



Does democracy protect the environment? The role of the Arctic Council

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Abstract

This paper examines the influence of democratic institutions on environmental policy stringency and the degree to which it is affected by membership in the Arctic Council. We hypothesize that, relative to countries with no Arctic presence, countries present in the Arctic given their territorial, trade, and touristic interests are more pro-environmentally inclined as they experience the effects of global warming first-hand, and the quality of democratic institutions may reinforce this effect. Our empirical analysis based on global macroeconomic data suggests that countries with democratic institutional environments are associated with more response to Arctic status and more stringent environmental policies. Moreover, the presence of democratic governments in the Arctic increases the stringency of both market- and non-market-based environmental regulations. The suggestive estimated monetary value associated with the impact of democratic institutions in the Arctic is about 101,000 international dollars per capita. These findings underscore that the development of democratic institutions may lead to strong welfare improvements and can be used in the design of international environmental agreements for Arctic area protection.

Keywords Arctic Council · Democracy · Environmental policy · Environmental regulations · Institutions

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1 Introduction

Climate change is affecting all parts of the world, but it does so in different ways and degrees depending on the location. A part of the world where the effects of climate change are particularly severe and vivid is the Arctic. The Arctic has warmed nearly four times faster than the globe since 1979 (Rantanen et al. 2022)—a phenomenon known as the Arctic amplification. The Arctic amplification affects the populations of the region drastically, disrupting the food systems, increasing disaster losses, and damaging infrastructure (Canosa et al. 2020; Ford et al. 2021). Given such severe exposure to the effects of climate change, does the presence and sovereignty over the lands within the Arctic circle prompt the adoption of stringent environmental policies? And does the quality of democratic institutions facilitate environmental policy-making in the Arctic? This paper addresses these questions, drawing on a rich dataset of 33 countries in the period from 1990 to 2015.

A large body of work focuses on the scientific evaluation of climate change and its effects on the Arctic's ecologies (Hinzman et al. 2005; Graversen et al. 2008; Serreze and Barry 2011; Dai et al. 2019; Overland 2021; Previdi et al. 2021; Rantanen et al. 2022). There is relatively limited work on the societal impacts of global warming affecting the Arctic. Existing contributions focus on opportunities and risks in specific sectors, community health, economic pressures, political stability, human rights, and the impacts on indigenous populations (Gjørnv et al. 2014; Greaves 2016; Stephen 2018; Mattar et al. 2020; Ford et al. 2021). Even less attention is dedicated to the appropriate policy responses in face of the challenges posed by climate change to the region, and existing work predominantly looks at the specific cases of adaptation responses in the Arctic (Ford et al. 2014; Berner et al. 2016; Matthews and Potts 2018; Birchall and Bonnett 2020; Canosa et al. 2020). Hence, the current study adds to this literature by providing novel insights on whether and how the Arctic presence shapes the adoption of stringent environmental policies at the macro level.

The quality of democratic institutions and how they shape the policy responses to the environmental challenges of the Arctic is a special focus of this work which relates it to the literature on the link between democratic regimes and environmental policies and outcomes. This literature has produced mixed results. There is evidence of a positive link in some cases whereby democracy appears to be conducive to better environmental outcomes (Torras and Boyce 1998; Harbaugh et al. 2002; Farzin and Bond 2006; Fredriksson and Wollscheid 2007; Bernauer and Koubi 2009; Nazarov and Obydenkova 2022a; Hartwell et al. 2019, 2021). However, in others, negative or no relationship between the extent of democracy and environmental outcomes is found (Midlarsky 1998; Scruggs 1998; Arvin and Lew 2011; Buitenzorgy and Mol 2011; You et al. 2015).¹ The mixed evidence is often explained by differences in datasets, measures, and methods employed, creating the need for further research to refine the existing evidence. Moreover, one of the key reasons as to why democracies are thought of as being conducive to better environmental outcomes is through having mechanisms in place to ensure the responsiveness of governments to

¹ The theoretical arguments in support of a potentially detrimental role of democracy in environmental protection suggest that under the protection of property rights, both individuals and corporations “can act wilfully, even recklessly, without regard to impact on the environment” (Midlarsky 1998, p. 343). Midlarsky (1998) goes on to argue that given the budget constraints, democracies may be more responsive to issues of the economic sustenance of major portions of the voting public rather than to environmental challenges.

(environmental) needs and priorities of the population. Yet, empirical engagements with this mechanism are rare.

Our findings suggest that democratic governments present in the Arctic indeed enforce more stringent environmental policies, both market-based such as taxes and trading schemes and non-market based, e.g., renewable energy investments and environmental standards. Thus, this study's contributions to the literature on the link between democratic regimes and environmental outcomes are threefold. First, we provide additional support for the proposition that the degree of democracy has an independent effect on the stringency of environmental policies. Second, we explicitly test the responsiveness of democratic regimes to pressing environmental priorities that we ascribe to the association with the Arctic region. Finally, we provide evidence of the effects of democracy on the market and non-market environmental regulations.

Methodologically, this study offers robust insights to the literature by drawing on a multi-dimensional index of environmental regulations in OECD countries that allows us to consistently compare the stringency of environmental policies across countries and over time. Many studies in the literature focus on the reduced form link between democracy and environmental outcomes such as CO₂ emissions (e.g., Farzin and Bond 2006; Arvin and Lew 2011), with limited attention dedicated to the study of environmental policy measures. Furthermore, the results of our analysis are robust to a battery of tests including those that address the concerns over potential bias due to the simultaneous nature of the relationship between democracy and environmental policy-making. In comparison, existing evidence on the relationship is largely limited to cross-sectional descriptive comparisons (Fredriks-son and Neumayer 2013; 2016).

