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The limits of democracy in tackling climate change

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ABSTRACT

Previous research has shown that democracies exhibit stronger commitments to mitigate climate change and, generally, emit less carbon dioxide than non-democratic regimes. However, there remains much unexplained variation in how democratic regimes perform in this regard. Here it is argued that the benefits of democracy for climate change mitigation are limited in the presence of widespread corruption that reduces the capacity of democratic governments to reach climate targets and reduce CO_2 emissions. Using a sample of 144 countries over 1970–2011, the previously established relationship between the amount of countries' CO_2 emissions and their level of democracy is revisited. It is empirically tested whether this relationship is instead moderated by the levels of corruption. The results indicate that more democracy is only associated with lower CO_2 emissions in low-corruption contexts. If corruption is high, democracies do not seem to do better than authoritarian regimes.

KEYWORDS Carbon dioxide emissions; democracy; corruption; climate change; mitigation

Introduction

Democracies have so far shown a stronger stand in climate change mitigation than non-democratic regimes: They tend to cooperate in international environmental treaties, adopt stricter environmental policies, and curb their carbon dioxide (CO_2) emissions (Li and Reuveny 2006, Bättig and Bernauer 2009). However, there is a substantial variation in how democratic regimes perform and much of this variation has been largely unexplained. As a result, we know little about the political and institutional drivers of CO_2 emissions in democracies. Here, I address this gap in the existing literature by investigating the conditions under which democracies tend to curb national CO_2 emissions.

Democratic institutions, which shape preference aggregation within a polity, have been argued to benefit countries' commitments to mitigate climate change (*e.g.* Neumayer 2002, Neumayer *et al.* 2002, Bättig and Bernauer 2009).

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Supplemental data for this article can be accessed here.

Indeed, the participation of civil society, the rise of environmental awareness through free media, and active collaboration in international environmental agreements – features common to democracies – play a crucial role in placing environmental issues on the political agenda and adopting environmental policies.

However, democracy is not a panacea for environmental problems. Democratic rulers are often shortsighted and focus on short-term gains rather than commit to long-term projects such as climate change mitigation (Haggard 1991, Keefer 2007). For example, in pursuing electoral victory, they often focus on the provision of visible outcomes for their electorate rather than prioritize solving global problems in their programs. In addition, business interests, which often go against environmental issues, can heavily influence political decisions in democracies and stir political leaders away from adopting and/or implementing emission reduction policies.

Such shortsighted behavior and susceptibility to influences that go against long-term interests of the society often exacerbate in the presence of corrupt institutions. Studies in environmental economics heavily emphasized that corruption, through various disruptive forces, fosters higher carbon dioxide emissions. Corruption obstructs coercive power of the state by lowering the quality of inspections, monitoring, and the ability of the bureaucrats to effectively design and implement policies (López and Mitra 2000, Damania 2002). It impedes voluntary compliance by reducing trust between the individuals and trust in government (Rothstein 2011). It diminishes extractive capacity of the state, preventing higher tax revenues, which could otherwise contribute to environmental budgets (Tanzi and Davoodi 1998). It hampers environmental policy-setting, as it provides business interests with the additional channels to influence political decision-making (Wilson and Damania 2005).

Through these mechanisms, corruption can disrupt the functioning of democracy in such long-term projects as climate change mitigation. While many studies in political science acknowledge that the benefits of democracies are limited in the presence of corrupt institutions, to my knowledge, there has been no empirical evidence of the moderating effect of corruption.

Here, I address this gap in the existing research by empirically testing whether the association between democracy and countries' CO_2 emissions is contingent on the level of corruption. To do this, I estimate a within-between effects regression using time-series cross-sectional data on national CO_2 emissions for 144 countries over 1970–2011.

In the next section, I provide an overview of previous research on the relationship between democracy, corruption, and environmental performance and introduce my central hypothesis derived from that research. The subsequent section on the analytical approach describes data and methods used in the

analysis. The section that follows presents the results of the study. The final section concludes with the discussion of the main findings.

Previous research

Democracy and climate change mitigation

Inherent features of democratic institutions are known to be both beneficial and detrimental for countries' commitments to solve environmental problems. This applies to both local and global environmental problems. While climate change is a global challenge and solutions are often connected to countries' participation in and compliance with international environmental treaties, actions that countries take in addressing climate change are similar to their actions in solving local environmental problems.

Much like other emissions, CO_2 largely comes from activities that can be defined by countries' national borders. Therefore, behavior of most CO_2 emitters is shaped by national political institutions in the countries where they operate. As in the case of other emissions that have more local impact, reducing CO_2 emissions requires countries to adopt emission reduction policies and secure enforcement and compliance, regulating the behavior of emitters within their borders. Therefore, some of the theories of how political institutions affect local environmental problems are also relevant to the global problem of climate change. The existing literature has comprehensively summarized arguments on how democracy can benefit or harm environmental commitments (see *e.g.* Li and Reuveny 2006, Bättig and Bernauer 2009, Bernauer and Koubi 2009, Spilker 2013, Sjöstedt and Jagers 2014). Therefore, here I address them only briefly.

