The Power of Peers

A Spatial Analysis of Nationally Determined Contributions
Supplementary data

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1. RETRIEVAL OF ARTICLES ON NDC AMBITION

To understand how peer effects are, or are not, taken into account when analysing the drivers and constraints of Nationally Determined Contributions (NDCs), this article performs a review into extant cross-country analyses of NDCs and their possible drivers or constraints.

Studies were selected based on 3 criteria:

1. To capture only articles analysing **NDCs and the Paris Agreement**, the titles and/or abstracts would have to include either "Nationally Determined Contributions" or some combination of "pledge", a common synonym for the NDCs and "Paris Agreement". This avoids including analysis of other climate ambition instruments

2. The review is particularly interested in articles that aim to explain the **policy ambition** inherent to the NDCs. Through query development, numerous different combinations of describing policy ambition were found to be relevant to narrow down the search to the topic without excluding relevant studies. The final collection came down to climate ambition, climate policy ambition, mitigation ambition, and ambit* climate polic*

3. Finally, to narrow down the pool of articles to those aiming to assess **drivers or constraints** of climate ambition, the search looks at the inclusion of either driver or constraint. In testing the query, the inclusion of alternatives such as barrier, factor, source, influence, political econom* or constrain* garnered no additional relevant results. These keywords either made little difference to the selected articles, or veered the resulting pool away from comparative analysis to more broad assessments of policy determinants (e.g. political econom*)

These three criteria resulted in the following search query: (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))),

On the 4th of December, 2023, these queries resulted in 5 articles gathered from Scopus and 5 articles gathered from Web of Science. Through forward and backwards citation chasing, aided by the Shiny app citationchaser (Haddaway et al., 2021), a dataset of 63 citing articles and 187 cited articles was collected. The RIS files exported from citationchaser were translated into dataframes using the revtools package (Westgate, 2019). The abstracts of these articles were also subjected to the query, resulting in one additional article[1] to be added to the dataset. To make sure that all relevant articles are included, articles that didn't fulfil only one criterium were subjected to a final manual review, of which 3 out of 9 were included in the final dataset comprising 10 articles. The main criterium for inclusion remained that the articles had to aim to say something about drivers or constraints of climate ambition within the NDCs

After full-text review, 3 articles were dropped because they did not include comparative methods that allow to infer drivers or constraints: 1 case-study approach, 1 commentary, and 1 clustering of determinants without statistical tests. An overview of these articles, their operationalisation, approach and the independent variables with their found effects can be found in table 1. To organise the findings of these articles, the well-known "interests, institutions, and ideas"-framework is used (Hall, 1997).

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[1] 3 articles matched the search criteria, 2 of which were already included in the seed article list.

Table 1: State of the art of the drivers of NDC climate ambition

Art.	Ambition operationalisation	Factors and their impact on climate ambition (+ higher, - less, 0 no effect/ inconclusive)
Sælen et al. (2019)	NDC emissions relative to baseline emissions + NDC emissions relative to "fair share" emissions. OLS (N= 162)	Ideas: Support for fairness principles (0) (content analysis)
Tørstad et al. (2020)	2100 warming: Pledged warming map OLS (N = 170, regression: 38-149 units)	Interests: ND-GAIN vulnerability index (+), Coal rents (-), Natural gas and oil rents (0), GDP/capita (log) (-) Institutions: V-Dem polyarchy index (+) Ideas: Public support for mitigation policies (0), postmaterialism (0), and cosmopolitanism (0) (World Value Survey, "WVS")
Ide (2020)	Climate Action Tracker sufficiency rating QCA, (N = 32)	Interests: Recession (-), Development (UNDP) (0), Energy generation fossil fuel dependence (-) ND-GAIN vulnerability index (0) Institutions: Democracy (Polity2 from the PolityIV project (0)
Zheng et al. (2021)	NDC factsheets and pledged warming map, Between estimator + Instrumental Variable Regression (N = 82)	Interests: GDP per capita (log) (-)*, CO_2/GDP (0), GDP growth (-)* Institutions: Democracy (Worldwide Governance Indicators and Polity2 PolityIV project,) (+)* Ideas: Individualism (+)* (WVS), Duty-Joy (0) (WVS), Distrust-Trust (-) (WVS)
Peterson et al. (2023)	NDC enhancement: Climate Watch data platform (Climate Watch, 2022) Logistic regression (N=111)	Interests: GDP per capita (log) (0), Reception of climate finance (OECD) (0), Fossil fuel rents (0), Affected by climate change (EMDAT Database) (0) Institutions: V-Dem polyarchy index (+) CSO consultation (V-DEM CSO + Climate watch) (+) Ideas: Left-wing government (0)
Albalate et al. (2023)	Change in 2019 to 2030 emissions + 2100 warming: Pledged warming map + Number of enacted climate change laws (OLS + IV)	Interest: Elderly population share (-), Losses (USD) from climate events (+/-)**, Fatalities from climate events (0) (GermanWatch global climate risk index), Govt. Health expenditures (GDP%) (+); Income level: high (+)**, upper-middle (+/-)**, low-middle (-)*
Rashid et al. (2023)	Climate Watch NDC enhancement tracker (harmonised emission reduction targets in 2015 and 2020) Regression analysis (OLS + logit) (N = 138)	Interests: Received finance commitments (OECD) (0), Vulnerability index (ND-GAIN exposure) (-)*, Share of global emissions (+), Renewable electricity generation (IRENA) (0), GDP/capita (0), CO_2/GDP (0), Export (% of GDP) (0), Total population (0), Air pollution (0)