2 Conceptual framework and hypotheses

2.1 Demand for environmental policies: the case of the Arctic

In spite of ample scientific evidence on the destructive consequences of climate change, the responses to address remain relatively limited in scope and magnitude. Existing evidence suggests that more stringent environmental policies (e.g., climate change, deforestation policies) at the macro level are often consistent with the pro-environmental individual preferences at the micro level (Brennan et al. 2020). But what are the determinants of individuals' demand for environmental policies?

A growing body of work shows that direct experiences of climate change-related events shape individuals' climate change concerns (Li et al. 2011; Konisky et al. 2016). Moreover, individuals exposed to extreme weather events or environmental conflicts are more likely to support climate change adaptation policies even within autocracies (Demski et al. 2017; Demchuk et al. 2022; Ray et al. 2017). These empirical observations link to theoretical claims that relate the lack of climate change responses to perceptions of climate change as a temporally, socially, or geographically distant phenomenon (Lorenzoni and Pidgeon 2006; Milifont 2010; McDonald et al. 2015; Mavisakalyan et al. 2018). Hence, personal exposure to climate change is expected to reduce such distance, motivating responses.

Based on recent estimates, the Arctic has warmed nearly four times faster than the globe since 1979 (Rantanen et al. 2022). The effects of these warming temperatures on the Arctic ecologies and societies are immense. Based on the IPCC's Sixth Assessment Report, "multiple physical, ecological and societal elements of polar regions are approaching a level

of change potentially irreversible for hundreds of years, if not millennia” (Constable et al. 2022, p. 2321). The impacts of these changes on the Arctic inhabitants include disruption of food systems, increased disaster losses, and damaged infrastructure (Canosa et al. 2020; Ford et al. 2021). Existing evidence also points towards significant health-related consequences of climate change, especially in small communities (Bring et al. 2015; Rosol et al. 2016). Increasingly, human rights, cultural heritage, and survival of the Arctic’s 400,000 Indigenous inhabitants are seen as being at risk due to the extreme changes in climate (Ford 2009; Barr 2019). Climate change has also created economic opportunities in the region, yet existing evidence shows that tourism (Shijin et al. 2020), mining activities (Tolvanen et al. 2019), and shipping (Hussain et al. 2021) have further accelerated the speed of the impacts of climate change and its consequences for local inhabitants (Aktürk 2022; Constable et al. 2022).

In sum, the lived experiences of Arctic’s inhabitants under rapidly changing climate conditions would imply the prevalence of preferences for environmental policy interventions in view of the finding in the literature that suggests that pro-environmental preferences are prompted by exposure to the effects of climate change (Li et al. 2011; Konisky et al. 2016). However, a large body of work shows that whether preferences translate into policies is likely to depend on the characteristics and quality of institutions. We turn to the discussion on the role of institutions in environmental policy-making next.

2.2 Institutions and environmental policy-making

A large body of work suggests that political and legal institutions and international organizations play an important role in environmental policy-making (Ambrosio et al. 2022). In particular, the literature has shown that legal origins (Fredriksson and Wollscheid 2018), accumulated statehood experience (Ang and Fredriksson 2021), colonial and historical legacies (Fredriksson and Wollscheid 2015; Nazarov and Obydenkova 2022), experience with corruption (Fredriksson and Neumayer 2016), legislators’ identity (Mavisakalyan and Tarverdi 2019), and the degree of decentralization in decision-making (Hartwell et al. 2021; Libman and Obydenkova 2014) are correlated with environmental outcomes and the stringency of environmental policies.

In considering institutions, the literature on environmental policy-making has specifically highlighted the role of democracy and regional international organizations (IOs), splitting the latter into democracy-composed (e.g., the European Union) and autocracy-led (Libman and Obydenkova 2018; 2013) types. This distinction between two types of regional IOs based on the political regimes of their member states has proven to be highly important for the development of studies on environmental governance (Ambrosio et al. 2022; Hall et al. 2022; Obydenkova 2022a; 2022b).

Based on existing evidence, a number of features of democracies appear to contribute to the adoption of environmental policies. Some of these have to do with the incentives of policymakers in democracies vs. autocracies to invest in environmental protection. Congleton (1992) argues that the uncertain career path to the top of an authoritarian regime and the relatively short term of office implies that authoritarian policymakers’ time horizons are shorter, and they set weaker environmental policies.² Similarly, according to the

² However, re-election incentives may lead politicians to adopt stronger environmental policies even in autocracies, should these be regarded as an option favored by the median voter (Downs 1957).

theories of public good provision, in autocracies where a few elites own the productive resources, the government will care less about the provision of public goods relative to their personal gains and would under-produce public goods including the environment (Olson 1993; Deacon 2009).

To explain why democratic regimes might be conducive to environmental policy-making, Payne (1995) focuses on the role of individual rights respected in democracies. One implication of this is the freedom enjoyed by environmentalists to market their ideas and transform them into environmental legislation. Relatedly, Arvin and Lew (2011) argue that the public has greater access to information on environmental problems in a democracy. In particular, democracies enjoy the freedom of mass media which results in high-quality information on environmental issues (Obydenkova 2008; Obydenkova and Salahodjaev 2017). Based on the considerations outlined above, the prediction regarding the role of democratic vs non-democratic regimes in environmental policy-making is as follows:

H1: compared to less democratic countries, more democratic countries enact more stringent environmental policies.

