The Power of Peers

A Spatial Analysis of Nationally Determined Contributions

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This is an Accepted Manuscript of an article published by Taylor & Francis in Climate Policy on April 12, 2025, available at: https://doi.org/10.1080/14693062.2025.2489738

Abstract: The Paris Agreement's pledge and review process was designed to ramp up climate ambition through norm-setting and repeated interactions. Yet this peer influence dynamic remains underexplored in analyses of the determinants of climate ambition. To address this gap, this paper examines whether the climate ambition of peer countries can explain climate ambition in subsequent rounds of Nationally Determined Contributions (NDCs). This paper builds on and contributes to research on the Paris Agreement, the drivers of climate ambition, and the broader literature on soft governance. Using spatial regression models, the analysis incorporates peer pressure into spatial lags of first-round NDC ambition to assess patterns of convergence and divergence in the second round of NDCs. The results show that climate ambition for peer groups with high geopolitical affinity, similar levels of democracy, and regional similarity converges, while countries with similar income levels exhibit diverging ambition trends. These results underscore the interdependent nature of climate ambition and suggest that leveraging peer networks could enhance global climate cooperation under the Paris Agreement.

Keywords: Paris Agreement, pledge and review, climate governance, peer groups, climate ambition, spatial regression, Nationally Determined Contributions

Key policy insights:

- Although NDC formulation is a national matter, climate ambition is found to be interdependent across countries. It is therefore relevant to take this interdependence into account, yet this has thus far been underexplored.
- There is no peer relationship between multilateral interaction or participation in UNFCCC negotiation groups with climate ambition. It can therefore be helpful to strengthen or reconfigure the participatory regime surrounding the Paris Agreement to promote climate ambition among peers.
- Climate ambition is found to converge among peer countries based on democracy levels, regional location, and voting patterns in the United Nations General Assembly. Starting new or strengthening ongoing cooperation initiatives among these peer groups may be beneficial for raising climate ambition.

INTRODUCTION

With global temperatures having breached the symbolic 1.5° warming above pre-industrial levels in 2024 (Copernicus, 2025), evaluating the effectiveness of the Paris Agreement has never been more urgent. Ambition under the Paris Agreement is formulated in the form of Nationally Determined Contributions (NDCs), which are meant to be pledged at least every 5 years (UNFCCC, 2015, Article 4). In 2025, the third round of NDCs, monikered 'NDC 3.0' by the UNFCCC (n.d.-a), is due. This governance design shifted the debate about what countries are supposed to do from the international to the domestic stage. Research on the drivers of ambition within the Paris Agreement, which predominantly focuses on domestic factors, reflects this as well (Albalate et al., 2023; Bel & Teixidó, 2020; Peterson et al., 2023; Tørstad et al., 2020; Zheng et al., 2021).

This paper asks: 'Does the NDC ambition of peer countries relate to a country's climate ambition?' It aims to test the Paris Agreement's 'peer pressure' proposition, which states that transparency and the mobilisation of international and domestic pressure can lead countries to increase their ambition (Dannenberg et al., 2023; Falkner, 2016; Sachs, 2020). Scholars supporting this soft governance approach see climate change not as a traditional collective action issue (Nordhaus, 2015; Ostrom, 2010), but instead view the Paris Agreement as a 'catalytic institution' that fosters cooperation and drives initial and continued climate action (Hale, 2020).

To empirically test this peer influence relationship, peer groups are translated into spatial variables and included in a spatial-x regression analysis. These variables use country 'peerness' or similarity to represent the distance between them. This approach explicitly models the interdependence of countries and provides a solution to Galton's problem, which proposes that countries as units of analysis cannot be considered to be independent (Braun & Gilardi, 2006). Peer levels are not expected to replace established cross-national determinants of NDC ambition but are meant as an additional explanation of ambition, supplementing the domestic focus in the literature.

This article proceeds as follows. First, a literature review examines the role of peer groups in global climate governance. Next, the methodology of the analysis is outlined, followed by a presentation of the regression results. Finally, the discussion reflects on the implications of these findings.

1. PEER GROUPS IN GLOBAL CLIMATE GOVERNANCE

This article examines how peer groups and interdependence can influence national policymaking. As Neumayer and Plümper (2010, p. 587) emphasise: 'all social science studies in which agents' strategies are partly dependent on the strategies chosen by other agents need to account for spatial dependence.' This dependence extends beyond geographic proximity to include latent interactions and shared characteristics

(Drolc et al., 2021). The following section non-conclusively outlines key forms of proximity and similarity that shape peer behaviour.

Common characteristics such as level of income or geographic region can drive policy convergence (Bernauer et al., 2010). However, Bernauer et al. (2010) also found geographic proximity to have a stronger effect than income-related ones, likely because countries tend to learn from and emulate their neighbours (Drolc et al., 2021). This regional peer relationship has been studied extensively for a multitude of issue areas, including international labour rights, monetary policy, and democracy (Baccini & Koenig-Archibugi, 2014; Smith, 2007). Desmarais et al. (2015, p. 400) highlight geographic proximity as the most studied peer dynamic, though some scholars caution against relying on it as a default explanatory variable (Fredriksson & Neumayer, 2016).