* Impact not significant/present for all ambition operationalisations

** Strong variation depending on ambition operationalisation

2. INDEPENDENT DATA

2.1 UNFCCC PEER GROUP OPERATIONALISATION

Table 2: UNFCCC party group membership

Party Group	Members	Source
ABU (now known as SUR)[2]	Argentina, Brazil, Uruguay	(Liu & Zhang, 2024)
African Group of Negotiators (AGN)	Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cape Verde, Cameroon, Central African Republic, Chad, Comoros, Congo, Côte D'Ivoire, DR Congo, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Eswatini, Gabon, Gambia (Republic of The), Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Togo, Tunisia, Uganda, United Republic of Tanzania, Zambia, Zimbabwe	(Liu & Zhang, 2024)
Alliance of Small-Island States (AOSIS)	Antigua and Barbuda, Barbados, Belize, Cape Verde, Comoros, Cook Islands, Cuba, Dominica, Dominican Republic, East Timor, Federated States of Micronesia, Fiji, Grenada, Guinea-Bissau, Guyana, Haiti, Jamaica, Kiribati, Maldives, Marshall Islands, Mauritius, Nauru, Niue, Palau, Papua New Guinea, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, São Tomé and Príncipe, Seychelles, Singapore, Solomon Islands, Suriname, The Bahamas, Tonga, Trinidad and Tobago, Tuvalu, Vanuatu	(Pearce & Yeo, 2015)
Annex I	Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, United States	(Pearce & Yeo, 2015)
BASIC	Brazil, China, India, South Africa	(Pearce & Yeo, 2015)
Bolivarian Alliance for the Peoples of our America (ALBA)	Antigua and Barbuda, Bolivia, Cuba, Dominica, Ecuador, Grenada, Nicaragua, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Venezuela	(Pearce & Yeo, 2015)

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[2] Paraguay joined SUR in 2024. Due to the timing, it is not included as a member in this list.

Cartagena Dialogue[3]	Australia, Bangladesh, Bhutan, Chile, Colombia, Denmark, Dominican Republic, Ethiopia, France, Germany, Ghana, Grenada, Indonesia, Kenya, Maldives, Marshall Islands, Mexico, Nepal, Netherlands, New Zealand, Norway, Rwanda, Samoa, Swaziland, Sweden, Tajikistan, The Gambia, UAE, United Kingdom	(Pearce & Yeo, 2015)
Coalition for rainforest nations[4]	Argentina, Bangladesh, Belize, Botswana, Cambodia, Cameroon, Central African Republic, Costa Rica, D. R. of the Congo, Dominica, Dominican Republic, Ecuador, Equatorial Guinea, Fiji, Gabon, Ghana, Guatemala, Guyana, Honduras, India, Indonesia, Kenya, Laos, Lesotho, Liberia, Madagascar, Malawi, Malaysia, Mali, Mozambique, Namibia, Nicaragua, Nigeria, Pakistan, Panama, Papua New Guinea, Paraguay, Republic of the Congo, Saint Lucia, Samoa, Sierra Leone, Singapore, Solomon Islands, South Africa, Sudan, Suriname, Thailand, Uganda, Uruguay, Vanuatu, Vietnam, Zambia	(Pearce & Yeo, 2015)
CACAM[5]	Armenia, Azerbaijan, Kazakhstan, Moldova, Turkmenistan, Uzbekistan	(Pearce & Yeo, 2015)
Environmental Integrity Group (EIG)	Georgia, Liechtenstein, Mexico, Monaco, Republic of Korea, Switzerland	IISD, 2022
EU (28)	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom of Great Britain and Northern Ireland	(Höhne et al., 2023)
Group of 77 and China	Afghanistan, Algeria, Angola, Antigua and Barbuda, Argentina, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belize, Benin, Bhutan, Bolivia (Plurinational State of), Botswana, Brazil, Brunei Darussalam, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Central African Republic, Chad, Chile, China, Colombia, Comoros, Congo, Costa Rica, Côte d'Ivoire, Cuba, Democratic People's Republic of Korea, Democratic Republic of the Congo, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Fiji, Gabon, Gambia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Iran (Islamic Republic of), Iraq, Jamaica, Jordan, Kenya, Kiribati, Kuwait, Lao People's Democratic Republic, Lebanon, Lesotho, Liberia, Libya, Madagascar, Malawi, Malaysia, Maldives, Mali, Marshall Islands, Mauritania, Mauritius, Micronesia (Federated States of), Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, Nicaragua, Niger, Nigeria, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Qatar, Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Solomon Islands, Somalia, South Africa, South Sudan, Sri Lanka, State of	(The Group of 77, n.d.)

[3] Relevant for early discussions on NDCs.
[4] Bolivia and Brazil are noted as countries that support and align with CfRN policies, but not negotiation group members.
[5] Countries of Central Asia, Caucasus, Albania, and Moldova

	Palestine, Sudan, Suriname, Syrian Arab Republic, Tajikistan, Thailand, Timor-Leste, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkmenistan, Uganda, United Arab Emirates, United Republic of Tanzania, Uruguay, Vanuatu, Venezuela (Bolivarian Republic of), Viet Nam, Yemen, Zambia, Zimbabwe	
Group of Mountain Partnership	Afghanistan, Bangladesh, Bhutan, India, Indonesia, South Korea, Nepal, Pakistan, Papua New Guinea, Philippines, Sri Lanka, Kyrgyzstan, Uzbekistan, Tajikistan, Andorra, Armenia, Austria, Azerbaijan, France, Georgia, Italy, Liechtenstein, Monaco, Montenegro, Romania, Serbia, Slovakia, Slovenia, Spain, Switzerland, Türkiye, The Republic of North Macedonia, Ukraine, Algeria, Iran (Islamic Republic of), Jordan, Morocco, Tunisia, Yemen, Costa Rica, Cuba, Dominican Republic, Guatemala, Jamaica, Mexico, Panama, Argentina, Bolivia (Plurinational State of), Chile, Colombia, Ecuador, Peru, Venezuela (Bolivarian Republic of), Burundi, Cameroon, Democratic Republic of the Congo, Eswatini, Ghana, Guinea, Kenya, Lesotho, Madagascar, Malawi, Nigeria - Federal Ministry of Environment, Togo, Uganda	(FAO, n.d.)
Independent Alliance of Latin America and the Caribbean (AILAC)	Chile, Colombia, Costa Rica, Guatemala, Honduras, Panama, Paraguay, Peru	(Liu & Zhang, 2024)
Landlocked Developing Countries (LLDC)	Afghanistan, Armenia, Azerbaijan, Bhutan, Plurinational State of Bolivia, Botswana, Burkina Faso, Burundi, Central African Republic, Chad, Eswatini, Ethiopia, Kazakhstan, Kyrgyzstan, Lao PDR, Lesotho, Malawi, Mali, Mongolia, Nepal, Niger, North Macedonia, Paraguay, Republic of Moldova, Rwanda, South Sudan, Tajikistan, Turkmenistan, Uganda, Uzbekistan, Zambia, Zimbabwe	(United Nations, n.d.)
League of Arab States	Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, UAE, Yemen	(Pearce & Yeo, 2015)
Least Developed Countries (LDC)	Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Central African Republic, Chad, Comoros, D. R. of the Congo, Djibouti, East Timor, Equatorial Guinea, Eritrea, Ethiopia, Guinea, Guinea-Bissau, Haiti, Kiribati, Laos, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, São Tomé and Príncipe, Senegal, Sierra Leone, Solomon Islands, Somalia, South Sudan, Sudan, Tanzania, The Gambia, Togo, Tuvalu, Uganda, Vanuatu, Yemen, Zambia	(Pearce & Yeo, 2015)
Like-Minded Developing Countries (LMDC)	Algeria, Argentina, Bangladesh, Bolivia, China, Cuba, Ecuador, Egypt, El Salvador, India, Indonesia, Iran, Iraq, Jordan, Kuwait, Malaysia, Mali, Nicaragua, Pakistan, Saudi Arabia, Sri Lanka, Sudan, Syria, Venezuela, Vietnam	(Pearce & Yeo, 2015)
Organisation of Oil-Producing Countries (OPEC)	Algeria, Angola, republic of the Congo, Ecuador, Equatorial Guinea, Gabon, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, Venezuela	(Pearce & Yeo, 2015)