A key argument on the role of institutions in environmental policy-making posits that policies are more likely to reflect public preferences under democratic vs. autocratic regimes. In particular, re-election incentives cause politicians to pass policies that reflect the (environmental) preferences of the polity, whereas no such mechanism to reconcile the public preferences with policy outcomes exists under autocracies (Downs 1957; Rodrik 2000). As a result, the environmental preferences of a median voter are likely to play a greater role in determining the stringency of environmental policies in democracies compared to autocracies (Bättig and Bernauer 2009).

Additionally, citizens in democracies are better informed and organized to protest relative to their counterparts in autocracies, which contributes to their capacity to attract the governments' responsiveness to their needs (Barrett and Graddy 2000; Farzin and Bond 2006). Popović (2020) argues that public campaigns and creating strong public pressure on environmental issues are effective practices that can lead to government responsiveness to environmental preferences in democracies. Democracies are also in a better position to ensure that the environmental interests of their citizens are not outweighed by political pressures from corporations (Arvin and Lew 2011).

Given the considerations above, as long as the median voter prefers better environmental outcomes, we should observe democracies enact more stringent environmental policies. Based on an earlier discussion on environmental conditions and demand for environmental policies in the Arctic, we propose that:

H2: relative to democratic countries with no Arctic presence, democratic countries present in the Arctic enforce more stringent environmental policies.

2.3 Different types of environmental policy instruments

The literature assumes that policymakers often make a choice between two broad types of policy instruments used to control environmental problems. Market-based instruments, such as taxes, trades, or subsidies, provide a price signal to regulate the behaviors of firms or individuals. Such instruments, if designed well, serve to encourage firms or individuals to engage in environmental control efforts that are in their own

interests (Stavins 2003). On the other hand, non-market-based instruments such as command-and-control regulations require compliance with specific standards. These instruments essentially make firms or individuals to take on similar shares of the environmental burden regardless of the cost, although they do this in different ways (Helfand 1991). What are the processes that determine the choices across the two types of instruments?

The literature on the choice of policy instruments focuses on comparisons based on their efficiency under uncertainty, the trade-off between credible commitment and flexibility, implementation, international considerations, and political economy (Hepburn 2006). The combination of different instruments adopted in practice often depends on market failures, costs of implementation, and the structure of the sector to be regulated. For example, as Botta and Kozluk (2014) note, trading schemes are often considered as more effective where few large sources of pollution are present, while standards might be more useful in tackling environmental externalities arising from a dispersed base of small sources where monitoring cost is too high.

As it comes to the relative performance of different policy instruments, the literature provides a nuanced set of results. Xie et al. (2017) show that both command-and-control and market-based regulation have a non-linear relationship with and can be positively related to “green” productivity but with different constraints on regulation stringency. A line of research suggests that market-based instruments are superior in terms of stimulating more innovation than less flexible command-and-control policies (Johnstone and Labonne 2007); however, no such distinction by policy instrument type is found in other instances (Arimura et al. 2007). In summary, both types of environmental policy instruments might be effective under certain conditions and contexts. Hence, we propose that:

H3: democratic institutions in countries with Arctic presence affect both market and non-market-based environmental regulations.

A large body of work shows that political factors are at times more important than economic factors in explaining the choice of policy instruments. The dominant view in this literature is that whenever both market- and non-market-based policy options are available, majorities may prefer the latter to the former even when the former would be socially optimal (Keohane et al. 1998; Alesina and Passarelli 2014). This is in line with the work of Buchanan and Tullock (1975) which proposes that due to political considerations, emission standards are more attractive than taxes (see also Damania 1999). Several other studies yield results consistent with this narrative. For example, Schneider and Volkert (1999) show that there are a number of incentives for political decision-makers to adopt command-and-control instruments instead of market-based instruments, even where the latter might be economically and ecologically more efficient. Aidt and Dutta (2004) study the transition from command-and-control to market-based policy instruments which follow from more ambitious environmental targets. In their framework, the market-based instruments are supported by the lobby of polluting firms, whereas the command-and-control instruments are preferred by citizens. Overall, an implication of discussed studies applied to the context of our study is that:

H4: the effects of democratic institutions on environmental regulations in the Arctic are stronger for non-market-based instruments than for market-based instruments.

3 The econometric model

To analyze the effects of democratic institutions and the Arctic presence on environmental regulations, we estimate the following econometric model:

$$EPS_{it} = \beta_0 + \beta_1 Polity_{it} + \beta_2 Polity_{it} * Arctic_i + \mathbf{X}_{it}' \boldsymbol{\delta} + \mathbf{Cntr}_i' \boldsymbol{\Phi} + \mathbf{Year}_t' \boldsymbol{\Gamma} + \varepsilon_{it} \quad (1)$$

where the subscript i stands for a country and the subscript t stands for a year. EPS_{it} stands for the environmental policy stringency index in each country. As described in the next section, this index is a continuous measure of environmental policy stringency in a given country and takes values between 0 (least stringent environmental policy) and 6 (most stringent environmental policy). $Polity_{it}$ is an indicator of country's political regime, ranging from -10 (strongly autocratic country) to $+10$ (strongly democratic country). The model coefficient estimate of β_1 helps us to test hypothesis H1. A positive and statistically significant estimate of this coefficient would provide evidence in favor of hypothesis H1, while negative and/or not statistically significant coefficient estimate would suggest that hypothesis H1 should be rejected.

