-abstract/63/5/743/196874/Foreign-Aid-Winning-Coalitions-and-Economic>
- Choi, Y., & Heo, U. (2024). The economic effects of winning coalition size on the aid-growth nexus. *Social Science Quarterly*, 105(4). <https://doi.org/10.1111/ssqu.13398>
- Chou, L., Zhang, W., Wang, M., & Yang, F. (2020). The influence of democracy on emissions and energy efficiency in America: new evidence from quantile regression analysis. *Energy & Environment*, 31(8), 1318–1334. <https://doi.org/10.1177/0958305x19882382>
- Congleton, R. D. (1992). Political institutions and pollution control. *The Review of Economics and Statistics*, 74(3), 412. <https://doi.org/10.2307/2109485>
- Deacon, R., & Saha, S. (2005). Public good provision by dictatorships: a survey. *Departmental Working Papers. University of California, Santa Barbara*. <https://escholarship.org/uc/item/1jk5b0vr>
- Eichhorn, K., & Linhart, E. (2022). Autocratic heterogeneity in the provision of environmental protection. *Zeitschrift Für Vergleichende Politikwissenschaft*, 16(1), 5–30. <https://doi.org/10.1007/s12286-022-00519-7>
- Fowler, L. (2019). Problems, politics, and policy streams in policy implementation. *Governance*, 32(3), 403–20. <https://onlinelibrary.wiley.com/doi/full/10.1111/gove.12382>
- Fredriksson, P. G., & Wollscheid, J. R. (2007). Democratic institutions versus autocratic regimes: The case of environmental policy. *Public Choice*, 30, 381–393. <https://www.jstor.org/stable/27698068>
- Global Carbon Budget (2024) – with major processing by Our World in Data. “Annual CO₂ emissions – GCB” [dataset]. Global Carbon Project, “Global Carbon Budget” [original data].
- Grossman, G., & Krueger, A. (1994). Economic growth and the environment. <https://doi.org/10.3386/w4634>

- IPCC. (2007). *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, Pachauri, R.K. and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.
- Iwińska, K., Kampas, A., & Longhurst, K. (2019). Interactions between democracy and environmental quality: toward a more nuanced understanding. *Sustainability*, 11(6), 1728. <https://doi.org/10.3390/su11061728>
- Kammerlander, A., & Schulze, G. G. (2021). Political-economic correlates of environmental policy. *Environmental Research Letters*, 16(2). <https://doi.org/10.1088/1748-9326/abdc89>
- Lisciandra, M., & Migliardo, C. (2016). An empirical study of the impact of corruption on environmental Performance: Evidence from Panel Data. *Environmental and Resource Economics*, 68(2), 297–318. <https://doi.org/10.1007/s10640-016-0019-1>
- Midlarsky, M. I. (1998). Democracy and the environment: An empirical assessment. *Journal of Peace Research*, 35(3), 341-361. <https://doi.org/10.1177/0022343398035003005>
- Mulligan, C. B., Gil, R., & Sala-I-Martin, X. (2003). Do democracies have different public policies than nondemocracies? *The Journal of Economic Perspectives*, 18(1), 51–74. https://www.nber.org/system/files/working_papers/w10040/w10040.pdf
- Onofrei, M., Vatamanu, A. F., & Cigu, E. (2022). The relationship between economic growth and CO2 emissions in EU countries: A Cointegration analysis. *Frontiers in Environmental Science*, 10. <https://doi.org/10.3389/fenvs.2022.934885>
- Paris Agreement. (2015). Retrieved from https://unfccc.int/sites/default/files/english_paris_agreement.pdf
- Povitkina, M. (2018). The limits of democracy in tackling climate change. *Environmental Politics*, 27(3), 411-432. <https://doi.org/10.1080/09644016.2018.1444723>
- Sekera, J. (n.d.). Public goods in everyday life. Global Development and Environment Institute, Tufts University. <https://ase.tufts.edu/gdae>
- Siebert, H. (1998). *Economics of the environment: theory and policy* (5th ed.). Springer.
- Sinha, A., Sedai, A. K., Kumar, A., & Nepal, R. (2021). Are autocracies bad for the environment? Global evidence from two centuries of Data. *The Energy Journal*, 44(2), 47–78. <https://doi.org/10.5547/01956574.44.2.asin>

- Spilker, G. (2013). *Globalization, political institutions and the environment in developing countries*. Routledge.
- Tiwari, K. A. (2011). Energy consumption, CO2 emissions and economic growth: Evidence from India. *Journal of International Business and Economy*, 12(1), 85-122.
<https://doi.org/10.51240/jibe.2011.1.5>
- United Nations Framework Convention on Climate Change, January 20, 1994.
https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf
- Wang, Z., Danish, N., Zhang, B., & Wang, B. (2018). The moderating role of corruption between economic growth and CO2 emissions: Evidence from BRICS economies. *Energy*, 148, 506–513. <https://doi.org/10.1016/j.energy.2018.01.167>
- Weiss, E. B., & Jacobson, H. K. (1999). Getting countries to comply with international agreements. *Environment: Science and Policy for Sustainable Development*, 41(6), 16-20.
<https://doi.org/10.1080/00139159909604641>
- Wurster, S. (2013). Comparing ecological sustainability in autocracies and democracies. *Contemporary Politics*, 19(1), 76–93. <https://doi.org/10.1080/13569775.2013.773204>

Appendix

The dataset contains 10 key variables: pol_cor (corruption), gdp, popsize (population size), capacity, emiss (the amount of present carbon dioxide emission), regime, energy_use, treaty (the ratio of participation in treaty), trnslw (the level of enforcement) and W4 (size of winning coalition). The following variables are treated as control ones:

Political Corruption (pol_cor): it measures the level of overall political corruption, ranging from 0 to 1. The data was sourced from Varieties of Democracy (V-dem) dataset.