Small Island Developing States (SIDS)	Antigua and Barbuda, Bahrain, Barbados, Belize, Cape Verde, Comoros, Cook Islands, Cuba, Dominica, Dominican Republic, East Timor, Federated States of Micronesia, Fiji, French Polynesia, Grenada, Guinea-Bissau, Guyana, Haiti, Jamaica, Kiribati, Maldives, Marshall Islands, Mauritius, Nauru, Niue, Palau, Papua New Guinea, Puerto Rico (U.S.), Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Seychelles, Singapore, Solomon Islands, Suriname, The Bahamas, Tonga, Trinidad and Tobago, Tuvalu, Vanuatu	(Pearce & Yeo, 2015)
Umbrella Group[6]	Australia, Canada, Iceland, Israel, Japan, New Zealand, Kazakhstan, Norway, Ukraine, the United States	(UNFCCC, n.d.)

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[6] The United Kingdom joined in 2023, after most of the NDC publications. This country is therefore not included in the membership

2.2 OVERVIEW PEER GROUP OPERATIONALISATION

Table 3 presents an overview of the variable operationalisation per hypothesis, including the source for each spatial lag.

Table 3: Description of variables used to calculate the spatial lags of ambition.

Hypothesis	Variable description	Source	Matrix
H1 Development	Same income group classification (World Bank standards) in 2019.	(World Bank, n.d.)*	Binary, symmetrical
H2 Interaction	Count of multilateral governmental organisation membership in 2014 (most recent datapoint) of the 25% most connected countries.	Correlates of War project, using the igoR package (Hernangómez, 2024)	Numeric, asymmetrical
H3 Geopolitical affinity	1 - absolute distance between country ideal points that are closer than 1 standard deviation away in the year before the NDC is published.	(Bailey et al., 2017)	Numeric, asymmetrical
H4 Ideology	Same ideology of the head of government, or, if there is no information, the country leader in the year before the NDC is published	(Herre, 2023)	Binary, asymmetrical
H5 Institutions	Countries within 0.1 on the V-Dem polyarchy index in 2019.	(Coppedge et al., 2023; Maerz et al., 2022)	Numeric, symmetrical
H6 Negotiating groups	Number of UNFCCC negotiating groups in common. Full membership lists can be found in the supplementary data.	(FAO, n.d.; C. Höhne et al., 2023; International Institute for Sustainable Development, 2022; Liu & Zhang, 2024; Pearce & Yeo, 2015; The Group of 77, n.d.; United Nations, n.d.-b)	Numeric, symmetrical
H7 Regions	Same United Nations Geographic Regions classification (M49).	(United Nations, n.d.-a)	Binary, symmetrical

* Data for the Cook Islands and Niue is supplemented using 2019 GNI per capita data from the Asian Development Bank (2023).

3. DESCRIPTIVE STATISTICS

Table 4: Descriptive statistics (timing of both the initial, and the updated NDC)

Type of variable	Statistic	N	Mean	St. Dev.	Min	Max
Climate ambition + context	year_initial.ndc	167	2016	0.83	2015	2020
	year_updated.ndc	151	2021	0.75	2018	2022
	warming_initial.ndc	167	2.23	1.6	0	3.9
	warming_updated.ndc	151	2.67	1.4	0	3.9
Control variables	NaturalGasRents_initial.ndc	164	0.67	2.78	0	31.8