Beyond geography, shared membership in international organisations can foster policy alignment. Countries that often interact with one another, such as through formal alliances, shared diplomatic ties, or economic competition, are more likely to mirror each other's climate policy and ambition (Baccini & Koenig-Archibugi, 2014; Edgerton, 2021; Terman & Voeten, 2018). Böhmelt et al. (2017), distinguish between 'institutional peer groups', where countries share regime types, or 'experiential peer groups', where countries look at those with similar track-records. Within this framework, democracy levels may also shape climate policy diffusion. Geopolitical affinity can also align countries to one another. Terman and Voeten (2018) found that countries with similar voting behaviour in the United Nations General Assembly (UNGA) were less likely to shame allies or provide stringent recommendations on their human rights policies, but more likely to accept recommendations from one another. In this vein, research has also found that ideological distance has a significant, negative effect on policy adoption, making it less likely for countries to copy the behaviour of another, less ideologically similar country (Desmarais et al., 2015; Grossback et al., 2004).

There are also groups that are specifically relevant to the NDC formulation process. Developing countries face constraints when drafting their NDCs, at least partially from a lack of support and resources throughout the process[1] (Khan et al., 2020; Röser et al., 2020). Interaction with other nations, particularly through existing frameworks such as the NDC Partnership and Regional Collaboration Centres, are vital for NDC formulation processes (NDC Partnership, 2021). Within the UNFCCC, these contacts are often organised in negotiation groups such as AOSIS or the Umbrella Group. Stephenson et al. (2019) found that there is a weak, but notable relationship between party grouping membership and NDC similarity. Socialisation

[1] This was especially the case for the formulation of the INDCs, or 'Intended Nationally Determined Contributions'.

within these, as Castro et al. (2014) dub them 'constructed peer groups', may enhance cohesion, positioning them as influential peer groups or norm translators (C. Höhne et al., 2023).

2. METHODS

This study uses spatial econometrics to study the relationship between peer groups and climate ambition. Since first being coined in 1974, spatial econometrics has grown beyond early focus on quantitative geography and regional science, not in the least due to the swift development of supporting software in R and other software (Bivand et al., 2021). The method lends itself well to political science, particularly when discussing policy diffusion and contagion (Di Salvatore & Ruggeri, 2021).

The analysis follows a theory-testing approach, aiming to assess whether the inclusion of the average peer ambition of the initial NDC, also known as its spatial lag, offers a better explanation for the variance among updated NDC levels than the base linear model. 'Peerness' is used to operationalise closeness or space: the extent to which countries are peers is translated into X-by-X connectivity matrices representing the peer 'distance' between countries (Ward & Gleditsch, 2008).

The assumption is not that peer effects explain the lion's share of variance in NDC ambition, but that its inclusion adds to existing domestic interest-based explanations. The core, non-spatial model controls for established domestic regressors of climate ambition: the log of GDP per capita (World Bank, 2023b), oil (World Bank, 2023d), gas (World Bank, 2023c), and coal rents (World Bank, 2023a), democracy (Coppedge et al., 2023; Maerz et al., 2022), and vulnerability to climate change (University of Notre Dame, n.d.). These regressors are drawn from a literature search described in the supplementary data. This core model is enhanced with a spatial variable $\mathrm{W}NDC_1$, as presented in formula (1).

$$\text{Spatial X Model: } NDC_2 = \theta \mathrm{W} NDC_1 + \beta_1 NDC_1 + \beta_2 \mathrm{X} + \epsilon \quad (1)$$

$WNDC_1$ represents the spatial lag, or the average climate ambition of peers of the first NDC (Ward & Gleditsch, 2008).[2] Θ is the spatial spillover coefficient, or 'the effect of X in neighbouring units' (Di Salvatore & Ruggeri, 2021, p. 10). The direct factor $\beta_1 NDC_1$ is also taken into account, so as to distinguish between the direct relationship with the initial NDC levels, namely the countries' own NDC ambition, from the indirect relationship held in the spatial lags (Golgher & Voss, 2016). $\beta_2 \mathrm{X}$ represents the effect of X, the collection of control variables gathered from extant research. Epsilon (ϵ) is the error term. This equation is a spatial-x

[2] This variable is calculated by multiplying NDC1 ambition with each peer group matrix and dividing the resulting vectors by the number of peers per country, per peer group.

model, where there is an expected spillover effect of one of the covariates (in this case the first NDC) (Neumayer & Plümper, 2010).

The expectation is that there is positive convergence in the targets: high peer ambition in the first round will lead to high ambition in the second. The analysis is conducted in R in the RStudio environment with the support of the spdep package (Pebesma & Bivand, 2023). All data and scripts are openly accessible via Zenodo at https://zenodo.org/doi/10.5281/zenodo.12705494.