Democratic institutions favor the development of commitments for addressing environmental problems, such as climate change mitigation, for several reasons. For example, press freedom and freedom of expression allows media outlets and civil society organizations to increase public awareness about climate change. Higher awareness helps people make more environmentally friendly decisions and give their votes to parties that address climate change and CO_2 reduction in their programs. Subsequently, free and fair elections, which are attributes of democratic systems, facilitate representation of aggregated preferences of the electorate in politics. Similarly, freedom of association and fair electoral competition provide an opportunity for green parties to organize and participate in the political processes. At the same time, freedom for civil society organizations to form and operate gives way for environmental non-governmental organizations to participate in the public life, conduct informational campaigns and consult to decision-makers. Additionally, democracies have been argued to participate more in international environmental agreements

and comply with the international treaties, as they respect rule of law (Weiss and Jacobson 1999, Bättig and Bernauer 2009).

Some features of democracies, however, are argued to hamper environmental commitments. Due to constant political challenge through electoral cycles, political leaders in democracies are known to be shortsighted, which can prevent them from allocating budget to implementation of such long-term policy projects as environmental protection (Congleton 1992). Additionally, despite the pluralistic nature of democracies, strong corporate interest groups can gain high influence over the political decision-making. Politicians become compelled to respond to these groups' short-term interests, which can go against environmental protection and the long-term benefit of the public (*e.g.* Bättig and Bernauer 2009).

Empirical evidence almost uniformly points to the positive effects of democracy on environmental outcomes (*e.g.* Gleditsch and Sverdrup 2003, Li and Reuveny 2006, Bättig and Bernauer 2009, Bernauer and Koubi 2009, Arvin and Lew 2011), apart from few exceptions (Midlarsky 1998). Spilker (2013) finds that democracy does not seem to matter for environmental outcomes in the developing world, arguing that citizens in low-income countries are unlikely to demand environmental commitments from politicians, as they have other policy preferences.

The important limitation of the majority of empirical studies explaining environmental outcomes, however, is that they fail to account for the effect of 'state capacity' or political institutions that shape the functioning of the state apparatus and therefore determine whether a state is able to reach its official goals (Skocpol 1985). The quality of public administration, which develops and implements action plans, and institutions that shape its performance, to a large extent determine whether the state is able to introduce and apply the appropriate policy instruments, ensure monitoring and enforcement to implement these decisions (Ringquist 1993). Such well-functioning apparatus, however, is not necessarily an attribute of democratic systems (Huntington 1991).

Corruption and climate change mitigation

The extent to which democracies can solve environmental problems is therefore also dependent on the quality of institutions, which shape the functioning of the state apparatus and therefore – the actual delivery of results. Institutions are 'rules of the game' or 'humanly devised constraints that structure political, economic and social interaction' (North 1990). One of the most detrimental institutional constraints for reducing CO_2 emissions, widely discussed in the environmental economics literature (but surprisingly omitted from the discussions in comparative environmental politics), is corruption.

Corruption can influence national levels of CO_2 emissions through at least five driving forces. First, corruption *disrupts coercive power of the state*. In a corrupt state, laws are rarely followed and policies simply do not get implemented (López and Mitra 2000, Damania *et al.* 2003). Corrupt 'rules of the game' create incentives for emitters to avoid prescribed rules of behavior and offer bribes to government officials instead (O'Connor 1994, Desai 1998). Corrupt bureaucrats in turn have incentives to take bribes and underreport emission levels instead of enforcing compliance with the regulations and fine unlawful emitting behavior (Damania 2002). Corruption also interferes in the process of hiring government officials and thus affects competence and level of commitment to policy objectives, leading to inadequate inspections and poor enforcement (Ringquist 1993). If corruption is also present in courts and judges can be bribed, it is easier for powerful interest groups impose their preferences in courts and avoid complying with environmental laws (McAllister 2008).

Second, corruption *impedes voluntary compliance* by reducing generalized trust and trust in government institutions (Rothstein and Eek 2009, Richey 2010). If actors do not trust that the government can enforce laws, they have few incentives to comply with them voluntarily. If emitters do not trust that others will comply with regulations and reduce emissions, they are less likely to comply themselves.

Third, by affecting trust, corruption also *obstructs extractive capacity* of the state, which can result in lower tax revenues and therefore lower financial resources available for solving environmental problems (Tanzi and Davoodi 1998, Fredriksson and Mani 2002). If people do not trust that their fellow citizens pay taxes, they will be highly motivated to avoid paying taxes themselves. If citizens do not trust that governments can direct tax revenues for promised purposes, they have high incentives to deviate from taxpaying.