	NaturalGasRents_updated.ndc	149	0.43	1.4	0	11.8
	OilRents_initial.ndc	164	2.13	6.13	0	46.6
	OilRents_updated.ndc	150	1.53	4.53	0	27.6
	CoalRents_initial.ndc	164	0.14	0.78	0	9.39
	CoalRents_updated.ndc	149	0.19	1.08	0	11.1
	GDPperCaplog_initial.ndc	165	8.57	1.4	5.63	11.6
	GDPperCaplog_updated.ndc	150	8.64	1.43	5.57	11.6
	v2x_polyarchy_initial.ndc	160	0.55	0.26	0.02	0.92
	v2x_polyarchy_updated.ndc	145	0.55	0.25	0.01	0.92
	Vulnerability_initial.ndc	166	0.43	0.1	0.25	0.68
	Vulnerability_updated.ndc	151	0.43	0.09	0.24	0.68
Peer group lags	development_lag_initial.ndc	142	2.23	1.07	1.24	3.89
	development_lag_updated.ndc	142	2.7	0.51	2.12	3.76
	interaction_lag_initial.ndc	141	116	30.6	55.3	184
	interaction_lag_updated.ndc	141	135	32.5	66.3	212
	geopolitical affinity_lag_initial.ndc	141	1.4	0.41	0.3	1.96
	geopolitical affinity_lag_updated.ndc	141	1.72	0.37	0.33	2.39
	ideology_lag_initial.ndc	138	2.27	0.3	1.6	2.6
	ideology_lag_updated.ndc	138	2.76	0.19	2.2	2.98
	institutions_lag_initial.ndc	142	0.11	0.04	0	0.18
	institutions_lag_updated.ndc	142	0.13	0.03	0	0.19
	negotiation groups_lag_initial.ndc	141	3.88	1.02	2.04	6.88
	negotiation groups_lag_updated.ndc	141	4.66	1.08	2.57	7.73
	regions_lag_initial.ndc	142	2.23	1.11	0	3.9
	regions_lag_updated.ndc	142	2.7	0.89	0.57	3.9

The base model used to test the spatial relationships with is as follows:

$$\text{warming\_updated.ndc} \sim \text{GDPperCaplog\_updated.ndc} + \text{OilRents\_updated.ndc} + \qquad (1)$$
$$\text{CoalRents\_updated.ndc} + \text{NaturalGasRents\_updated.ndc} + \text{v2x\_polyarchy\_updated.ndc}$$
$$+ \text{Vulnerability\_updated.ndc} + \text{warming\_initial.ndc}$$

The correlation plot of the updated NDC assessment and all covariates presented in formula (1) as well as the spatial lags of the initial NDC assessments are presented below in Figure 1. Some of the regressors show significant correlation amongst themselves, including the log of GDP/capita, levels of democracy, and vulnerability. These patterns also repeat themselves in the spatial lags or average peer ambition when looking at development, geopolitical affinity, institutions, and regions. This could mean that there is a risk of omitted variable bias or multicollinearity in the analysis. The different iterations of the model below do show overall consistency in the magnitude and direction of the coefficients, however, which assuages some of these concerns (Kalnins, 2018).

Figure 1: Correlation plot of all regressors
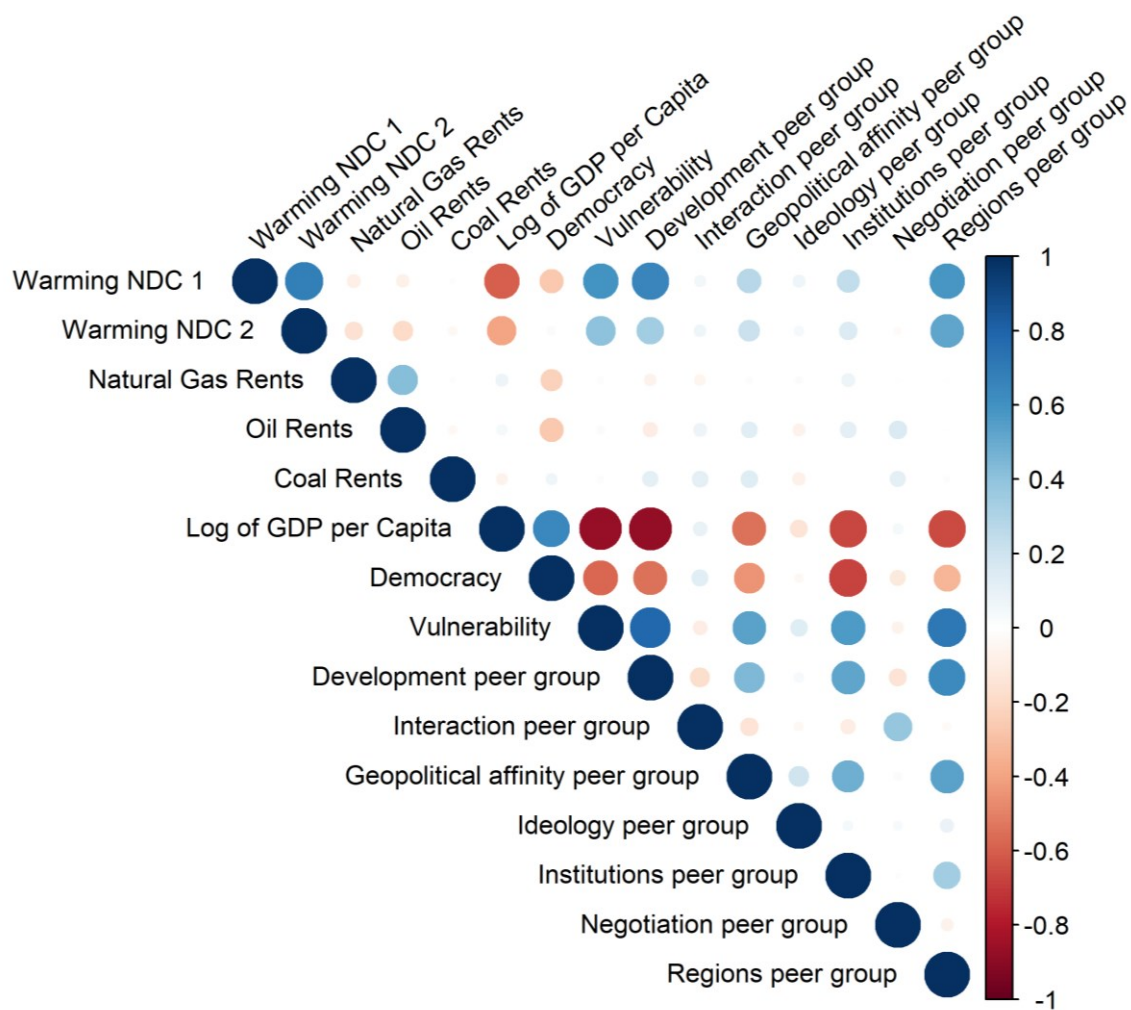
Note: the size of each circle denotes level of significance. The colour refers to the size of the correlation coefficient.