$Arctic_i$ is a dummy variable and equals one if a country belongs to the Arctic Council and zero otherwise. Our sample includes all Arctic Council members, except Iceland, i.e., Canada, Denmark, Finland, Norway, Sweden, Russia, and USA, and 26 countries that are not members of the Arctic Council (for details, see the Sect. 4 and Table 1). The interaction term, $Polity_{it} * Arctic_i$, is of particular interest in our study. It helps to analyze how different is the effect of democratic institutions on environmental policy stringency in countries with and without the Arctic presence, that is, to test hypothesis H2. Specifically, a positive and statistically significant coefficient estimate of β_2 , the parameter on this interaction term, would provide evidence in favor of hypothesis H2.

\mathbf{X}_{it} is a vector of variables such as being an OECD member, the natural logarithm of GDP per capita, the share of manufacturing in GDP, trade openness, population density, forest land area, and the resource rents as a percentage of GDP. The choice of these explanatory variables is based on the review of previous studies on the role of institutions and political regimes on environmental policy (see, e.g., Fredriksson and Wollscheid 2007, 2015; Obydenkova and Salahodjaev 2017, among others). \mathbf{Cntr}_i and \mathbf{Year}_t are country- and year-fixed effects, respectively. β , $\boldsymbol{\delta}$, $\boldsymbol{\Phi}$, and $\boldsymbol{\Gamma}$ are the vectors of parameters of the model to be estimated. ε_{it} is an error term. Robust standard errors are clustered at a country level.

Equation (1) is estimated using the fixed effects regression since it allows us to account for unobserved time-invariant heterogeneity in our sample, e.g., cultural heritage or traditions.³ Note that the variable $Arctic_i$ is not included in our analysis, as it does not vary over time and is subsumed in the fixed effects regression.

In our study, EPS_{it} is the overall index that includes both market and non-market components. To test hypotheses H3 and H4, we estimate Eq. (1) for market and non-market EPS_{it} separately. Specifically, statistically significant coefficient estimate on $Polity_{it} * Arctic_i$ in the models for both market and non-market components of EPS_{it} would provide evidence in favor of hypothesis H3, while statistically significant difference between the estimates of β_2 in models for market and non-market components would support hypothesis H4.

³ The Hausman test rejects the random effects model in favor of the fixed effects model (p -value 0.000). The results of random effects estimation are available upon request.

Table 1 Descriptive statistics and definitions of variables used in the analysis

Variable	Definition	No. obs.	Mean	St. dev.	Min	Max
<i>Dependent variables</i>						
EPS	Environmental policy stringency index	692	1.66	0.95	0.21	4.13
EPS, market	Market-based environmental policy stringency index	692	1.11	0.85	0	3.98
EPS, non-market	Non-market-based environmental policy stringency index	712	2.18	1.25	0	5.5
GDP loss	The losses due to extreme environmental events in a given year (% of GDP)	1416	0.28	3.40	0	125
<i>Independent variables</i>						
Polity	Polity score of political regime	692	8.87	3.09	-7	10
Democracy	Index of institutionalized democracy	692	9.14	1.98	0	10
Arctic	= 1 if a country belongs to the Arctic Council and 0 otherwise	692	0.21	0.41	0	1
OECD	= 1 if a country belongs to OECD and 0 otherwise	692	0.80	0.40	0	1
ln(GDP)	Natural logarithm (real gross domestic product per capita in constant 2017 international dollars)	692	10.22	0.72	7.49	11.11
Manufacturing	Value added by the manufacturing sector (% of gross domestic product)	692	16.51	4.74	6.30	32.45
Trade openness	Sum of exports and imports of goods and services measured as a share of gross domestic product (% of GDP)	692	68.83	35.30	15.51	191.10
Population density	Population density (people per sq. km of land area)	692	132.27	118.94	2.22	496.89
Forest land	Forest area (% of a country's land area)	692	34.03	17.44	7.93	73.69
Resource rents	Total natural resource rents (% of GDP)	692	1.94	3.17	0.01	18.95

Source: authors' construction. Notes: the analyzed sample includes Australia, Austria, Belgium, Brazil, Canada, China, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, India, Indonesia, Ireland, Italy, Japan, Mexico, the Netherlands, Norway, Poland, Portugal, Russia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, USA, and the UK. The Arctic Council countries are Canada, Denmark, Finland, Norway, Russia, Sweden, and USA

3.1 Robustness checks

We provide several additional results to assure that our main econometric model specification in Eq. (1) is robust to modifications. First, instead of the index of overall political regime, $Polity_{it}$, we use the index of institutionalized democracy, $Democracy_{it}$. This index shows the strength of democracy inherent to institutions in a particular country. Specifically, we estimate the following model:

$$EPS_{it} = \beta_0 + \beta_1 Democracy_{it} + \beta_2 Democracy_{it} * Arctic_i + \mathbf{X}_{it}' \delta + \mathbf{Cntr}_i' \Phi + \mathbf{Year}_t' \Gamma + \varepsilon_{it} \quad (2)$$

where $Democracy_{it}$ stands for the index of institutionalized democracy, ranging from 0 (the least developed democratic institutions) to 10 (the most developed democratic institutions). The rest of variables in Eq. (2) are the same as in Eq. (1). Note that $Democracy_{it}$ is not the subset of $Polity_{it}$ but is a separate index reflecting how developed democratic institutions are (for details, see Sect. 4 and Marshall and Jagers 2020). To confirm our main findings, the coefficient estimate on $Democracy_{it} * Arctic_i$ in Eq. (2) should be similar in sign with the coefficient estimate on $Polity_{it} * Arctic_i$ in Eq. (1).