Fourth, corruption *hampers policy-making*, since polluting businesses can bribe policy-makers to reflect their own interests in policies, regardless of whether such interests reflect the common good (Wilson and Damania 2005). Additionally, elected officials are unlikely to commit to policies that require long-term implementation, such as climate change mitigation policies, if they know that they will not get implemented due to corrupt and incapable public administration (Dahlström *et al.* 2013).

Fifth, corruption can affect the CO_2 emissions *indirectly* through its impact on national income. It hinders economic development and thereby can be associated with lower emissions at the early stages of economic development by obstructing growth of industries. At high levels of economic development, it can prevent investment in green technologies in the industrial sector and therefore can be associated with the increasing emissions (Welsch 2004).

Apart from corruption, there are other institutional factors that can impede democratic performance, such as, for example, bureaucratic capacity or the strength of the rule of law. I focus on corruption for two reasons. First, the economics literature has established corruption as an important determinant of carbon dioxide emission levels (*e.g.* Welsch 2004, Cole 2007). Therefore, using corruption as a predictor makes it easier to compare the results of my research with results established in the economics literature. Second, corruption penetrates many institutional arrangements in the political system, by both influencing bureaucratic capacity and the rule of law. Focusing on corruption helps capture a more specific mechanism of institutional constraints of democracy.

Hypothesizing the interaction between democracy and corruption

By triggering the disruptive forces described above, corruption has the potential to undermine the positive effects of democracy on achieving carbon dioxide emission reductions and intensify the negative effects that democracy might have on curbing emissions. In the first case, by obstructing compliance, coercive capacity, and extractive capacity of the state, corruption hampers implementation of climate policies that democratic institutions can help bring to the political agenda. In the second case, corruption can impede pro-climate policy-making in democracies by facilitating the influence of special interests over politics and stimulating short time-horizons already inherent to democratic institutions, and harmful to long-term projects such as climate change mitigation.

Independent uncorrupt public administration and courts free from political influence, on the other hand, can impose checks and balances on the political leaders and prevent them from pursuing short-term goals that electoral cycles impose (Keefer and Vlaicu 2007, Cornell and Lapuente 2014). This makes long-term commitments, such as climate change mitigation, more likely.

To sum up, previous research has argued that democratic institutions that shape preference aggregation within a polity primarily influence how the demand for climate mitigation is articulated and whether climate issues reach the political agenda. Democratic institutions, however, cannot guarantee that these climate commitments translate into effective climate action and, subsequently, the outcomes – lower CO_2 emissions. The performance of democracies depends on the set of institutions that shape the functioning of the state apparatus and therefore determine whether democracies are able to reach the goals they set. Among such institutions, corruption is one of the strongest driving forces of poor performance. I therefore argue that the level of carbon dioxide emissions in democracies depends on their levels of corruption.

H_1 More democracy is associated with lower CO_2 emissions when the level of corruption is low.

H_2 When the level of corruption is high, there is no negative association between democracy and CO_2 emissions.

Thus, with H_1 I expect CO_2 emissions to be lower in democracies with low levels of corruption. H_2 may imply either that more democracy is associated with more emissions in highly corrupt contexts, or that the level of democracy has no association with the level of emissions when corruption is high.

While the argument is unsurprising, to my knowledge, there have been no tests in the existing empirical literature that account for the moderating effect of corruption in the relationship between democracy and the environmental outcomes. The few studies that model the interdependent effects of democracy and governments' capacity to implement goals test it on such public goods as economic growth (Knutsen 2013), education, and low child mortality (Hanson 2015). However, the conditional effects of democracy and corruption on projects that require long-term commitments, such as climate change mitigation and reduction of CO_2 emissions, remain under-researched.[1]

Analytical approach

Dependent variable

The dependent variable of this study is national CO_2 emissions, which I use as a proxy for countries' contributions to climate change. The measure aggregates the amount of CO_2 that emitters operating within countries' borders release. Focusing on the level of emissions or *de facto* performance has advantages over analyzing *de jure* performance (the presence of climate policies), as it directly accounts for actions that countries take to achieve emission reductions, not only the presence of laws, which may not be followed, even if present.[2] The indicator is taken from the Emission Database for Global Atmospheric Research (EDGAR) and is measured in tons of CO_2 emissions per capita per country and per year (Oliver *et al.* 2015).[3] The indicator is log-transformed due to positive skewness.