The following sections describe the operationalisation of key variables: (1) the dependent NDC ambition variable, (2) the control variables representing cross-national drivers of climate ambition, and (3) the peer groups used to construct the spatial lags. Descriptive statistics of all variables are included in the supplementary data.

2.1 DEPENDENT VARIABLE: NDC OPERATIONALISATION

There are various ways to quantify or operationalise climate ambition (N. Höhne et al., 2018). This paper focuses on one specific phenomenon of climate ambition, namely the climate ambition put forth in country's NDCs. Still, these NDCs can be evaluated in a myriad of ways. Due to the high flexibility in reporting requirements NDCs are quite heterogenous which complicates comparability (de Villafranca Casas et al., 2021; Pauw et al., 2018; Rajamani & Bodansky, 2019). There is also little clarity on what increasing ambition actually means and how this should be evaluated. (Pauw & Klein, 2020). Nonetheless, several quantifications of NDCs have been developed. Table 1 gives an overview of four major resources.

Table 1: Available quantifications of Nationally Determined Contributions

	Indicators	**Last updated**	**N**	**Source**
Climate Action Tracker	NDC sufficiency; Effect of climate policies and action on emissions; impact over time; comparability of effort (fair share)	Continuous	39 +EU	Climate Analytics and NewClimate Institute (n.d.)
INDC and NDC factsheets	Emissions change	2022	193	Meinshausen et al. (2022b)
Pledged Warming Map	Estimated median global warming in 2100 based on a self-interested approach of effort-sharing	2022[3]	173	Robiou du Pont et al. (2017)

[3] The original warming assessment has been supplemented with data on the updated NDCs from the November 2022 update of Meinshausen et al. (2022)

Climate watch NDC Tracker	NDC submissions comparison (2024 update includes submissions after November 4, 2024)	Continuous	197 (global)	World Resources Institute (2024)

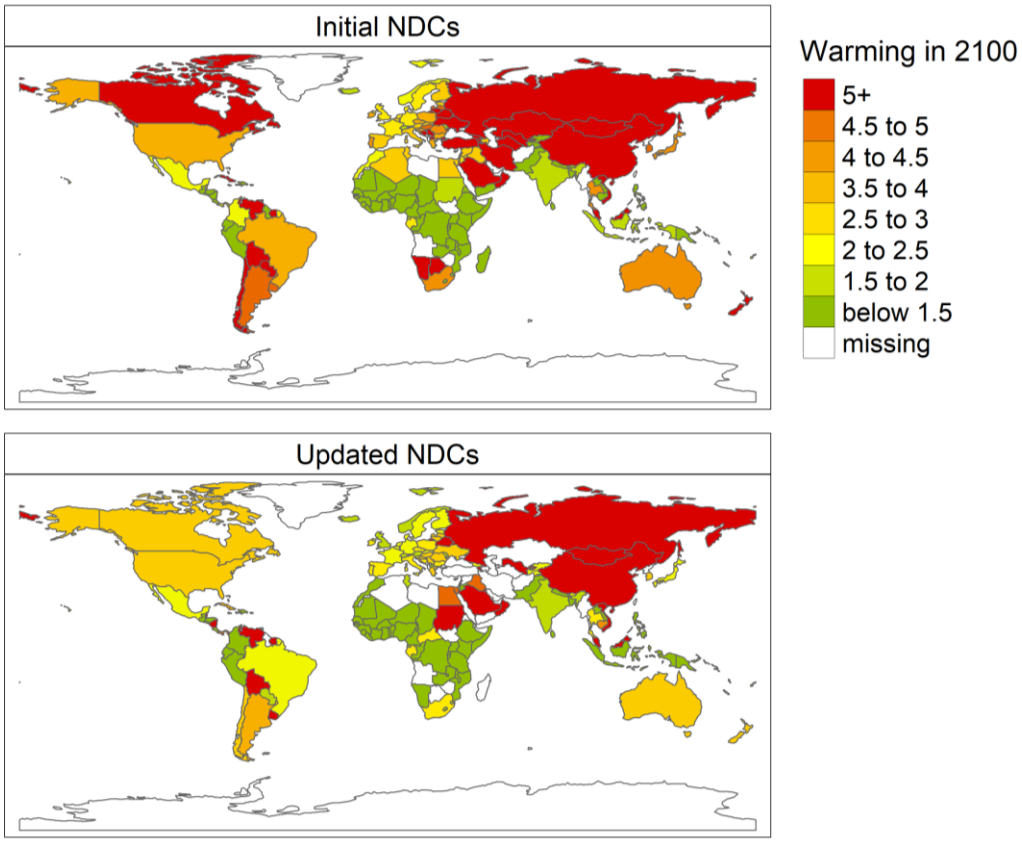
Source: Author's own compilation, last updated January 7, 2025

Given this paper's focus on the relationship between a country's NDCs and the ambition of its peer countries, a dataset with at least two rounds of assessed NDCs is needed. For the regression analysis, it is also beneficial to have a high N, which excludes the Climate Action Tracker. The NDC Enhancement Tracker from Climate Watch (2021) is also chosen against due to the need for a quantified target. One approach to quantifying the NDCs has been to calculate their projected emission reductions (Albalate et al., 2023; Flagg & Rudel, 2021). Compared absolute emission targets without considering historical emissions and other measures of equity runs the risk of grandfathering, which unfairly benefits developed nations (Knight, 2013; van den Berg et al., 2020).

