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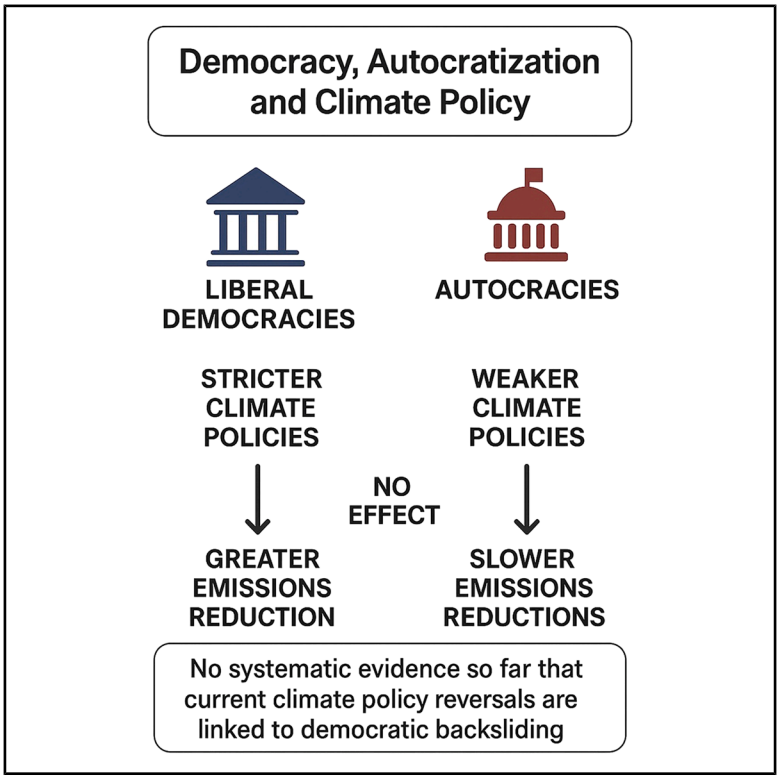
Does democratic backsliding undermine climate policy? No evidence (yet)

Graphical abstract



Highlights

- Political institutions predict climate policy outputs and outcomes
- Liberal democracies tend to perform better than autocracies in this regard
- This study explores the common presumption that there is an opposite effect
- However, there is no evidence that democratic backsliding undermines climate policy

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In brief

Earth sciences; Social sciences; Political science

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Does democratic backsliding undermine climate policy? No evidence (yet)

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SUMMARY

Countries with liberal democratic institutions tend to have stricter climate policies and have made more progress in reducing emissions than autocracies. Does this, in turn, mean that democratic backsliding or autocratization, a widely observed trend in the global system in recent years, has a generally negative effect on climate change mitigation efforts? Using the best available data and various estimation strategies for causal inference, we cannot find systematic evidence for this widely held presumption. This finding seems encouraging, but it remains open whether current climate policy reversals, e.g., in the US, could bring about a more general trend where democratic backsliding will undermine climate policy worldwide.

INTRODUCTION

Many studies have provided theoretical arguments and empirical evidence for the claim that, all else being equal, liberal democratic institutions tend to adopt stricter climate policies and make more progress in reducing greenhouse gas emissions. The underlying mechanism is that more political liberties, essential features of liberal democracy, are associated with various factors that are conducive to climate policy: (1) more freedom for scientific research and communication; (2) more opportunities for science to shape public opinion; (3) more space for public opinion, civil society, and citizen demands to develop, get organized, and be expressed toward policymakers; and (4) stronger accountability of political leaders vis-à-vis citizens and their demands.[1–3]

It is important to note that the above arguments do *not* imply that democracies perform well in climate policy in an absolute sense. To the contrary, virtually no liberal democracy is currently doing enough to reach net-zero emissions by 2050. The political economy literature has, in fact, contributed a wealth of insights on why problem solving in democracies is oftentimes deficient, both in climate policy and other domains.[4–11] Rather, the above arguments hold that, all else equal (e.g., income levels), liberal democracies perform *better than* autocracies in their climate policies. The empirical evidence for this hypothesis is quite robust in the existing literature.

Considering this widely observed pattern, one might conclude that democratic backsliding or autocratization,[12] i.e., the opposite of being or becoming more democratic, weakens a country's climate change mitigation efforts. The following article assesses the evidence for this claim. The rise of right-wing populism in Western democracies and a trend toward more autocratic forms of governance across the globe[13] have gone hand in hand with more anti-science rhetoric and attempts to roll back climate and other environmental policies. Will this led to the erosion of global political efforts to mitigate climate change? The example of the US, where neither democratic backsliding or dismantling of federal (but less so state-level) climate policy can be observed, suggests that this *can* happen. But we should be careful about extrapolating from one nation to the rest of the world, even though this country's choices have a large effect on the global climate system. Hence, a systematic analysis of how democratic backsliding or autocratization in the past few decades has affected climate policy (output) and greenhouse gas emissions (outcome) can help us understand what the potential political risks of this mega-trend to worldwide climate change mitigation efforts might be.