# 4. REGRESSION OF CLIMATE AMBITION AND SPATIAL AUTOCORRELATION

To contextualise the spatial distribution of the dependent variable, local and global calculations of Moran's I are generated, using a Monte Carlo Simulation to estimate the p-values (Ward & Gleditsch, 2008). The overall Moran's I and their significance is presented in Table 5. This shows that 4 out of 7 peer groups result in significant positive autocorrelation. This means that, on average, for those peer groups 'neighbours' tend to present similarly high or low ambition levels.

Table 5: Spatial autocorrelation of climate ambition

Hypothesis	*Moran's I + Monte Carlo Simulation*
Development	Significant positive autocorrelation $I = 0.116$ ($I_0 = -0.007$) **(p = 0.01)**
Multilateral interaction	No significant autocorrelation $I = -0.003$ ($I_0 = -0.007$) (p = 0.2)
Geopolitical affinity	Significant positive autocorrelation $I = 0.019$ ($I_0 = -0.007$) **(p = 0.03)**
Ideology	No significant autocorrelation $I = -0.003$ ($I_0 = -0.007$) (p = 0.2)
Institutional peer	Significant positive autocorrelation $I = 0.074$ ($I_0 = -0.007$) **(p = 0.01)**
Negotiating groups	No significant autocorrelation $I = -0.016$ ($I_0 = -0.007$) (p = 0.9)
Regions	Significant positive autocorrelation $I = 0.408$ ($I_0 = -0.007$) **(p = 0.01)**

Figure 2 shows the LISA-plots (local indicators of spatial autocorrelation) for the dependent variable to further contextualise the global Moran's I values presented above. More specifically, the local Moran's I is calculated per country. HH or "high-high" and LL or "low-low" represent countries with high ambition that also have peers with high ambition or low ambition surrounded by peers with low ambition. Both of these categories will contribute to a positive autocorrelation. HL or "high-low" are countries with high ambition surrounded by low-ambition peers, and LH ("low-high") represents the opposite. These countries will contribute to a negative autocorrelation. Inspecting the maps in more detail, it is clear that much of the similarities between groups centre around African countries, with a collection of those countries in the 3 significant groups (those on the left of the figure) appearing in the "high-high"/HH quadrant. Some significant similarities are also being driven by North America in the case of the development peers and East Asia in the case of institutional similarity.

**Figure 2: LISA plots for the dependent variable per peer group**
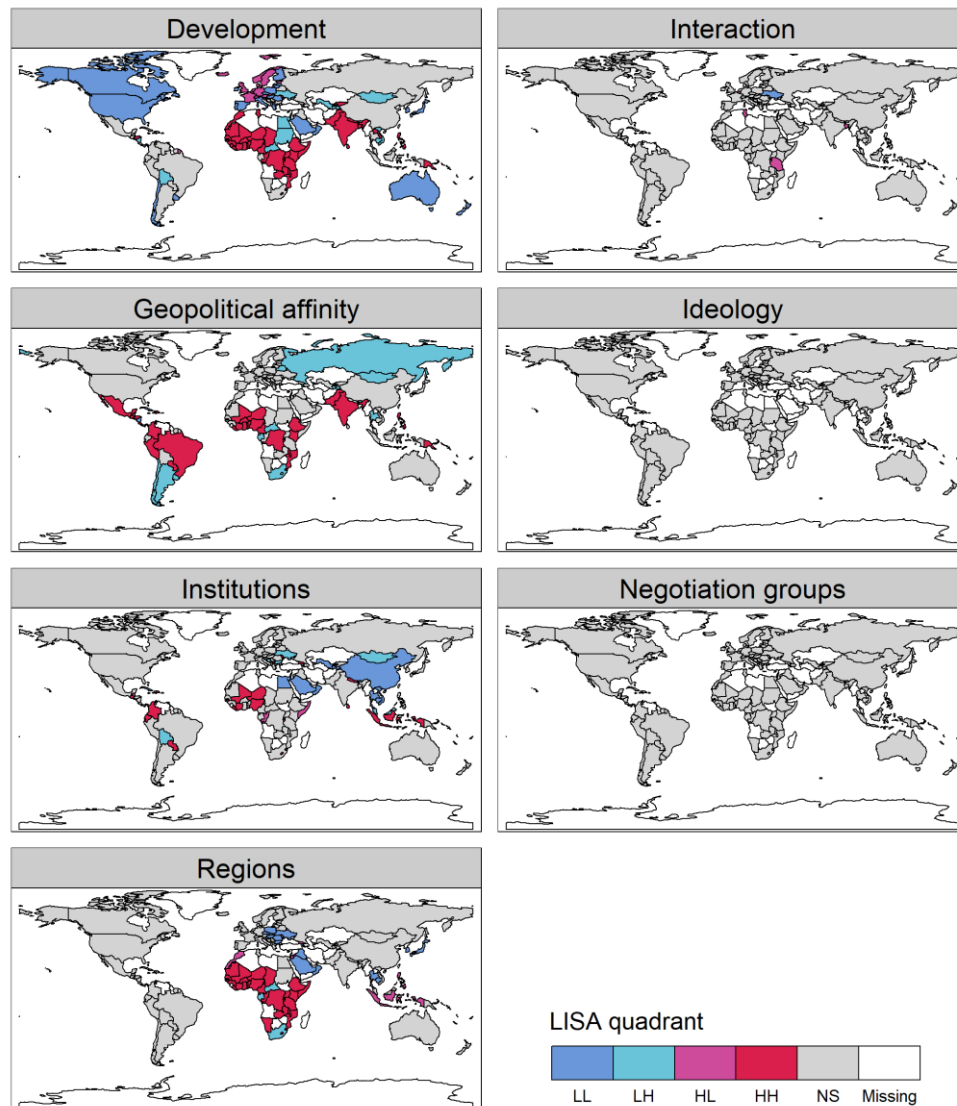
Source: Own figure made using the tmap package (Tennekes, 2018)

Looking then how these spatial relationships translate into spatial lags, Figure 3 shows the average peer ambition per round. It must be noted that these values only show the average for peer groups as a binary connection, the weights that are present for the interaction, geopolitical affinity, Institutions, and negotiating group hypotheses have been removed in order to facilitate a more clear comparison. These weights are taken into account in the regression analysis.