This paper therefore opts to use the Robiou du Pont and Meinshausen (2018)'s quantification of NDCs in the form of the pledged warming map. They estimated the projected warming in 2100 based on each country's NDC, if all other countries would project similar climate ambition according to the equity approach that best matches the interests of that country: capability to pay (GDP per capita), historical responsibility (equal cumulative per capita emissions), or equality (equal per capita emissions). Figure 1 shows a map of this projected warming for both the initial NDC and the updated NDCs. Using this NDC assessment is not without caveats, however. On one hand, there is the issue of the endogeneity of GDP per capita, which is also one of the regressors in the core model of the analysis. On the other, some have criticised the normative foundation of the paper and its approach to modelling equity, including how it is still sensitive to grandfathering and that it doesn't capture the true richness of equity scholarship (Dooley et al., 2021; Kartha et al., 2018). Despite these concerns, the pledged warming map is peer reviewed and has also been used as an approximation of NDC ambition in other peer reviewed research such as Tørstad et al. (2020).

The Meinshausen et al. (2022) dataset is used to add a publication year to each assessed NDC. Regarding conditionality, the most ambitious interpretation of each NDC is selected. The Pledged Warming Map varies from a projected global warming of 1.2°C (most ambitious) and warming of over 5.1°C (least ambitious). To facilitate interpretation, following Tørstad et al. (2020), these values are inverted so that higher values reflect higher ambition (max(x) – x). The final dependent variable therefore ranges from 0 to 3.9.

Figure 1: Expected global warming in 2100 (in °C)



Source: Map generated using the tmap package (Tennekes, 2018) and data from Robiou du Pont and Meinshausen (2018)

2.2 OPERATIONALISING PEER GROUPS

To test the hypotheses, spatial lags of first-round ambition levels are calculated, representing the average ambition among peers for each peer group. An overview of the variable operationalisation per hypothesis, including the source for each spatial lag, can be found in the supplementary data. Notably, none of the matrices in this research are row-standardised to preserve the relative relevance of peers per country (Neumayer & Plümper, 2016).

To capture peer influence on the second round of NDCs, the spatial lags are calculated using data preceding the publication of these updated NDCs. For two out of the six hypotheses, geopolitical affinity and ideology, the data from the year before NDC publication is used. For another two, data from 2019 is used, since most updated NDCs in the dataset were published after 2019 (Meinshausen et al., 2022). For the multilateral interaction hypothesis, the most recent available data from the Correlates of War Project was used, which is 2014 (Hernangómez, 2024). Finally, for the UNFCCC negotiation groups, the most recent additions to negotiation groups were not considered, as the negotiation groups might not have had a strong impact on their NDC formulation process yet.

For the **development hypothesis**, The first hypothesis resulted in a symmetric, binary connectivity matrix, representing the shared income group for each country based on the 2019 World Bank income group classification (World Bank, n.d.).

To identify neighbours for the **multilateral interaction hypothesis**, member participation in intergovernmental organisations was gathered from the Correlates of War Project, using the igoR package (Hernangómez, 2024). The 25% most connected countries were identified as neighbours for each country, others were assigned '0'.

For the **geopolitical affinity hypothesis**, voting behaviour in the United Nations General Assembly is used to estimate geopolitical proximity. More specifically, data on the absolute distance between country ideal points within the UNGA is used (Bailey et al., 2017). Since the initial scale has mean 0 and standard deviation 1, if two countries have an absolute distance of higher than 1, this is seen as a non-connection. To make sure that higher values equal higher 'connectivity', and that 0 equals to no connection, the connectivity matrix is calculated as 1-absolute distance.

To determine if two countries have a similar **ideology**, the Global Leader Ideology dataset by Bastian Herre (2023) is used. This dataset, covering leaders from 1945 until 2020, makes a distinction between the head of government and the leader, or the 'politically most powerful individual' (Herre, 2023, p. 741). For the purposes of this article, ideological similarity is based on the ideology of the head of government as the main executive power.[4] This results in another binary X by Y matrix, where '1' represents a similar ideology of X and Y in the year before X handed in their NDC.[5] This matrix is therefore asymmetrical: XY can be similar, but YX can be different, as a different ideology could represent at a different point in time.

The **institutional peer hypothesis** is based on the 2019 V-Dem Electoral democracy index, which, for the dataset, ranges from 0.016 to 0.915. Lower values represent low levels of electoral democracy (Coppedge et al., 2023). Countries were determined to be institutional peers if their V-Dem score was within 0.1 point on the index from each other. If not, these countries were assigned '0'.