In addition, we address several potential caveats in our analysis. First, we demonstrate that our findings are not just a data artifact but are rather meaningful. To do that, we randomly select 7 countries out of 33 in our sample and assume these countries are in the Arctic Council. In other words, we generate the counterfactual (placebo) Arctic variable that equals one if a country is in the Arctic council and zero otherwise. Then, we estimate Eqs. (1) and (2). We repeat this exercise 10,000 times and plot the distribution of the estimated coefficients on $Polity_{it} * Arctic_i$ and $Democracy_{it} * Arctic_i$ from each round. If our findings are not a data artifact, the distribution will be concentrated around zero. In other words, if one selects randomly countries being in the Arctic Council from our sample, the estimated coefficients on $Polity_{it} * Arctic_i$ and $Democracy_{it} * Arctic_i$ have to be around zero.

Second, we may have a potential endogeneity issue related to simultaneity bias, leading to biased coefficients and faulty conclusions. That is, it might be the case that the environmental policy stringency index affects the quality of democratic institutions, the competitiveness of political participation, and the existence of institutionalized constraints on executive power. For instance, citizens may not like stringent regulations (i.e., taxes, barriers, pollution, and emission limits), as a result, they may oppose the current government and select a new one with a lower institutional quality. As a result, the polity and democracy variables might be endogenous. To address this issue, we apply the Lewbel instrumental variable (IV) approach (Lewbel 2012). This approach is widely used in the literature to address endogeneity problem in the absence of valid external instruments.⁴ Lewbel (2012) demonstrates that products of exogenous variables in the model and heteroscedastic errors can be used as valid instruments. To generate valid exogenous instruments, three steps are taken. In the first one, we regress $Polity_{it}$ and $Polity_{it} * Arctic_i$ from Eq. (1) and $Democracy_{it}$ and $Democracy_{it} * Arctic_i$ from Eq. (2) on a set of exogenous variables, Z , including OECD, $\ln(\text{GDP})$, manufacturing, trade openness, population density, forestland, resource rents, and country- and year-fixed effects. From this step, we obtain residuals $\hat{\varepsilon}$. The second step includes demeaning of exogenous variables such that $(Z - \bar{Z})$ where \bar{Z} is a

⁴ Examples of application of the Lewbel IV approach are Arcand et al. (2015), Mavisakalyan et al. (2021), and Otrachshenko et al. (2023), among others.

mean of Z . Finally, the product of previous steps is generated, $(Z - \bar{Z})\hat{e}$, to instrument our endogenous variables.

Finally, we use the GDP losses occurred due to extreme environmental events, such as storms, tornados, floods, droughts, and wildfires, as an alternative dependent variable. While this indicator does not capture the nature of environmental regulations directly but rather captures the consequences of having less stringent environmental policies, it is available for a broader sample. As such, it allows us to explore the robustness of the results to employing a larger and more heterogeneous sample of countries.

4 Variables and data

We use several data sources. Our dependent variable is the environmental policy stringency (EPS) index. It is an economy-wide multi-dimensional index of environmental regulations developed by the Organization for Economic Co-operation and Development (OECD) and is available from Botta and Kozluk (2014). This index allows researchers to compare the stringency of environmental policy across countries consistently. It measures to what extent environmental policies in a given country penalize environmentally harmful behavior and reflects the opportunity costs of polluting. EPS has two major components that enter the index with equal weight: market- and non-market-based environmental policy stringencies (for detailed explanations, see Botta and Kozluk 2014). Market-based environmental policies include tax rates on major pollutants (CO_2 , NO_x , and SO_x) and diesel; emission trading schemes for CO_2 (i.e., the price of one CO_2 allowance) and emission trading schemes for renewable energy certificates and for energy efficiency certificates; feed-in tariffs for wind and solar energy; and presence of deposit and refund schemes. Non-market-based environmental policies include environmental standards, e.g., emission limit values for major pollutants and sulfur content limit in diesel, and governmental R&D expenditures/subsidies on renewable energy. Each component of the market and non-market policies is weighted, and the resulting EPS index ranges from 0 (least stringent on all environmental policy instruments) to 6 (most stringent on all environmental policy instruments) (for weighting details, see Fig. 4 in Botta and Kozluk 2014). Since no country is least/most stringent on all instruments simultaneously, the EPS index takes values between 0 and 6, i.e., the actual EPS range in the data is narrower than 0 to 6.

An alternative dependent variable that we use in our analysis, the losses due to extreme environmental events as a percentage of GDP, is taken from the Germanwatch and is available as an unbalanced panel of 145 countries over the period 2007–2017.

The indices of democratic institutions come from the Polity5 dataset (Marshall and Jaggers 2020). Specifically, we use the revised polity score and the index of institutionalized democracy (for details of constructing all indices, see Marshall and Gurr 2020).

The polity score ranges from -10 (strongly autocratic country) to $+10$ (strongly democratic country) and characterizes the political regime present in a country. As suggested by Marshall and Jaggers (2020), the polity score range can be divided into several ranges: autocracy (polity score in the range from -10 to -6), anocracy or mixed regime (polity score in the range from -5 to $+5$), and democracy (polity score in the range from $+6$ to $+10$).