The values show that average peer ambition, just as average ambition in general, has gone up. The shapes of the boxplots also imply that the variance between peer groups has diminished (the plots are smaller and more concentrated. The difference between ambition levels of target countries and their peer groups are discussed in the main body of the paper.

Figure 3: Average peer ambition (in °C) per round
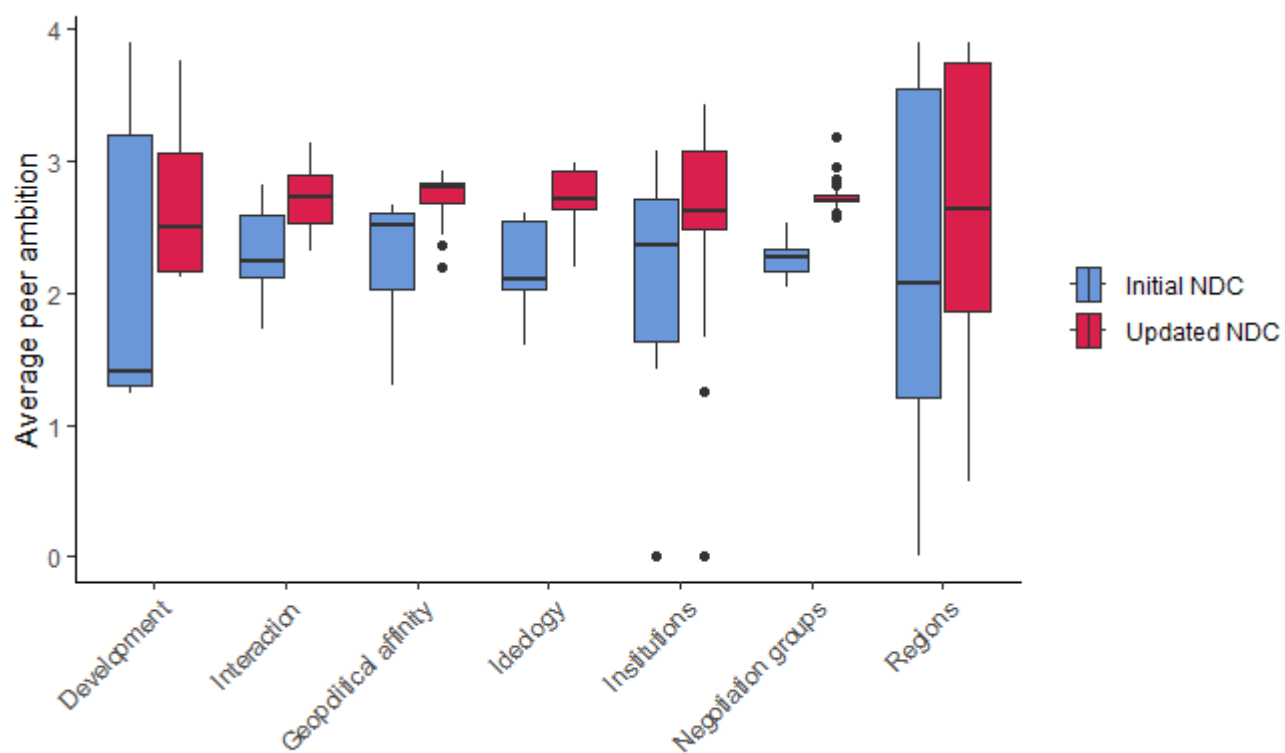
5. SENSITIVITY TESTS

5.1 TESTING THE RELEVANCE OF EACH PEER GROUP

As suggested by Neumayer and Plümper (2016), the relevance of each peer group is tested below. When the peer groups were designed, some cut-off points had to be established to define at what point two units are not connected anymore. These cut-off points should not be taken for granted and can be tested by estimating an equation including spatial lags for both the relevant and irrelevant units. This is done according to the following formula:

$$NDC_2 = W^1 \times NDC_1 + W^2 \times NDC_1 + \beta_1 NDC_1 + \beta_2 X + \epsilon \qquad (2)$$

Where: $w^2 = \begin{cases} 1 \ if \ w^1 = 0 \\ 0 \ if \ w^1 \neq 0 \end{cases}$, with w^1 and w^2 representing the elements of the matrices

Table 6 shows the results of these models for each peer configuration. Countries that were deemed not to be neighbours in any way will be called "irrelevant" in the following discussion. We look specifically at the peer conceptualisations that were found to be significant: Development, Geopolitical affinity, Institutions and Regions. The results show that the lag of development is robust: the lag of the relevant peers remains significantly negative and the effect of ambition from the irrelevant group is close to 0 (coefficient of 0.016). The lag of geopolitical affinity does not remain significant, but the lag of irrelevant peers is close to 0 as well (-0.040). The lag of institutions is more complex, with neither relevant, nor irrelevant lags being significant. The coefficient of the lag of irrelevant peer countries is also larger than that of the peer institutions. A peculiar effect can be seen among the regional peers: The average peer ambition of peers has not only diminished in coefficient size (from 0.266 to 0.131) but it is now not significant anymore. Instead, there is a significant positive effect of the irrelevant group.