To populate the peer groups based on **UNFCCC negotiation groups**, Pearce and Yeo (2015), Höhne et al. (2023), and Liu and Zhang (2024) were cross-referenced with the UNFCCC Party Groupings webpage (UNFCCC, n.d.-b). Membership of the Environmental Integrity Group was pulled from the International Institute for Sustainable Development (2022), and the website from the Group of Mountain Partnership, the G77

[4] Where there is no data about the head of government, the ideology of the country's leader is used as the reference. If there is no information for a given year, but there is data on, at the earliest, the 2017 leader, this ideology is taken as a reference. 2017 is the earliest possible lag of updated NDCs.

[5] For the twenty-five countries that submitted their second NDC in 2021, 2020 is used as the year of reference.

plus China and Landlocked Developing Nations were used for the most recent membership data for those groups (FAO, n.d.; The Group of 77, n.d.; United Nations, n.d.-b). A more detailed overview of the country groups, their sources, and inclusion decisions can be found in the supplementary data. Each count of a country being in the same negotiation group as another country is added, for weights varying from 0 (1 country, namely Bosnia and Herzegovina) to 6 (8 countries).

Finally, whether or not countries are part of the same **region** is operationalised using the United Nations Geographic Regions classification (United Nations, n.d.-a). This is a symmetrical, binary matrix with a '1' if a country is part of the same region and '0' if not.

Four out of seven peer groups are non-binary, meaning that weights denoting distance are applied to the spatial lag. Following Neumayer and Plümper (2016), the relevance of each peer group is tested and shared in the supplementary data.

2.3 CONTROL VARIABLE OPERATIONALISATION

To paint a comprehensive image of the relationship between peer groups and climate ambition, this analysis pays mind to extant analyses and includes regressors with a proven relationship with climate ambition. To comprehensively identify these regressors, a systematic search was performed in December 2023 through a three-part query[6] in both Scopus and Web of Science. This narrowed the literature down to (1) the NDCs and the Paris Agreement, (2) policy ambition, and (3) drivers and constraints of policy. To make sure that all articles on the drivers of NDC ambitions were captured despite the high specificity of the query, the results were supplemented through forwards and backwards citations searching. The collection, selection, and general variable overview of these articles is described in the supplementary data.

Based on this literature on climate ambition, several cross-national variables are included in the analysis that are expected to determine climate ambition. The inclusion of these control variables is important, as it is otherwise difficult to isolate the relationship of the peer ambition level. Data on GDP/capita and fossil fuel rents (coal, natural gas, and oil rents) are imported from the World Bank Data platform (World Bank, 2023a, 2023c, 2023d, 2023b). Levels of democracy are supplied as the polyarchy index gathered from the Varieties of Democracy dataset (Coppedge et al., 2023; Maerz et al., 2022). Finally, climate vulnerability is taken from the Notre Dame Global Adaptation Initiative (ND-GAIN) (University of Notre Dame, n.d.). All of these datapoints have been selected for the year before the updated NDC was published to avoid post-treatment bias (Baccini & Koenig-Archibugi, 2014).

[6] The query used was: (TITLE-ABS-KEY(((pledge AND "Paris Agreement") OR "Nationally Determined Contributions") AND ("climate ambition" OR "climate policy ambition" OR "mitigation ambition" OR "ambit* climate polic*") AND (driver OR determinant))).

3. RESULTS

The base linear regression model, excluding spatial lags, is presented in Table 2. The table shows the estimates for both the initial (1) and the updated NDCs (2-3), with the latter including the warming estimations of the initial NDC (3). The findings align with Tørstad et al. (2020), who conducted an ordinary least squares regression with a similar configuration: GDP per capita has a negative significant relationship with climate ambition, while democracy and vulnerability have a positive significant relationship. One notable difference is that coal rents no longer have a significant relationship with projected warming.

Introducing initial NDC levels yields interesting effects. The initial NDC has a strong, significant positive relationship with the updated NDC. The inclusion also adds to the explanatory power of the model: the R squared is increased from 0.36 to 0.56. When holding the initial ambition levels of a country constant, levels of democracy have a positive relationship with climate ambition, whereas oil rents have a slightly significant (p<0.1) negative correlation. This diminishes the previously observed significance of GDP/capita and climate vulnerability. This is consistent with Peterson et al. (2023), who found that democracy has a positive relationship with NDC enhancement. While they use a different metric of ambition, this finding implies a similar relationship. They did not find fossil fuel rents to restrict NDC enhancement, which makes the negative relationship of oil rents relevant to pursue in further research.