Global efforts to mitigate climate change are essentially the sum of efforts by individual countries, but there is strong variation in how much each of them contributes to the global public good.[14] This variation is driven by many idiosyncratic factors, such as political leaders, the dynamics of electoral processes, or interest group lobbying, but also by some more fundamental structural factors, such as economic conditions and political institutions. As indicated above, many studies provide theoretical arguments and empirical evidence suggesting that, on average, liberal democratic institutions, on average, have made more progress in establishing ambitious climate policies. They also offer some evidence that those policies are beginning to translate into emissions reductions.[15,16]

The flipside of the democracy-climate change mitigation nexus, however, remains unclear: does democratic backsliding, which has taken place in several countries worldwide over the last few years, also result in backsliding in climate change mitigation? Some recent studies suggest so,[17,18] but a more

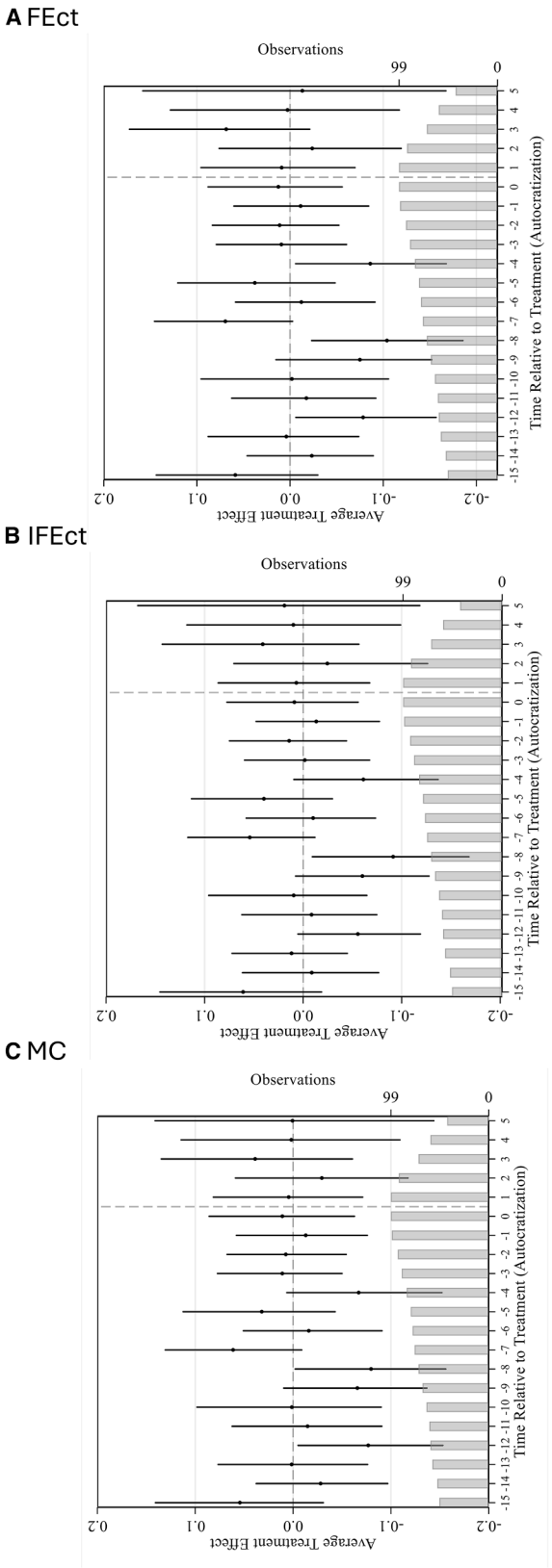

Figure 1. The impact of democratic backsliding (autocratization) on climate policy

(A) This figure shows the dynamic treatment effect estimates from simulated (N = 1,000, block bootstraps) data using the fixed effects counterfactual estimator (FEct) by Liu, Wang, and Xu.[19] The dependent variable is the logged number of climate policies. The treatment is the onset of autocratization. We control for population, income, income square, globalization, and a lagged dependent variable. The bar plot illustrates the number of treated units at the given time period relative to the onset of the treatment (the number decreases as time goes by because there are fewer and fewer units that are treated for a sustained period of time). The vertical bars pertain to the 95 percent confidence intervals of the average treatment effect of the treated.

(B) The same as the plot in A, but when using the Interactive fixed effects counterfactual estimator (IFEct).

(C) The same as the plot in A, but when using the matrix completion estimator (MC).

systematic analysis focusing both on climate policy choices and emissions is needed.

Here, we report results from an analysis of whether and to what extent autocratizing countries have also experienced backsliding in their climate policies and their reductions of greenhouse gas emissions. Climate policy choices are more likely to vary in the short run with changes in political conditions, whereas emissions are more path dependent as they are driven by more fundamental economic and societal structures. This should make it easier to identify climate policy backsliding, in the form of weakened climate policies, relative to identifying slower progress in reducing emissions as such.

RESULTS

Influence of autocratization on climate policies and greenhouse gas emissions

The analysis is based on the best available data for climate policies, greenhouse gas emissions, and democratic backsliding, and we use three empirical procedures geared toward counterfactual estimation for causal inference.[19] The sample includes 160 countries between 1991 and 2022. We focus on two outcome variables: climate policies as derived from the Climate Policy Database (Figures 1A–1C; Table 1) and greenhouse gas emissions per capita (Figures 2A–2C; Table 2). The main explanatory factor is democratic backsliding. It is defined in terms of autocratization episodes (country-years) where we observe a 10% decline in the V-Dem *Electoral Democracy Index* (see STAR Methods section).