GDP (gdp) measures a country's economic output per capita, which was taken from the World Bank's dataset collection. During the analysis, the variable was rescaled using the formula of (Original Value - Minimum Value)/ (Maximum Value - Minimum Value). It was done to adjust each value relative to the minimum and maximum values in the column.

Population size (popsize) for each year. Similar to gdp variable, it was also rescaled. Since the population numbers for each country were large. The values for the variable were taken from Our World in Data's dataset collection.

Capacity (capacity): This index, which measures the level of the government's ability to maintain authority and integrity, was derived using the loadings from the original article by O'Reilly and Murphy (2022).

Energy consumption (energy_use): Similar to popsize, the information for the variable was derived from Our World in Data's dataset collection. According to the website, "it is measured in terawatt-hours, using the substitution method".

Law transparency index (trnslw): Similar to pol_cor, the data was derived from Varieties democracy's dataset. The variable examines factors like clarity, stability, and enforcement of laws.

Statistical Output

Model 1

Variable	Coefficient	Std_Error	t_value	p_value	Significance
W4	-0.0648215	0.129266	-0.5015	0.61616	-
Energy Use	0.5005165	0.2895158	1.7288	0.08415	.
Political Corruption	-0.2171331	0.1018162	-2.1326	0.0332	*
Law Transparency	-0.0196349	0.0142153	-1.3812	0.16751	-
Population Size	7.8058296	0.6809149	11.4637	<2.2e-16	***
GDP per Capita	0.0109578	0.0018464	5.9345	4.051e-09	***
State Capacity	-0.1548175	0.1310106	-1.1817	0.2376	-

Table 1. Results of the regression analysis for Model 1.

Model 2

Variable	Coefficient	Std_Error	t_value	p_value	Significance
Regime 1	-8234632	7838253	-1.0506	0.29371	-
Regime 2	-25642710	10264615	-2.4982	0.01264	*
Regime 3	-21194333	12493072	-1.6965	0.09011	.
Law Transparency	244875	4503987	0.0544	0.95665	-
Energy Use	461461787	91747274	5.0297	<0.001	***
Political Corruption	24805134	33391482	0.7429	0.45774	-
State Capacity	2133482	41574644	0.0513	0.95908	-
GDP per Capita	-163884	662606	-0.2473	0.8047	-
Population Size	146836594	290477022	0.5055	0.61332	-

Table 2. The results of the regression analysis for Model 2's H2b hypothesis, with the reference for closed autocracy.

Variable	Coefficient	Std_Error	t_value	p_value	Significance
Regime 0	8234632	7838253	1.0506	0.293711	-
Regime 2	-17408078	6195477	-2.8098	0.005054	**
Regime 3	-12959701	9076408	-1.4278	0.15365	.
Law Transparency	244875	4503987	0.0544	0.956652	-
Energy Use	461461787	91747274	5.0297	<0.001	***
Political Corruption	24805134	33391482	0.7429	0.457743	-
State Capacity	2133482	41574644	0.0513	0.959083	-
GDP per Capita	-163884	662606	-0.2473	0.804702	-
Population Size	146836594	290477022	0.5055	0.613318	-

Table 3. The results of the regression analysis for Model 2's H2b hypothesis, with reference to electoral autocracy.

Variable	Coefficient	Std_Error	t_value	p_value	Significance
Regime 3	4448376	7528018	0.5909	0.554715	-
Regime 1	17408078	6195477	2.8098	0.005054	**
Regime 0	25642710	10264615	2.4982	0.012644	*
Law Transparency	244875	4503987	0.0544	0.956652	-
Energy Use	461461787	91747274	5.0297	<0.001	***
Political Corruption	24805134	33391482	0.7429	0.457743	-
State Capacity	2133482	41574644	0.0513	0.959083	-
GDP per Capita	-163884	662606	-0.2473	0.804702	-
Population Size	146836594	290477022	0.5055	0.613318	-

Table 4. The results of the regression analysis for Model 2's H2b hypothesis, with reference to electoral democracy.

Variable	Coefficient	Std_Error	t_value	p_value	Significance
Regime 1	12959701	9076408	1.4278	0.15365	.
Regime 0	21194333	12493072	1.6965	0.09011	.
Regime 2	-4448376	7528018	-0.5909	0.55472	-
Law Transparency	244875	4503987	0.0544	0.95665	-
Energy Use	461461787	91747274	5.0297	<0.001	***
Political Corruption	24805134	33391482	0.7429	0.45774	-
State Capacity	2133482	41574644	0.0513	0.95908	-
GDP per Capita	-163884	662606	-0.2473	0.8047	-
Population Size	146836594	290477022	0.5055	0.61332	-

Table 5. The results of the regression analysis for Model 2's H2b hypothesis, with reference to liberal democracy.