The index of institutionalized democracy is taken from the Polity5 dataset (Marshall and Jaggers 2020) and reflects the extent to which democratic institutions such as the competitiveness of political participation and the existence of institutionalized constraints on

the executive power are developed in a country. This index ranges from 0 (the least developed democratic institutions) to 10 (the most developed democratic institutions).

Other control variables, including GDP per capita, the share of manufacturing in GDP, trade openness, population density, forest land area, and the resource rents, are collected from the World Development Indicators Database maintained by the World Bank.

The final dataset includes about 700 observations and is an unbalanced panel of 33 countries in the period from 1990 to 2015.⁵ Countries included in our analysis are the ones, for which the EPS index is available. The summary statistics and definitions of all variables used in the analysis are shown in Table 1.⁶

5 Results

5.1 Baseline results

Table 2 presents the main results for the polity and democracy variables. As shown, both polity and democracy variables are not statistically significant. This suggests that democratic institutions do not have an independent impact on environmental policy stringency. Thus, we do not find evidence to support hypothesis H1 that democratic countries enact more stringent environmental policies as compared to non-democratic countries. However, the interaction of the polity indicator with a country being in the Arctic Council is positive and highly statistically significant. The results in column 2 also confirm this finding. This finding supports our hypothesis H2 that democratic countries present in the Arctic enact more stringent environmental policies, suggesting that responsiveness to environmental need is one of the main mechanisms through which democracy shapes environmental outcomes.

To test hypotheses H3 and H4, we present the results for market and non-market EPS separately. Table 3 presents the results for market and non-market EPS. As observed, both components are affected by the polity and democracy variables in the same manner as in Table 2. This supports our hypothesis H3.

We then test whether the effects of democratic institutions on environmental regulations in the Arctic are stronger for non-market-based instruments than for market-based instruments (hypothesis H4). That is, our hypotheses are

$$H_0 : \beta_{\text{Market}} = \beta_{\text{Non-market}}$$

$$H_A : \beta_{\text{Market}} \neq \beta_{\text{Non-market}}$$

We find that the statistical difference between the estimated coefficient on the Polity*Arctic variable in the model for the market EPS (Table 3, column 1) and the non-market EPS (Table 3, column 3) (p -value equals 0.07). The differences between the estimated coefficients on Democracy*Arctic in Tables 3 (columns 2 and 4) are also statistically

⁵ The sample includes 27 OECD member countries (Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Mexico, the Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, USA, and the UK) and 6 non-member countries (Brazil, China, India, Indonesia, Russia, and South Africa).

⁶ Table A1 in the supplementary online appendix also shows the correlation matrix of variables used in the analysis.

Table 2 Main results with the overall environmental policy stringency

	Overall EPS	Overall EPS
	(1)	(2)
Polity	-0.021 (0.035)	
Polity*Arctic	0.502*** (0.106)	
Democracy		-0.058 (0.057)
Democracy*Arctic		1.020*** (0.200)
OECD	0.158 (0.127)	0.206 (0.129)
ln(GDP)	0.674 (0.441)	0.660 (0.430)
Manufacturing	-0.027 (0.032)	-0.025 (0.031)
Trade openness	-0.001 (0.005)	-0.001 (0.005)
Population density	-0.009** (0.004)	-0.009** (0.004)
Forest land	0.093 (0.061)	0.083 (0.059)
Resource rents	-0.028 (0.034)	-0.028 (0.034)
Country-fixed effects	Yes	Yes
Year-fixed effects	Yes	Yes
Observations	692	692
R-squared	0.758	0.76
Number of countries	33	33

*** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. The fixed effects regression results are presented. The dependent variable is the overall environmental policy stringency (EPS) index. Robust standard errors clustered at a country level are in parentheses

significant with p -value 0.07. Overall, we may conclude that there is difference between the estimated market and non-market coefficients. Interestingly enough, democratic institutions of countries present in the Arctic affect the non-market EPS index more than the market EPS. This supports our hypothesis H4.

5.2 Robustness check

To show that our results are robust, we randomly generate a placebo dummy variable that equals one if a country (in total 7 out of 33 countries in our analysis) is in the Arctic Council and zero otherwise. Then, we estimate Eq. (1) with this placebo Arctic dummy 10,000 times. As shown in Fig. 1, the estimated coefficients on the Polity*Arctic and

Table 3 Main results with the market-based and non-market-based environmental policy stringency

	Market-based EPS	Market-based EPS	Non-market-based EPS	Non-market-based EPS
	(1)	(2)	(3)	(4)
Polity	-0.005 (0.029)		-0.029 (0.042)	
Polity*Arctic	0.445*** (0.113)		0.549*** (0.118)	
Democracy		-0.029 (0.053)		-0.075 (0.066)
Democracy*Arctic		0.910*** (0.222)		1.113*** (0.221)
OECD	0.187 (0.219)	0.219 (0.209)	0.062 (0.178)	0.131 (0.202)
ln(GDP)	0.522 (0.496)	0.507 (0.489)	0.801 (0.619)	0.776 (0.605)
Manufacturing	-0.043 (0.029)	-0.040 (0.028)	0.002 (0.034)	0.006 (0.033)
Trade openness	-0.001 (0.006)	-0.002 (0.005)	-0.001 (0.005)	-0.002 (0.005)
Population density	0.000 (0.005)	0.000 (0.005)	-0.018*** (0.007)	-0.018*** (0.006)
Forest land	0.066 (0.044)	0.057 (0.044)	0.140* (0.071)	0.131* (0.070)
Resource rents	-0.056* (0.029)	-0.056* (0.029)	0.000 (0.053)	-0.0002 (0.052)
Country-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
Observations	692	692	712	712
R-squared	0.576	0.577	0.718	0.721
Number of countries	33	33	33	33

*** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. The fixed effects regression results are presented. The dependent variable is the market-based environmental policy stringency index in columns 1 and 2 and the non-market-based environmental policy stringency index in columns 3 and 4. Robust standard errors clustered at a country level are in parentheses

Democracy*Arctic variables are concentrated around zero, suggesting that our results are not just a data artifact.