The main quantity of interest is the dynamic treatment effect, "or the average treatment effects on the treated (ATT) over different periods, without assuming treatment effect homogeneity of any kind."[19] These ATTs are plotted in Figures 1A–1C and 2A–2C. Liu et al.[19] recommend three test procedures to distinguish among the estimation procedures and to select the most appropriate one: the Placebo Test, the Equivalence Test, and the Carryover Test (see STAR Methods section).

According to Figures 1A–1C, there are no strong pre-trend leading toward the onset of the treatment, and no treatment estimates in the pre-treatment period are significantly different from zero. In the post-treatment period, there are no significant effects of autocratization on climate policies, suggesting that autocratization has no causal impact on climate policy

Table 1. Climate policy main models

	FEct	IFEct	MC
Lagged Dependent Variable	0.334***	0.167***	0.348***
	(0.028)	(0.039)	(0.039)
Autocratization	0.024	0.017	0.018
	(0.046)	(0.047)	(0.040)
Democracy	−0.017	−0.019	−0.044
	(0.117)	(0.080)	(0.082)
GDP per capita (ln)	−0.350	−0.025	−0.063***
	(0.324)	(0.018)	(0.018)
GDP per capita (ln)^2	0.023	0.002	0.006***
	(0.018)	(0.002)	(0.002)
Population (ln)	−0.034	−0.006	−0.011***
	(0.703)	(0.004)	(0.004)
Globalization	0.002	0.003**	0.005***
	(0.003)	(0.001)	(0.001)

Table entries are coefficients; standard errors in parentheses; constant, year fixed effects, and country fixed effects included in the models, but omitted from presentation; *p < 0.10, **p < 0.05, ***p < 0.01 (two-tailed).

legislation. In addition, coming to Figures 2A–2C, there are no strong pre-trend leads toward the onset of the treatment, and only one treatment estimate in the pre-treatment period is significantly different from zero. In the post-treatment period, there are no significant effects of *autocratization* on greenhouse gas emissions, suggesting that autocratization has no causal impact on climate change outcomes.

In Tables 1 and 2, we summarize the models underlying these substantive quantities of interest. Rather than displaying the dynamic treatment effects that vary by observation year, though, Tables 1 and 2 show the average treatment effects for autocratization over time. The average treatment is statistically insignificant in any model specification, thus mirroring Figures 1A–1C and 2A–2C. The control variables are associated with statistically significant effects in some models, but this depends on estimation specifications and the outcome variable under study.

Alternative climate policy output and outcome indicators

While we consider all nine policy instruments, all 33 sub-instruments, and six mitigation areas for the climate policy variable above (see STAR Methods section), we also use a more narrowly defined operationalization for that dependent variable. That is, in Table 3, we re-estimate the main policy model when focusing on the policy objective (instrument) of "air pollution" only or on the policy instrument of "climate strategy." In addition, we use a binary dependent variable in the third model of Table 3. Employing this more aggregated operationalization can address measurement error in a count-type dependent variable, especially if the data generating process is difficult to observe. The binary dependent variable receives a value of 1 if a country has implemented at least one policy as defined by the CPDB each year. Finally, the last model in Table 3 is based on high-impact policies only. Schaffrin et al.[20] and Knill et al.[21] stress that the intensity (content of policy instruments) matters – not only the density in the form of the number of policies. To capture intensity, we focus only on those CPDB policies that are coded as "high impact:" these are policies identified by national experts to have high potential to reduce greenhouse emissions. For reasons of parsimony, we only present the FEct models. According to Table 3, the average treatment effect on the treated remains statistically insignificant even when using alternative, more narrowly defined operationalizations for climate policy, the binary indicator, or a variable based on high-impact policies only.

We also explored alternative approaches to capturing climate outcomes. On the one hand, we re-estimate the main model based on greenhouse gas emissions but now use carbon dioxide (CO_2) emissions measured in metric tons per capita, as provided by the World Development Indicators. CO_2 emissions, as captured by this dataset, stem from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during the consumption of solid, liquid, and gas fuels, and gas flaring. The World Development Indicators' data were originally compiled by the World Resources Institute. We use the logged version of this variable. On the other hand, we employ the ecological footprint based on consumption, which, according to the codebook, "measures [in global hectares per capita] the human demand for nature by assessing how much biologically productive land and sea area is necessary to maintain a given consumption pattern." In more detail, the ecological footprint is a "measure of the biologically productive land and water area an individual, population, or activity requires to produce all the resources it consumes, to accommodate its occupied urban infrastructure, and to absorb the waste it generates, using prevailing technology and resource management practices." The components of the variable include cropland, forest land, fishing grounds, grazing land, and built-up land. The final variable "is defined as the area used to support a defined population's consumption," i.e., it focuses on consumption that "includes the area needed to produce the materials consumed and the area needed to absorb the carbon dioxide emissions." It is calculated as a country's primary production footprint plus the footprint of imports minus the footprint of exports. Higher values stand for worse environmental quality. The data are taken from the Global Footprint Network, which relies on institutions such as the UN, the FAO, the IPCC, or the IEA as primary sources for the footprint's individual components. Again, we only present the FEct models. According to Table 4, the average treatment effect on the treated remains statistically insignificant when using alternative data for climate outcomes.