Table 6: Spatial-X models for all peer group configurations, including a spatial lag for non-neighbouring countries

	Warming, Estimate (Std. Error)						
Hypothesis	Development	Multilateral interaction	Geopolitical affinity	Ideology	Institutions	Negotiating groups	Regions
Constant	4.390** (1.750)	1.410 (1.620)	0.775 (1.610)	2.380 (2.020)	-0.331 (1.810)	0.662 (1.640)	0.988 (1.540)
GDPperCaplog	-0.403*** (0.141)	-0.156 (0.124)	-0.145 (0.124)	-0.186 (0.125)	-0.048 (0.132)	-0.153 (0.124)	-0.058 (0.123)
OilRents	-0.048** (0.019)	-0.032 (0.020)	-0.036* (0.019)	-0.019 (0.023)	-0.033* (0.019)	-0.034* (0.019)	-0.038** (0.019)
CoalRents	-0.041 (0.070)	-0.082 (0.073)	-0.101 (0.073)	-0.084 (0.073)	-0.077 (0.071)	-0.100 (0.073)	-0.095 (0.070)
NaturalGasRents	0.039 (0.079)	0.016 (0.084)	0.039 (0.083)	0.016 (0.085)	0.013 (0.082)	0.034 (0.083)	0.007 (0.081)
v2x_polyarchy	1.710*** (0.446)	1.870*** (0.473)	2.030*** (0.467)	1.890*** (0.487)	1.880*** (0.663)	1.990*** (0.474)	1.560*** (0.456)
Vulnerability	1.950 (1.630)	1.230 (1.680)	0.809 (1.690)	0.965 (1.670)	1.550 (1.650)	1.740 (1.680)	-0.286 (1.720)
Initial NDC	0.587*** (0.066)	0.515*** (0.066)	0.520*** (0.064)	0.503*** (0.065)	0.531*** (0.065)	0.504*** (0.065)	0.463*** (0.064)
Lag initial NDC	**-0.555*** (0.194)**	0.003 (0.007)	0.510 (0.326)	-0.350 (0.720)	4.020 (5.570)	0.158 (0.113)	0.131 (0.124)
Lag initial NDC - irrelevant	0.016 (0.345)	-0.007 (0.015)	-0.040 (0.082)	0.107 (0.312)	5.870 (14.500)	-0.020 (0.018)	**0.476* (0.241)**
Observations	142	141	141	138	142	141	142
R²	0.603	0.567	0.576	0.55	0.577	0.573	0.596
Adjusted R²	0.576	0.537	0.547	0.519	0.548	0.543	0.569
F statistic	22.300*** (df = 9; 132)	19.000*** (df = 9; 131)	19.800*** (df = 9; 131)	17.400*** (df = 9; 128)	20.000*** (df = 9; 132)	19.500*** (df = 9; 131)	21.700*** (df = 9; 132)
AIC (AIC for lm)	380 (lm = 391)	390 (lm = 389)	387 (lm = 389)	380 (lm = 378)	389 (lm = 391)	389 (lm = 388)	382 (lm = 391)

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

5.2 RUNNING DIFFERENT ITERATIONS OF THE SPATIAL-X MODEL

The following tables show the results of different configurations of the spatial model.

Table 7 presents the spatial-X models without the inclusion of the initial NDC as regressor. This shows that, when the direct effect of the initial NDC is not taken into account, the indirect effect of the average ambition of almost all peer conceptualisations have no significant relationship with climate ambition. One exception is the regional component which does have a highly significant positive relationship with climate ambition. This effect is to the detriment of the positive effect of vulnerability on climate ambition, which points to an interaction between the average climate ambition of fellow regional countries and climate vulnerability. Given the high regional dependence of climate vulnerability, this is not a surprising relationship.

The lack of a significant relationship for the other spatial lags, points to the importance of context: both the inclusion of the initial NDC (the direct effect) and controlling for cross-national variables are necessary in order to find a significant effect of these spatial variables. This is shown in table 8, where only the direct and indirect effect of the spatial variables are included as explanatory variables. Here, again with the exception of the regional lag of ambition, only the direct effects are significant. The spatial lags on their own are significant (see table 9), though these models do not have a high explanatory value (R^2 varying between 0.02 and 0.26).

Table 10 presents the spatial-X models, with the inclusion of the NDC submission year. This is included in the model because other analyses of climate ambition, namely Peterson et al. (2023), found a significant relationship between submission year and the enhancement of climate ambition. In these spatial models, however, NDC submission year does not have any significant effect on climate ambition. Its inclusion also has negligible effect on the coefficients or significance of the other regressors compared to the models without the inclusion of the submission year.

Table 7: Spatial-X models for all peer group configurations, excluding the initial NDC as regressor

Hypothesis	Development	International interaction	Geopolitical affinity	Ideology	Institutions	Negotiating groups	Regions
	Warming, Estimate (Std. Error)						
Constant	3.560 (2.180)	2.720 (1.940)	2.700 (1.940)	4.110* (2.080)	2.650 (2.140)	2.580 (1.940)	2.690 (1.800)
GDPperCaplog	-0.457*** (0.172)	-0.411*** (0.143)	-0.404*** (0.144)	-0.444*** (0.146)	-0.393** (0.152)	-0.433*** (0.143)	-0.310** (0.138)
OilRents	-0.038 (0.024)	-0.040* (0.024)	-0.039 (0.023)	-0.020 (0.028)	-0.036 (0.023)	-0.036 (0.023)	-0.029 (0.022)
CoalRents	-0.095 (0.088)	-0.108 (0.087)	-0.115 (0.088)	-0.110 (0.087)	-0.099 (0.087)	-0.118 (0.087)	-0.099 (0.082)
Natural-GasRents	0.040 (0.100)	0.044 (0.100)	0.045 (0.100)	0.032 (0.102)	0.036 (0.099)	0.045 (0.099)	-0.020 (0.095)
v2x_polyarchy	2.730*** (0.542)	2.670*** (0.551)	2.810*** (0.554)	2.720*** (0.571)	2.790*** (0.562)	2.880*** (0.551)	2.280*** (0.527)
Vulnerability	4.260** (1.990)	4.170** (1.970)	3.750* (2.000)	3.830* (1.970)	4.200** (1.970)	4.210** (1.980)	1.100 (2.020)
Lag initial NDC	-0.077 (0.181)	0.003 (0.003)	0.282 (0.282)	-0.282 (0.326)	1.570 (3.580)	0.139 (0.095)	0.455*** (0.118)
Observations	142	141	141	138	142	141	142
R^2	0.362	0.364	0.365	0.332	0.362	0.371	0.425
Adjusted R^2	0.329	0.331	0.331	0.296	0.329	0.338	0.395
F statistic	10.900*** (df = 7; 134)	10.900*** (df = 7; 133)	10.900*** (df = 7; 133)	9.250*** (df = 7; 130)	10.900*** (df = 7; 134)	11.200*** (df = 7; 133)	14.200*** (df = 7; 134)
AIC (AIC for lm)	443 (lm = 441)	440 (lm = 439)	440 (lm = 439)	430 (lm = 429)	443 (lm = 441)	439 (lm = 439)	428 (lm = 441)