Table 2: Linear regression model for both the initial and updated NDCs

	Estimate (Std. Error)		
	Initial NDC	Updated NDC	
	(1)	(2)	(3)
Constant	2.130 (1.920)	3.100 (1.890)	1.340 (1.580)
GDPperCaplog	-0.464*** (0.148)	-0.416*** (0.142)	-0.152 (0.123)
OilRents	-0.003 (0.018)	-0.036 (0.023)	-0.034* (0.019)
CoalRents	0.008 (0.124)	-0.100 (0.087)	-0.080 (0.072)
NaturalGasRents	-0.003 (0.036)	0.037 (0.099)	0.019 (0.082)
v2x_polyarchy	1.990*** (0.526)	2.730*** (0.540)	1.860*** (0.461)
Vulnerability	6.910*** (1.956)	4.120** (1.960)	1.350 (1.660)
Initial NDC			0.505*** (0.064)
Observations	155	142	142
R^2	0.456	0.361	0.564
Adjusted R^2	0.434	0.333	0.541
F statistic	20.700*** (df = 6; 148)	12.700*** (df = 6; 135)	24.700*** (df = 7; 134)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 3 presents the spatial-x regression models, incorporating peer group through the variable 'Lag initial NDC'. A significant relationship was found in four models: a negative one in the case of development and positive correlations with geopolitical affinity, institutions, and regional proximity.[7] These findings suggest

[7] This means that for every additional 1°C projected temperature change in 2100 in NDC1, this would respectively add 0.40, 5.92, and 0.27 to the target in the second NDC. Because the peer groups for geopolitical affinity and institutions are numerical and therefore weighted, the average peer ambition is also affected by the numerical weights, which affects the interpretation of the coefficient. This does not, however, impact the direction or significance of the result.

that countries within institutional, geopolitical, and regional peer groups tend to enhance their NDC commitments when their peers demonstrate higher ambition. Counter to theoretical expectation, the opposite is true for development, where a negative relationship is found.

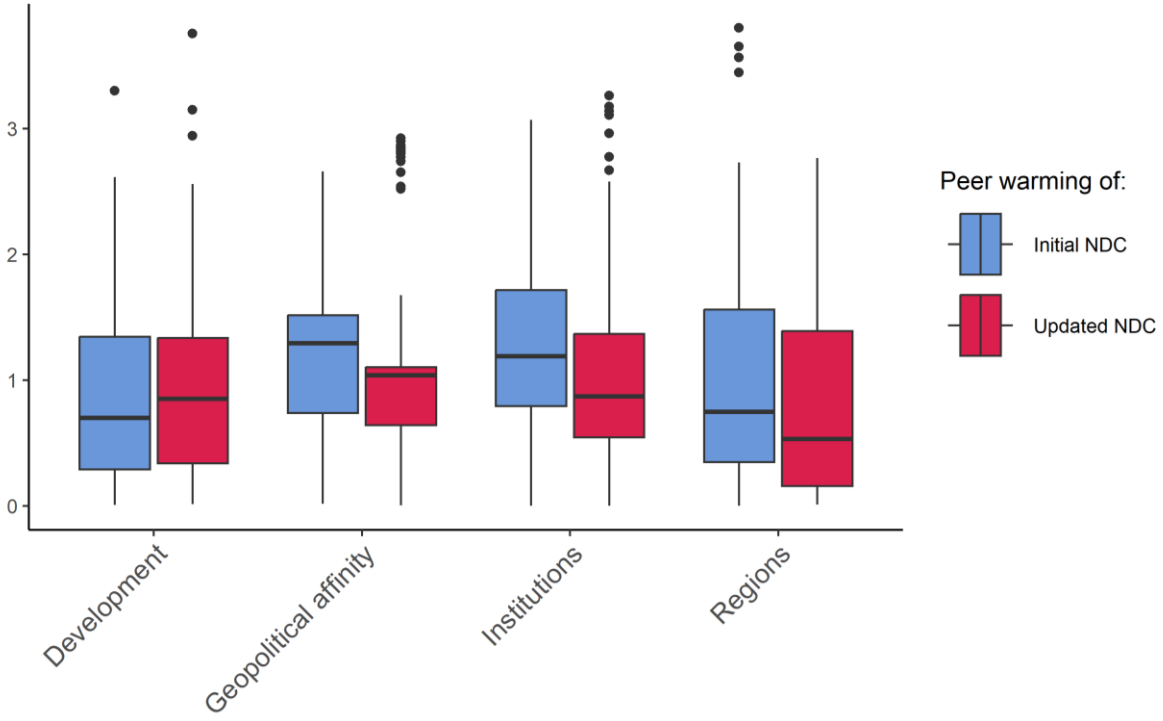
Table 3: Spatial-X models for all peer group configurations – with initial NDC as regressor