Alternative operationalization of *autocratization*

Moreover, we altered the specifications of the variable autocratization. In Tables 1 and 2, to operationalize episodes of democratic backlash, we use the V-Dem's *Electoral Democracy Index* and a 0.1 threshold (10% decline on a scale between 0 and 1) with testing for overlapping confidence intervals (see STAR Methods section). In Table 5, we summarize the estimated average treatment effect on the treated for autocratization and five different operationalizations. First, we add to the specifications that there must be a cumulative decrease of at least 0.05 in a possible autocratization period after the test for overlapping

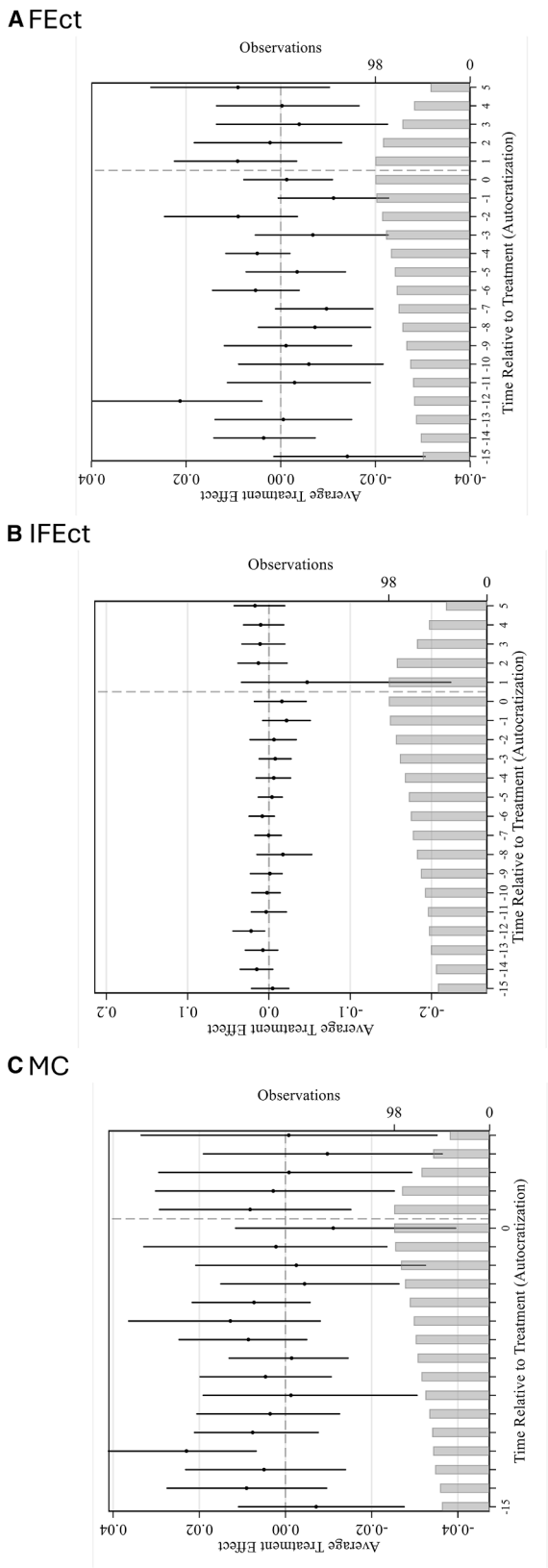

Figure 2. The impact of democratic backsliding (autocratization) on greenhouse gas emissions

(A) This figure shows the dynamic treatment effect estimates from simulated (N = 1,000, block bootstraps) data using the fixed effects counterfactual estimator (FEct) by Liu, Wang, and Xu.[19] The dependent variable is greenhouse gas emissions per capita (in mt of CO2 equivalent, excluding LULUCF, logged). The treatment is the onset of autocratization. We control for population, income, income square, globalization, and a lagged dependent variable. The bar plot illustrates the number of treated units at the given time period relative to the onset of the treatment (the number decreases as time goes by because there are fewer and fewer units that are treated for a sustained period of time). The vertical bars pertain to the 95 percent confidence intervals of the average treatment effect of the treated.

(B) The same as the plot in A, but when using the Interactive fixed effects counterfactual estimator (IFEct).

(C) The same as the plot in A, but when using the matrix completion estimator (MC).

confidence intervals. Second, we employ the same specifications as in Tables 1 and 2, but rather than using the V-Dem's *Electoral Democracy Index*, we rely on the V-Dem's *Liberal Democracy Index*. Third, we continue to use the *Liberal Democracy Index*, but now also specify a cumulative decrease of at least 0.05 in a possible autocratization period. Fourth, we return to the V-Dem's *Electoral Democracy Index*, but now specify a 0.2 threshold (20% decline on a scale between 0 and 1) with testing for overlapping confidence intervals. Finally, the autocratization variable is based on the *Electoral Democracy Index*, a 0.2 threshold, and a cumulative decrease of at least 0.05.

All estimated average treatment effects on the treated are statistically insignificant, except for the model on greenhouse gas emissions and the *Liberal Democracy Index*, where autocratization is estimated at 0.008 and is significant at the 10 percent level. However, even if statistically significant at conventional levels, the overall substantive impact is negligible, thus confirming our core finding that democratic backsliding does not undermine climate policy.