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

Table 8: Spatial-X models for all peer group configurations, excluding the controls for the determinants of climate ambition

	Warming, Estimate (Std. Error)						
Hypothesis	Development	International interaction	Geopolitical affinity	Ideology	Institutions	Negotiating groups	Regions
Constant	1.490*** (0.206)	0.965** (0.372)	1.380*** (0.305)	1.340** (0.673)	1.330*** (0.271)	1.550*** (0.373)	1.020*** (0.194)
Initial NDC	0.635*** (0.069)	0.593*** (0.054)	0.596*** (0.057)	0.575*** (0.055)	0.592*** (0.054)	0.596*** (0.054)	0.491*** (0.066)
Lag initial NDC	-0.113 (0.106)	0.003 (0.003)	-0.047 (0.212)	0.026 (0.292)	0.453 (2.350)	-0.062 (0.089)	0.236** (0.095)
Observations	151	150	150	144	145	150	151
R^2	0.448	0.449	0.445	0.442	0.477	0.449	0.466
Adjusted R^2	0.441	0.441	0.438	0.434	0.47	0.442	0.459
F statistic	60.200*** (df = 2; 148)	59.900*** (df = 2; 147)	59.000*** (df = 2; 147)	55.900*** (df = 2; 141)	64.800*** (df = 2; 142)	59.900*** (df = 2; 147)	64.700*** (df = 2; 148)
AIC (AIC for lm)	448 (lm = 447)	446 (lm = 445)	447 (lm = 445)	424 (lm = 423)	416 (lm = 414)	446 (lm = 444)	443 (lm = 447)

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

Table 9: Spatial-X models for all peer group configurations, excluding the controls for the determinants of climate ambition and the initial NDC

	Warming, Estimate (Std. Error)						
Hypothesis	Development	International interaction	Geopolitical affinity	Ideology	Institutions	Negotiating groups	Regions
Constant	1.530*** (0.257)	2.370*** (0.467)	1.840*** (0.397)	2.290** (0.889)	2.020*** (0.359)	2.690*** (0.482)	1.180*** (0.225)
Lag initial NDC	0.500*** (0.103)	0.003 (0.004)	0.583** (0.267)	0.182 (0.388)	6.210** (3.120)	-0.005 (0.119)	0.657*** (0.089)
Observations	151	150	150	144	145	150	151
R^2	0.135	0.003	0.031	0.002	0.027	0.00001	0.266
Adjusted R^2	0.13	-0.004	0.025	-0.005	0.02	-0.007	0.261
F statistic	23.400*** (df = 1; 149)	0.440 (df = 1; 148)	4.760** (df = 1; 148)	0.219 (df = 1; 142)	3.970** (df = 1; 143)	0.001 (df = 1; 148)	53.900*** (df = 1; 149)

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

Table 10: Spatial-X models for all peer group configurations, including updated NDC submission year

Hypothesis	Warming, Estimate (Std. Error)						
	Development	International interaction	Geopolitical affinity	Ideology	Institutions	Negotiating groups	Regions
Constant	-208.000 (214.000)	-74.500 (225.000)	-68.400 (223.000)	-116.000 (224.000)	-61.200 (221.000)	-102.000 (223.000)	-93.600 (218.000)
Submission year	0.105 (0.106)	0.038 (0.111)	0.034 (0.110)	0.059 (0.111)	0.030 (0.109)	0.051 (0.110)	0.047 (0.108)
GDPperCaplog	-0.415*** (0.137)	-0.157 (0.124)	-0.137 (0.123)	-0.189 (0.125)	-0.056 (0.132)	-0.152 (0.125)	-0.114 (0.122)
OilRents	-0.048** (0.019)	-0.033 (0.020)	-0.036* (0.019)	-0.018 (0.023)	-0.033* (0.019)	-0.033* (0.019)	-0.030 (0.019)
CoalRents	-0.043 (0.070)	-0.082 (0.073)	-0.103 (0.073)	-0.089 (0.072)	-0.077 (0.071)	-0.090 (0.073)	-0.083 (0.071)
Natural-GasRents	0.033 (0.079)	0.019 (0.083)	0.031 (0.083)	0.010 (0.085)	0.012 (0.082)	0.021 (0.083)	-0.016 (0.082)
v2x_polyarchy	1.790*** (0.452)	1.930*** (0.477)	2.040*** (0.475)	1.960*** (0.491)	2.090*** (0.478)	1.990*** (0.485)	1.710*** (0.469)
Vulnerability	1.800 (1.610)	1.240 (1.690)	0.697 (1.700)	0.903 (1.680)	1.480 (1.660)	1.520 (1.690)	-0.252 (1.750)
Initial NDC	0.593*** (0.066)	0.513*** (0.066)	0.520*** (0.064)	0.508*** (0.064)	0.529*** (0.065)	0.507*** (0.065)	0.464*** (0.065)
Lag initial NDC	-0.572*** (0.154)	-0.00001 (0.003)	0.397* (0.233)	-0.117 (0.270)	5.840* (3.000)	0.071 (0.079)	0.266** (0.105)
Observations	142	141	141	138	142	141	142
R^2	0.606	0.566	0.576	0.551	0.577	0.569	0.585
Adjusted R^2	0.579	0.536	0.546	0.519	0.548	0.54	0.557
F statistic	22.500*** (df = 9; 132)	19.000*** (df = 9; 131)	19.700*** (df = 9; 131)	17.500*** (df = 9; 128)	20.000*** (df = 9; 132)	19.200*** (df = 9; 131)	20.700*** (df = 9; 132)
AIC (AIC for lm)	379 (lm = 391)	391 (lm = 389)	387 (lm = 389)	380 (lm = 378)	389 (lm = 391)	390 (lm = 388)	386 (lm = 391)

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

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