	Warming, Estimate (Std. Error)						
Hypothesis	Development	Multilateral interaction	Geopolitical affinity	Ideology	Institutions	Negotiating groups	Regions
Constant	4.380** (1.730)	1.340 (1.610)	0.775 (1.610)	2.030 (1.730)	-0.397 (1.790)	0.891 (1.620)	1.260 (1.550)
GDPperCaplog	-0.401*** (0.136)	-0.156 (0.123)	-0.136 (0.122)	-0.187 (0.125)	-0.053 (0.131)	-0.150 (0.124)	-0.112 (0.121)
OilRents	-0.048** (0.019)	-0.033* (0.020)	-0.036* (0.019)	-0.018 (0.023)	-0.033* (0.019)	-0.034* (0.019)	-0.030 (0.019)
CoalRents	-0.041 (0.070)	-0.082 (0.073)	-0.102 (0.072)	-0.087 (0.072)	-0.076 (0.071)	-0.088 (0.073)	-0.082 (0.070)
NaturalGasRents	0.040 (0.079)	0.023 (0.083)	0.034 (0.082)	0.014 (0.084)	0.014 (0.081)	0.025 (0.082)	-0.013 (0.081)
v2x_polyarchy	1.710*** (0.444)	1.900*** (0.467)	2.020*** (0.465)	1.910*** (0.482)	2.070*** (0.468)	1.950*** (0.473)	1.670*** (0.458)
Vulnerability	1.940 (1.600)	1.300 (1.670)	0.746 (1.680)	0.997 (1.660)	1.520 (1.640)	1.600 (1.680)	-0.181 (1.740)
Initial NDC	0.587*** (0.065)	0.512*** (0.066)	0.519*** (0.064)	0.507*** (0.064)	0.528*** (0.064)	0.506*** (0.065)	0.463*** (0.065)
Lag initial NDC	**-0.550*** (0.152)**	0.0001 (0.002)	**0.399* (0.232)**	-0.121 (0.269)	**5.920** (2.970)**	0.069 (0.079)	**0.266** (0.104)**
Observations	142	141	141	138	142	141	142
R^2	0.603	0.566	0.575	0.55	0.577	0.569	0.584
Adjusted R^2	0.579	0.539	0.55	0.522	0.552	0.543	0.559
F statistic	25.200*** (df = 8; 133)	21.500*** (df = 8; 132)	22.400*** (df = 8; 132)	19.700*** (df = 8; 129)	22.700*** (df = 8; 133)	21.800*** (df = 8; 132)	23.400*** (df = 8; 133)
AIC (AIC for lm)	**384** (lm = 389)	389 (lm = 387)	**386** (lm = 387)	378 (lm = 376)	**387** (lm = 389)	388 (lm = 387)	**384** (lm = 389)

Note: *p<0.1; **p<0.05; ***p<0.01

The negative relationship of the ambition level of development peers on a country's own ambition means that, for each increase of average peer ambition, ambition in the updated NDC is decreased. This can of course also mean an increase of ambition in response to a low average peer ambition. The absolute difference between a country's updated NDC and the spatial lags per income group supports this interpretation: high- and upper-middle-income countries show greater ambition divergence than low- and lower-middle-income countries.[8] The negative relationship therefore does not necessarily mean that countries are proposing lower ambition than their peer groups, but rather that they in general made significantly different choices. This is further illustrated in figure 2, where the absolute difference between a country's ambition and their peer group, on average, increases for the development peer groups, yet decreases for the other peer groups.

Figure 2: Absolute difference between target country ambition (in °C) and their peer group.



The inclusion of the spatial lag of development peers (hypothesis 1) renders the log of GDP per capita also a significant negative predictor of NDC ambition. This suggests that, when controlling for initial ambition levels in countries with similar levels of development, wealthier countries exhibit lower climate ambition. A similar effect is visible for levels of democracy when adding institutional peers. This is likely because of

[8] More specifically, the differences are: High income = 0,868, Upper-Middle income = 1.124, Lower-Middle income = -0.148, and Low income = -0.290.

the underlying relationship between these spatial measures and these respective regressors. The supplementary data provide further insights into these correlations.

Finally, these models explicitly account for both the direct and indirect effect of initial climate ambition (Golgher & Voss, 2016). Sensitivity tests are included in the supplementary data where only the spatial lags are tested, both with and without the domestic cross-national controls. These tests yield mixed evidence for the spatial lags of development, geopolitical affinity, and institutions, but consistently support a positive relationship between regional peer groups and climate ambition.

4. DISCUSSION

The analysis shows that there are spatial connections among NDCs, namely for countries with the same income level, geopolitical affinity, similar levels of democracy, and regional proximity. These findings emphasise the need for scholars, practitioners, and other actors and initiatives involved in global climate governance to pay more attention to interdependent relationships between countries. Future comparative research may benefit from incorporating spatial lags or other measures of interdependence to increase the robustness of research findings.

The findings corroborate the literature in that two out of the significant peer groups (development and democracy/institutions) are commonly included as drivers of climate policy and climate ambition (Ide, 2020; Peterson et al., 2023; Tørstad et al., 2020; Zheng et al., 2021). They are also in line with the findings of Tørstad et al. (2020) that subjective variables are less important than objective ones and those of Peterson et al. (2023) that government ideology does not have a significant effect on climate ambition enhancement.

While the results of the analysis overall align with existing literature, they deviate on three specific counts that warrant further investigation: (1) the negative relationship of development with peer ambition implies diverging targets rather than convergence, (2) the significant relationships of geopolitical affinity and regional similarity highlights that they could have a role in explaining climate ambition, which is thus far absent in NDC research, and (3) the lack of a significant relationship between peers based on multilateral interaction and membership in UNFCCC groups questions the role of multilateral interaction in the formulation of climate pledges, one primary tool for pledge and review to ratchet up ambition.