The influence of right-wing executives

Finally, we control the political ideology of a country's executive. It has been suggested that, given the right-wing populist nature of anti-climate leaders such as Trump or Bolsonaro, the negative impact of autocratization might only apply to right-wing ideology. To this end, we created one variable on governments' right-wing ideology based on the World Bank's Database of Political Institutions. These data provide information on political leaders' (chief executive) and the largest government party's political orientation, distinguishing between left, center, right, and other. The classification follows the typical left-right spectrum, while "other" mostly refers to non-democratic leaders and systems where this scale cannot fully be applied. We use this information to create one dichotomous variable, which receives a value of 1 if either a political leader or the largest executive party is coded as "right." In turn, we restrict the sample to these rightist executives and estimate the FEct model again for climate policies and greenhouse gas emissions. Table 6 summarizes the corresponding findings, although again, the autocratization variable exerts an insignificant effect. Hence, the null effect does not only apply to rightist governments.

Table 2. Greenhouse gas emissions main models

	FEct	IFEct	MC
Lagged Dependent Variable	0.880***	0.665***	0.627***
	(0.013)	(0.073)	(0.047)
Autocratization	0.005	0.006	0.002
	(0.005)	(0.018)	(0.014)
Democracy	−0.001	0.032	0.027
	(0.020)	(0.086)	(0.060)
GDP per capita (ln)	0.284***	−0.023	−0.048**
	(0.075)	(0.028)	(0.022)
GDP per capita (ln)^2	−0.016***	0.003	0.005**
	(0.005)	(0.003)	(0.002)
Population (ln)	−0.050	0.074	0.422***
	(0.034)	(0.077)	(0.034)
Globalization	0.003***	0.007**	0.005***
	(0.001)	(0.002)	(0.002)

Table entries are coefficients; standard errors in parentheses; constant, year fixed effects, and country fixed effects included in the models, but omitted from presentation; *p < 0.10, **p < 0.05, ***p < 0.01 (two-tailed).

Table 4. Alternative climate outcome operationalizations

	FEct (CO_2 emissions)	FEct (Ecological footprint)
Lagged Dependent Variable	0.888***	0.830***
	(0.016)	(0.036)
Autocratization	0.003	0.008
	(0.004)	(0.016)
Democracy	−0.002	−0.016
	(0.016)	(0.080)
GDP per capita (ln)	0.233***	0.883**
	(0.058)	(0.433)
GDP per capita (ln)^2	−0.013***	−0.046*
	(0.003)	(0.027)
Population (ln)	−0.030*	−0.191*
	(0.018)	(0.103)
Globalization	0.002***	0.009**
	(0.001)	(0.004)

Table entries are coefficients; standard errors in parentheses; constant, year fixed effects, and country fixed effects included in the models, but omitted from presentation; *p < 0.10, **p < 0.05, ***p < 0.01 (two-tailed).

DISCUSSION

Recent democratic backsliding in some Western democracies and elsewhere is accompanied by strong and explicit efforts to dismantle both climate science and policy.[22] However, even if we do not find current, systematic evidence for this claim, the fact remains that "absence of evidence" is not "evidence of absence." We should therefore remain cautious about extrapolating from the past three decades into the future or across different contexts. While our analyses cover the global system and the period from the early 1990s through the most recent year with reliable data on climate policy, emissions, and autocratization, the findings should not be taken to imply that democratic backsliding will *never* threaten climate mitigation efforts. Rather, we are unable to identify a significant negative effect of democratic backsliding on climate policy choices and emissions at the current point in time, which highlights that, on average, the relationship is weaker and more heterogeneous than often assumed.

To the extent that these results withstand further empirical scrutiny, an important next step is to explore the conditions under which accumulated environmental policy choices remain robust against adverse political change and, conversely, the conditions under which they may unravel. Understanding these contingencies is essential for assessing whether today's policy architecture is strong enough to withstand the political pressures that democratic backsliding may generate in the years ahead.

Table 3. Alternative climate policy operationalizations

	FEct (Air pollution)	FEct (Climate strategy)	FEct (Binary variable)	FEct (High impact)
Lagged Dependent Variable	0.078	−0.031	0.092***	−0.028
	(0.051)	(0.022)	(0.019)	(0.204)
Autocratization	0.005	−0.023	−0.032	−0.693
	(0.009)	(0.016)	(0.023)	(0.869)
Democracy	0.057	−0.079**	0.011	3.253
	(0.045)	(0.037)	(0.085)	(8.150)
GDP per capita (ln)	0.009	−0.003	−0.111	8.059
	(0.118)	(0.160)	(0.254)	(44.238)
GDP per capita (ln)^2	−0.001	0.001	0.009	−0.264
	(0.006)	(0.010)	(0.016)	(2.431)
Population (ln)	−0.024	−0.050	0.085	−2.681
	(0.020)	(0.044)	(0.081)	(8.809)
Globalization	0.001	−0.001	0.006**	0.008
	(0.001)	(0.001)	(0.002)	(0.193)

Table entries are coefficients; standard errors in parentheses; constant, year fixed effects, and country fixed effects included in the models, but omitted from presentation; *p < 0.10, **p < 0.05, ***p < 0.01 (two-tailed).