Next, our results may potentially be prone to endogeneity. To address this issue, we apply the Lewbel IV approach described in Sect. 3. The results are presented in Table 4. As shown, all results remain the same in terms of signs and statistical significance, indicating that endogeneity is most likely not an issue in our case.

Finally, we use the GDP losses occurred due to extreme environmental events as an alternative dependent variable (see Table A2 in the supplementary online appendix). This indicator reflects the risks that countries bear due to non-stringent environmental policies. It is also available for a larger sample of countries than those used in our baseline analysis

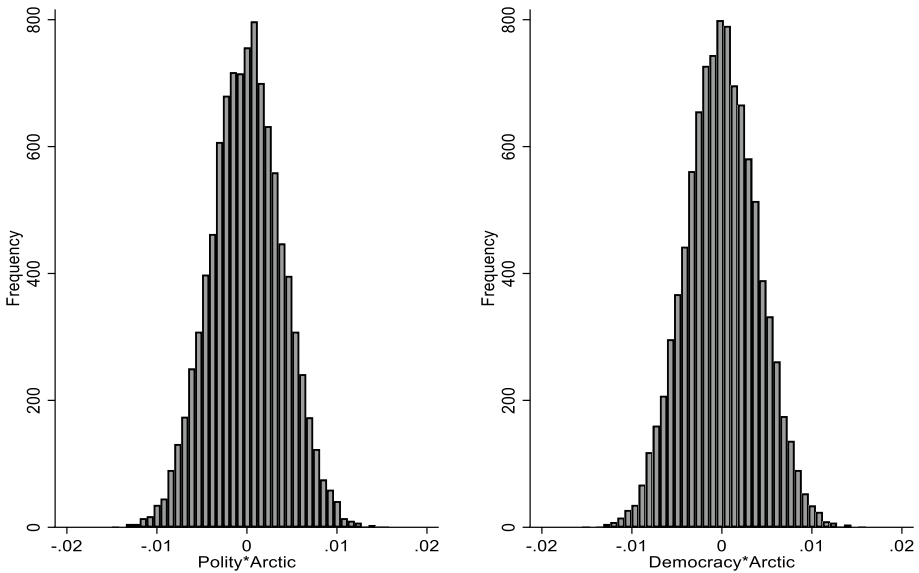


Fig. 1 Simulation results with placebo Arctic membership, overall environmental policy stringency. Source: authors' construction. Notes: the results are reported based on the 10,000 estimations of Eq. (1) with a placebo Arctic dummy, i.e., randomly assigned Arctic membership status to 7 out of 33 sample countries

and, as such, allows us to explore the robustness of the results to employing a larger and more heterogeneous sample of countries. As shown in Table A2, democratic institutions in countries present in the Arctic reduce the risks that countries bear due to the lack of stringent environmental policies, which is consistent with our baseline results.

5.3 Economic importance of the results

In this section, we run a hypothetical scenario where it is assumed that democratic institutions worsen in 33 countries simultaneously by one standard deviation. Such exercise provides a better understanding of what happens with the impact of institutional variables if all countries of our sample face a sudden exogenous shock, reducing institutional quality. Given the rise of support for populist parties in many countries (see, e.g., Agerberg 2017; Guth and Nelsen 2021), this is a plausible scenario. To implement such exercise, entropy balancing is employed (Hainmueller 2012).⁷ Specifically, we rebalance data such that the mean of polity and democracy is reduced by one standard deviation, that is, from 8.87 and 9.14 to 5.78 and 7.16, respectively.⁸ After that, for each observation in our study, weights are computed based on new means. These weights are applied in Eqs. (1) and (2).⁹

⁷ We use the ebalance command in the Stata software.

⁸ From the means of polity and democracy, we subtract their corresponding one standard deviation such that new means become 5.78 (=8.87 – 3.09) and 7.16 (=9.14 – 1.98), respectively. The information on the means of variables and their standard deviations is available in Table 1.

⁹ Examples of using this approach are Nikolova et al. (2022) (to adjust treatment and comparison groups) and Otrachshenko et al. (2022a, 2022b) (to balance the collected data to population means), among others.