The negative relationship of development level, operationalised in terms of income group classification, means that countries are likely to diverge from the average ambition level of their income group. This underscores the complexity of national circumstances that cannot be captured by development level alone. The relationship between development and climate ambition has already garnered plenty of scientific

attention (Albalate et al., 2023; Tørstad et al., 2020; Zheng et al., 2021), though this angle of interdependence has not been analysed as such.

Peers based on levels of democracy, geopolitical affinity, and regional classification do show more convergence. They, at least latently, 'look at each other', therefore further analyses should be mindful of these interactions. This is already the case for democracy (Peterson et al., 2023; Tørstad et al., 2020), but regional location and geopolitical affinity have thus far remained absent in analyses of NDC ambition. Especially regional dependence should be considered, given its stability throughout sensitivity testing.

Finally, the lack of a significant relationship for multilateral interaction or negotiating groups suggests that, despite anecdotal evidence emphasising their role in climate negotiations, peer ambition among these groups is not able to explain mitigation ambition. Although more research is needed to robustly disprove the relationship between international embeddedness and climate ambition, this might be a sign that the participatory regime surrounding the Paris Agreement needs strengthening.

It should be noted that the approach of this paper to capture latent or indirect relationships of similarity or 'peerness' leaves the intentionality of peer pressure exogenous to the analysis. Further research could differentiate more between intentional and unintentional influence among countries. Considering countries' perceptions of one another could also lead to a better fit. The research design also only tests for the relationship of peer proximity, meaning countries that are close to one another. Distance could also come into play, where countries are less or more likely to share ambition levels of extremely dissimilar countries. Additionally, there could be non-peer countries that still have an exceptional influence on others. Some states are more likely to function as 'leaders'. For example, some highly vulnerable country groups have been able to use their resulting moral legitimacy to push other countries to raise ambition (Averchenkova & Chan, 2023; Brun, 2016). Research has also shown that larger and wealthier states are more often sources of policy than smaller countries (Desmarais et al., 2015).

This analysis serves as an exploration of climate ambition, peer groups, and dynamics of interdependence. Future research can build on this in at least three ways: (1) by examining alternative accounts of climate ambition, (2) by examining alternative drivers of ambition, and (3) by using alternative methods of analysis to triangulate the results. The first pathway for further research is to assess ambition beyond the framework of the Paris Agreement. 2019 and 2020 saw a boom in countries pledging to reach net zero (Van Coppenolle et al., 2023). Articles aiming to explain the diffusion of net zero, such as Green et al. (2024), could in the future also take these interdependent peer relationships into account.

Secondly, to speak on ambition beyond the NDCs, it is also merited to investigate policy drivers and explanations beyond what has thus far been tested on NDCs. Due to this paper's narrow search protocol, aimed to capture only the drivers of climate ambition under the Paris Agreement, some critical domestic-level

variables are overlooked (Lamb & Minx, 2020; Schwander & Fischer, n.d.). This includes bureaucratic structure or shifts in national leadership, which could otherwise play a role in explaining policy diffusion (Marsh & Sharman, 2009). More comparative research could shed light on the interaction of these variables with climate ambition.

Finally, due to the large-N nature of this research design, not only is this article only able to speak about correlation and not causation, but it can also only paint a general picture of the relationship between peer groups and climate ambition. There are sure to be cases where domestic circumstances seem to override any external or peer effects. One such dynamic is for example when a new executive is elected: the election of President Joseph Biden led to a reversal of his predecessors Donald Trump's decision to withdraw from the Paris Agreement, which was reinstated when Donald Trump was re-elected in 2024 (Popli, 2025). Similarly, Brazil reinstated its 2015 NDC after the election of president Lula da Silva after his predecessor Jair Bolsonaro was accused of backsliding in its 2020 and 2023 NDCs (Maisonnave, 2023). More case-based research such as process tracing is needed to triangulate the broad peer group dynamics that are uncovered in this paper.

What does this mean for the Paris Agreement? Peer pressure is one of the main dynamics through which the soft governance of pledge-and-review is meant to ramp up climate ambition. In the absence of review mechanisms that are able to assess adequacy or progression (Mayer, 2023; Raiser et al., 2022; Weikmans et al., 2020), leveraging these peer groups can be one way to increase ambition. Given that UNFCCC negotiation group ambition did not show any significant relationship with climate ambition, alternative configurations of these groups could be explored that better align and reinforce climate ambition. Alternatively, governance approaches such as climate clubs (Nordhaus, 2015) could be useful to mobilise these peer groups as well. In this endeavour, there may be synergies to find with recent work on the clustering of countries and their climate policy (D'Arcangelo et al., 2024; Guy et al., 2023). With the United States having restarted their withdrawal from the Paris Agreement at the start of Donald Trump's second term as president, these substitutive bolstering mechanisms could be crucial to fostering ambitious climate action.

5. BIBLIOGRAPHY

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