Limitations of the study

Our empirical analysis captures general patterns across countries and time, but a key limitation is that it may not reflect the dynamics of individual cases or short-term disruptions. The US illustrates this point. Current democratic backsliding has coincided with highly visible efforts to dismantle climate science and reverse policy commitments. While such developments did not produce detectable global or long-term effects in our analysis, they may still have substantial consequences if they trigger policy reversals in other states, weaken international cooperation, or erode confidence in existing institutions. In this sense, our results should be read as bound: they highlight resilience in the aggregate to date, but they do not guarantee resilience in the future.

Second, the analysis centers on the adoption of climate policies, yet it does not capture their dismantling, weakening, or

Table 5. Alternative *Autocratization* operationalizations

	0.05 cumulative decrease	*Liberal Democracy Index*	*Liberal Democracy*, 0.05 cumulative decrease	0.2 threshold	0.2 threshold, 0.05 cumulative decrease
Climate Policy Models	0.039	0.009	0.026	0.041	−0.021
	(0.038)	(0.041)	(0.055)	(0.082)	(0.052)
Greenhouse Gas Emissions Models	0.011	0.008*	0.001	0.007	−0.001
	(0.008)	(0.004)	(0.008)	(0.007)	(0.008)

Table entries are estimated average treatment effects on the treated for *Autocratization*; standard errors in parentheses; *p < 0.10, **p < 0.05, ***p < 0.01 (two-tailed).

termination. This is an important omission, as the erosion of existing policies may differ in its political drivers and consequences from the processes that lead to new commitments. In some contexts, autocratization may not halt new policy adoption outright but may gradually weaken existing frameworks through underfunding, regulatory rollback, or selective enforcement. Future research could extend our approach by systematically tracking such forms of policy retrenchment to assess whether the observed patterns discussed above hold once dismantling dynamics are explicitly accounted for.

Third, a further limitation is that the absence of statistically detectable effects should not be mistaken for evidence that no effects exist. Empirical analyses of historical data can only identify patterns visible within the available time frame and a measurement precision. That said, the subtle or delayed consequences of autocratization for climate policy may go unnoticed, especially if they unfold gradually or through indirect channels. Caution is thus warranted in extrapolating from past patterns to future outcomes, as structural shifts in global politics or climate governance could yet alter the relationship between democratic backlash and climate policy.

Table 6. Right-wing executives

	FEct (Climate policy outputs)	FEct (Greenhouse gas emissions)
Lagged Dependent Variable	0.253***	0.865***
	(0.049)	(0.040)
Autocratization	0.171	−0.009
	(0.139)	(0.010)
Democracy	−0.609*	−0.082**
	(0.332)	(0.041)
GDP per capita (ln)	−0.692	0.427**
	(1.234)	(0.199)
GDP per capita $(ln)^2$	0.036	−0.021**
	(0.066)	(0.010)
Population (ln)	−0.434	0.028
	(0.266)	(0.035)
Globalization	−0.012*	0.003
	(0.007)	(0.001)

Table entries are coefficients; standard errors in parentheses; constant, year fixed effects, and country fixed effects included in the models, but omitted from presentation; *p < 0.10, **p < 0.05, ***p < 0.01 (two-tailed).

RESOURCE AVAILABILITY

Lead contact

Further information and requests for resources should be directed to and will be fulfilled by the lead contact, Tobias Böhmelt (tbohmelt@essex.ac.uk).

Materials availability

The study did not generate new unique reagents.

Data and code availability

- The main data frame used in this study is based on the Quality of Government (QoG) Institute's standard time-series cross-section dataset. All replication materials may be found at: https://doi.org/10.7910/DVN/LOPXHX.
- Data: All data used in this study are available in the Harvard Dataverse https://doi.org/10.7910/DVN/LOPXHX.
- Code: The full set of Stata scripts used for model estimation, table generation, and the figures is available in the same repository.
- Other materials: The archive also contains log files used to support estimation and performance optimization.

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AUTHOR CONTRIBUTIONS

Th.Be. conceived the idea for the research; To.Bö. designed the methodology and led the data analysis; Th.Be. led the writing of the article. Both authors contributed critically to the drafts and gave final approval for publication.

DECLARATION OF INTERESTS

The authors declare no competing interests.

STAR★METHODS

Detailed methods are provided in the online version of this paper and include the following:

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STAR★METHODS

KEY RESOURCES TABLE

REAGENT or RESOURCE	SOURCE	IDENTIFIER
Deposited data		
Final dataset comprising all variables as outlined below and the replication instructions	Harvard Dataverse	https://doi.org/10.7910/DVN/LOPXHX
Quality of Government (QoG) Institute time-series cross section data	Quality of Government (QoG) Institute	https://www.gu.se/en/quality-government/qog-data/data-downloads/standard-dataset
Climate Policy Database	Climate Policy Database	https://climatepolicydatabase.org
Total greenhouse gas emissions per capita excluding fluxes caused by Land Use Change Land Use and Forestry (LULUCF)	World Bank Group	https://data.worldbank.org/indicator/EN.GHG.ALL.PC.CE.AR5
Democratic backsliding, autocratization	Pelke and Croissant[12]	https://larslott.github.io/publications
Control variables	Quality of Government (QoG) Institute	https://www.gu.se/en/quality-government/qog-data/data-downloads/standard-dataset
Software and algorithms		
Stata MP 19.5	StataCorp	https://www.stata.com/
Counterfactual estimators for causal inference	Liu et al. (2024)[19]	https://yiqingxu.org/packages/fect/stata/fect_md.html