Table 4 The Lewbel IV approach, overall environmental policy stringency

	Overall EPS	Overall EPS
	(1)	(2)
Polity	-0.016 (0.032)	
Polity*Arctic	0.495*** (0.099)	
Democracy		-0.050 (0.053)
Democracy*Arctic		1.007*** (0.190)
OECD	0.149 (0.121)	0.194 (0.119)
ln(GDP)	0.682 (0.424)	0.666 (0.413)
Manufacturing	-0.029 (0.031)	-0.026 (0.030)
Trade openness	-0.001 (0.005)	-0.001 (0.005)
Population density	-0.009** (0.004)	-0.009** (0.004)
Forest land	0.097* (0.058)	0.087 (0.056)
Resource rents	-0.028 (0.033)	-0.028 (0.032)
Country-fixed effects	Yes	Yes
Year-fixed effects	Yes	Yes
Observations	692	692
R-squared	0.857	0.858
Number of countries	33	33

*** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. The dependent variable is the overall environmental policy stringency (EPS) index. Robust standard errors clustered at a country level are in parentheses

Table 5 presents the results. As shown, changing means of polity and democracy by one standard deviation worsens the effects of democratic institutions for countries present in the Arctic on the EPS substantially compared to main results presented in Table 2. In the case of polity and democracy, the estimated coefficients drop by 7.8 and 8.8 percentage points (p.p.), respectively. These results complement our previous findings, providing evidence that a fall in the quality of institutions (and as a result, smaller estimated coefficients) in all countries is associated with less stringent environmental policies.

Finally, to demonstrate the importance of our findings, we compute an implicit monetary value of democratic institutions in the Arctic on the EPS (Table 2, column 2). To

Table 5 Results for worsening institution variables by 1 standard deviation, the overall environmental policy stringency

	Overall EPS	Overall EPS
	(1)	(2)
Polity	-0.013 (0.024)	
Polity*Arctic	0.463*** (0.070)	
Democracy		-0.039 (0.042)
Democracy*Arctic		0.930*** (0.139)
OECD	0.016 (0.147)	0.063 (0.148)
ln(GDP)	0.513 (0.319)	0.499 (0.310)
Manufacturing	-0.020 (0.029)	-0.016 (0.027)
Trade openness	0.001 (0.004)	0.001 (0.004)
Population density	-0.008** (0.004)	-0.008** (0.003)
Forest land	0.076 (0.046)	0.073* (0.042)
Resource rents	-0.050 (0.033)	-0.053 (0.033)
Country-fixed effects	Yes	Yes
Year-fixed effects	Yes	Yes
Observations	692	692
R-squared	0.869	0.870
Number of countries	33	33

*** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. The fixed effects regression results are presented. The dependent variable is the overall environmental policy stringency (EPS) index. Robust standard errors clustered at a country level are in parentheses. The estimated entropy balancing weights are applied

compute such monetary equivalent, we adapt the approach used by Powdthavee and van den Berg (2011)¹⁰ as follows:

$$\text{Tag} = \overline{\text{GDP}} \times \left(\exp \left(\frac{\beta^{\text{Democracy*Arctic}}}{\beta^{\ln(\text{GDP})}} \right) - 1 \right) \quad (4)$$

¹⁰ Powdthavee and van den Berg (2011) use the life satisfaction variable as a dependent variable, while in our study, we use the environmental policy stringency index.

where Tag is the estimated price tag associated with autocracy for an average country in our sample. $\overline{\text{GDP}}$ is the average GDP per capita in our sample in constant 2017 international dollars, and β is the estimated coefficients on $\text{Democracy}^*_{\text{Arctic}}$ and the natural logarithm of GDP from Table 2, column 2. Using Eq. (4), the estimated price tag is about 101,282¹¹ international dollars per capita. That is, the effect of democratic institutions' presence in the Arctic on environmental policy stringency is similar to increasing the average GDP per capita in the sample by 101,282 international dollars, e.g., by making all counties in the sample richer by this amount. Note that these findings are suggestive, and more research is required in this direction.

6 Discussion and conclusions

Climate change has an increasingly adverse impact on the Arctic region, leading to multiple ecological problems, disaster losses, infrastructure damage, and food system disruption. Apart from the direct influence on the region itself, the sea level rise in the Arctic leads to changes in ocean currents globally, highlighting that environmental policy-making and governance in the Arctic are an urgent task that requires global efforts. This paper contributes to the literature by providing evidence that the development of democratic institutions in countries with the Arctic presence enacts more stringent environmental policies.

The findings of this paper have several implications. First, our results underscore that enhancing multilateral governance and developing democratic institutions in countries with the Arctic presence should be an essential component in global efforts on preserving the Arctic region and its ecosystem. Second, the findings also suggest that democratic institutions in the Arctic affect non-market-based environmental policies more strongly than market-based environmental policies. That is, the development of democratic institutions in the Arctic is more likely to enforce the development of renewable energy, introduction of environmental standards and emission limits than the introduction and regulation of taxes, and emission trading schemes. This result implies that more stringent non-market environmental policies associated with democratic institutions also have a potential for promoting more sustainable use of the Arctic resources. Finally, our results are also significant economically. The findings suggest that the favorable impact of democratic institutions in counties present in the Arctic is approximately equivalent to 101,000 of international dollars per capita, which exceeds GDP per capita of USA, United Arab Emirates, or Norway ca. one and half times. That is, the development of democratic institutions may also lead to strong welfare improvements associated with more stringent environmental policies.

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Author contribution AM: conceptualization; formal analysis; writing—original draft; writing—review and editing.

VO: conceptualization; formal analysis; methodology; writing—original draft; writing—review and editing.

OP: conceptualization; data curation; formal analysis; writing—original draft; writing—review and editing.

¹¹ $101,282 = 27,447 * \left(\exp\left(\frac{1.020}{0.66}\right) - 1 \right)$.

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Data availability The datasets analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical approval The data used in this study are in the aggregated form at the country level. No ethics committee approval is required.

Consent to participate All authors agree with participating in this work.

Consent for publication All authors approve the work in its current form and agree to its publication. The submitted work is original, has not been published elsewhere, and is not under consideration in any other journal.

Competing interests The authors declare no competing interests.

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