METHOD DETAILS

Data

We constructed a monadic, country-year level time-series cross-sectional dataset. As a data frame, we use the compilation dataset of the Quality of Government (QoG) Institute. All countries and years for which data are available are considered for the sample, though we focus on the post-1990 period. Although official concerns about climate change can be traced back at least as far as the 1970s (First Earth Summit, Stockholm), it may not be reasonable to expect states to introduce policies and actively engage with greenhouse gas emissions until the early 1990s. For example, the Framework Convention on Climate Change was signed in 1992 only. Our final sample eventually includes 160 countries between 1991 and 2022.

Dependent variables

For the main analyses, we employ two different dependent variables. First, there is the logged number of climate policies implemented in a given year for each country. After considering different sources and evaluating them in terms of country coverage, year coverage, and quality,[23] we opted for the Climate Policy Database (CPDB). The CPDB comprises information on more than 6,000 policies in 198 countries. According to the CPDB's codebook, "[p]olicies included in this database are often a combination of policies with an explicit climate change mitigation objective, such as greenhouse gas emissions reduction strategies; energy policies, that help to decarbonise the energy supply and/or reduce energy demand; and policies that aim to introduce low-emissions practices and technologies to non-energy sectors, such as agriculture and land use. In this database a policy can be a law, strategic document, a target, or any other policy document that result in lasting reduction on the country's emissions intensity."

For constructing our policy dependent variable, we consider all nine policy instruments or objectives (barrier removal, climate strategy, economic instruments, information and education, policy support, regulatory instruments, research and development, target, and voluntary approaches) in all six sectors or mitigation areas (agriculture, buildings, electricity, general, industry, and transport) of the data. According to the CPDB, "policy instruments provide a link between desired policy outcomes and implementation. The term refers to instruments used to put the policy in practice, e.g., subsidies or carbon pricing." For each country-year in our sample, we count the number of policy instruments as defined by the CPDB. After imputing missing values by 0s, we add the value of 1 to the variable and log-transform it (the value of 1 is added so to avoid taking the logarithm of 0). We use the logged number of policies due to theoretical and empirical reasons. Theoretically, there should be smaller returns in climate policies ambition for more and more policies being implemented. Empirically, the log-transformation accounts for this. Our final climate policy dependent variable ranges between 0 and 3.97, has a mean of 0.33 (standard deviation of 0.62), and is covered by 6,733 observations.

Similar or the same operationalizations of climate (or environmental) policy ambition that are based on the number of policies do exist in the literature.[8,24–27] These and related operationalizations are based on Knill et al.[21] who advise that one approach to capture policy outputs is via "policy density" (number of policy instruments). Having said that, the CPDB measure is not without limitations: the measure could well be too broad with nine policy instrument types across six different sectors. Moreover, as Thomas and Bond[28] argue in a different context, count data like the CPDB might be subject to measurement error. To address these and related concerns, we point the reader to the additional analyses in the main text, which summarize the findings from analyses that (1) employ more narrowly defined policy data, (2) use a binary dependent variable, and (3) focus on high-impact policies only.

Second, to capture climate policy outcomes, we rely on total greenhouse gas emissions per capita excluding fluxes caused by Land Use Change Land Use and Forestry (LULUCF). The variable is log-transformed (for the same theoretical reason as in the case of policies) and measured in metric tons equivalent of CO_2 per capita. Total population is based on the *de facto* definition of population, which counts all residents regardless of legal status or citizenship. The values shown are midyear estimates. Total annual emissions pertain to the six greenhouse gases covered by the Kyoto Protocol (carbon dioxide (CO_2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphurhexafluoride (SF6)) from the energy, industry, waste, and agriculture sectors, standardized to carbon dioxide equivalent values divided by the economy's population. The original data source for this variable is the Emissions Database for Global Atmospheric Research. The climate policy outcome (greenhouse gas emissions) variable has a mean value of −12.477 and there is information for 6,074 country-year observations.

Explanatory variable

Our main explanatory variable captures episodes of democratic backsliding or autocratization. The data are from the the Varieties of Democracy (V-Dem) dataset as used in Pelke and Croissant.[12] These scholars operationalize autocratization episodes and use the V-Dem's Electoral Democracy Index and a 0.1 threshold (10% decline on a scale between 0 and 1) with testing for overlapping confidence intervals. Additional criteria for a country-year to be coded as an episode of autocratization are (a) no stagnation for four years in a row and (b) no annual increase in the democracy score of 0.02 or higher. Testing for overlapping confidence intervals prevents a detection of autocratization periods that are largely based on measurement noise rather than real democracy erosion processes. The 0.1 threshold reduces the risk of conceptual stretching of the autocratization concept and is also able to detect autocratization episodes that do not result in a sharp decline of democratic qualities. In additional analyses in the main text, we explore the robustness of our main finding using different autocratization measures and operationalizations.

Control variables

We consider several standard controls based on the literature of the Environmental Kuznets Curve.[29] First, there are income and population. Both variables are log-transformed to account for their skewed distributions and are derived from the World Bank Development Indicators. More populous countries have an overall higher demand for energy and burning fossil fuels is necessary for meeting all citizens' demands. According to the World Bank, population is defined as a country's midyear total population, which counts all residents regardless of legal status or citizenship (except for refugees not permanently settled). States usually see economic wealth as more important than environmental performance. GDP per capita (in constant 2017 international dollar) is defined as the gross domestic product (GDP) – the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products – divided by midyear population. We control for a non-monotonic impact by adding the squared term of income.

Second, there is there is the V-Dem *Electoral Democracy Index*, which comprises five components based on Dahl's[30] polyarchy: an elected executive, free and fair elections, universal suffrage, freedom of association, and freedom of expression. Boese[31] argues the variable's performance is superior due to the coherence of its definitions, measurement strategies, and aggregation procedures. Note that this item captures general levels of democracy, not episodes of autocratization.

Our last control variable is *Globalization*, which is the KOF[32] globalization index. A higher value of this variable signifies a greater embeddedness in the global political, economic, and social network. Countries could be subject to transnational influences pushing them to more effective policy outcomes considering their trading partners' efforts. Having said that, the opposite effect could materialize as well: states' integration into global trade could generate competing economic incentives that limit their support for environmental commitments – ambitious climate policies and better environmental quality are thus less likely to evolve.[33] All explanatory variables are temporally lagged by one year to address endogeneity issues.

QUANTIFICATION AND STATISTICAL ANALYSIS

Model overview

We implement a series of counterfactual estimators for causal inference as developed by Liu et al.[19] All statistical analysis has been done in Stata MP 19.5. As indicated above, the country-year is the unit of analysis and we focus on the post-1990 period. Specifically, Liu et al.[19] propose a "simple framework of counterfactual estimation for causal inference with time-series cross-sectional data," in which the average treatment effect on the treated is estimated by directly imputing counterfactual outcomes for treated observations." The corresponding estimation procedures outperform "traditional" two-way fixed-effects models and allow for a more

precise estimation of causal treatment effects – in our case, the effect stemming from *Autocratization*. Three different estimators are developed by Liu et al.,[19] and our main analyses present results based on each of these procedures.

First, there is the fixed effects counterfactual (FEct) estimator. This approach is more efficient than two-way fixed-effects models, and unbiased as well as consistent in the estimation of parameters. It is essentially a weighting estimator in which "each treated observation is matched with its predicted counterfactual […], which is the weighted sum of all untreated observations."[19] Second, there is the interactive fixed effects counterfactual (IFEct) estimator. Like the third estimator, the matrix completion (MC) model, the IFEct is "designed to construct a lower rank approximation of the outcome data matrix using information of untreated observations to account for potential time-varying confounders."[19] However, the IFEct and the MC differ in "their ways of regularizing latent factors."[19]

The FEct models in the main text include both unit and time fixed effects and we obtain uncertainty estimates (standard errors)using the non-parametric bootstrap procedure (1,000 bootstrap runs). The IFEct models in the main text are based on the FEct specifications as well, but additionally we specify that there is one factor. Finally, the MC approach requires to specify a hyper-parameter (the penalty term) lambda, which we set to 0.004.

Model interpretation

The main quantity of interest calculated by any of these three counterfactual estimators is the dynamic treatment effect, "or the average treatment effects on the treated (ATT) over different periods, without assuming treatment effect homogeneity of any kind."[19] These ATTs are plotted in Figures 1A–1C and 2A–2C. Liu et al.[19] recommend three test procedures to distinguish among the estimation procedures and to select the most appropriate one: the Placebo Test, the Equivalence Test, and the Carryover Test (see next section model tests).

Model tests

All three counterfactual estimators used in the main text provide a Placebo Test to address the concern of over-fitting in the pre-trend. We specified a two pre-treatment periods as "placebo periods" to remove observations for model fitting to test in turn whether the estimated treatment effect in this range is significantly different from zero. Only one of our six main models fails the Placebo Test. However, the core result of that estimation (IFEct with greenhouse gas emissions), namely an insignificant autocratization treatment effect, does not differ from the other models.

For all three counterfactual models, we have evaluated whether the identification assumption is met or not via the Equivalence Test. This procedure checks whether the 90 percent confidence intervals for the estimated average treatment effect on the treated at the pre-treatment period exceed a pre-specified range. In our case, we specify a pre-treatment period of 15 years. The tests show that the climate policy models all pass the Equivalence Test, while the IFEct and the MC methods fail it when using greenhouse gas emissions as the dependent variable. Having said that, the core result is qualitatively similar across all estimation procedures for climate outcomes.

Under a general treatment pattern where treatments may exit and switch off, the estimation procedures also offer to conduct a Carryover Test, which addresses the concern that the treatment effect persists for some time after its "exit." Two post-treatment periods are defined as "carryover periods," where we remove observations for model fitting, and then test whether the average treatment effect on the treated in this range is significantly different from zero. According to our tests, all approaches pass the Carryover Test except for the FEct model using greenhouse gas emissions. The model's treatment effect is not significantly different from the estimated effects in the IFEct or the MC approaches.