Independent variables

I operationalize the concepts of democracy and corruption using data from the Varieties of Democracy (V-Dem) project (Coppedge *et al.* 2016a), which has an advantage over other existing sources due to transparent aggregation and data collection processes, as well as broader data

availability over time. To capture the narrow definition of democracy, I use the electoral democracy index, which is based on the conceptualization by Dahl (1989). The index measures the degree of suffrage, freedom of association and expression, whether chief executive and legislature are elected through popular elections, and the extent to which elections are free and fair (Coppedge *et al.* 2016b). The index ranges from 0 to 1, with higher values corresponding to more democratic regimes and low values corresponding to autocracies. I rescale the index to take values from 0 to 10 for more intuitive interpretation of the effects.

To measure corruption, I use the political corruption index, which captures how pervasive corruption is within executive, legislative, and judicial branches of the government, as well as in the public administration. Corrupt practices within the public administration and all three branches of government are detrimental to democracies' performance in climate change mitigation. Accounting for these different dimensions of corruption provides an opportunity to test theories on the relationship between corruption and CO_2 emissions.[4]

The measure is an expert estimate of corruption in countries at a particular point of time, where higher values represent higher corruption. I reverse the indicator, allowing higher values reflect lower levels of corruption, and refer to the new inverted indicator as 'absence of corruption' or 'corruption (inversed)' in the analysis. I rescale the indicator to take values from 0 to 10 to make the comparison between corruption and democracy indicators easier to interpret in interaction.[5]

Control variables

There are numerous factors that can affect countries' levels of CO_2 emissions. To isolate the effects of democracy and corruption from the other factors established in the empirical literature as determinants of national CO_2 emissions, I include a number of control variables related to the countries' economies, geography, and demographics. I keep the number of explanatory factors to a minimum to achieve a parsimonious model and avoid overspecification.

First, I include a variable gauging countries' real GDP per capita in constant 2005 prices, taken from Gleditsch (2011). On the one hand, higher GDP per capita is believed to correlate with higher CO_2 emissions as increased production often means higher emissions. On the other hand, higher GDP per capita is also associated with a transition toward a service economy and therefore lower production levels, shift to greener technologies, possible move toward more pro-environmental attitudes, and therefore adoption of environmental policies. Consequently, GDP per capita is often argued to correlate negatively with emissions when income reaches a

certain level. Recent studies, however, only find modest support for the curvilinear relationship between GDP per capita and CO_2 emissions, if at all (Galeotti *et al.* 2006, Liddle 2015). Therefore, here I model the linear relationship between the two.[6] Including GDP per capita can also to some extent account for the development of post-material values in countries and partially capture how likely people are to prioritize climate change mitigation among other public policy issues and demand it from the elected leaders.

Second, I control for the population density and urbanization rate, both taken from the World Bank (2014). On the one hand, countries' average population density and urbanization rate are expected to have a positive association with national CO_2 emissions due to concentration of cars and heating facilities in densely populated areas and cities (Arvin and Lew 2011). On the other hand, due to well-developed public transportation, walking accessibility, and more energy efficient technologies, cities can have relatively lower CO_2 emissions than sparsely populated areas (Makido *et al.* 2012, Timmons *et al.* 2016). Despite ambiguous effects, both urbanization rate and population density are relevant control variables in the analysis of CO_2 emissions.

Third, I include the amount of merchandise exports in current purchasing power parity (PPP) from the Penn World Table (Feenstra *et al.* 2015). The amount of merchandise exports captures the extent of production countries undertake to meet demand from the international market. Higher merchandise exports are expected to positively relate to CO_2 emissions. I divide the measure by the population size, taken from Gleditch (2011).

Fourth, I control for the extent of oil production to capture the effect of lobby groups that might hamper adoption of climate policies. Additionally, oil production proxies countries' dependency on fossil fuels, which makes the development of renewable energy less attractive. The variable measuring oil production is in billion metric tons and is taken from Ross and Mahdavi (2015). I divide both the measure of merchadise exports and the measure of oil production by the population size, taken from Gleditch (2011).

Additionally, I include latitude of countries' capital cities in the list of control variables from La Porta *et al.* (1999). Latitude accounts for exogenous geographical factors, such as differences in average temperatures or weather conditions, and can decrease the unobserved heterogeneity bias in the between-sample. I also include Kyoto protocol ratification and island dummies. Countries that ratified the Kyoto protocol are expected to have higher commitments to climate change mitigation, while island states are known to emit less due to limited potential for production.[7]

To improve the distribution of residuals, I log-transform the positively skewed variables that affect distribution of residuals (*i.e.* GDP per capita,

merchandise exports per capita, and population density) and exclude an outlier (Cambodia) detected by the model checks. The final dataset covers 144 countries from 1970, when the first steps toward environmental legislation were taken in the United States, to 2011, due to data availability. The online supplemental materials list all countries included in the analysis and present the descriptive statistics and relevant correlations.

Method

In estimating the relationship between democracy, corruption, and CO_2 emissions, I am both interested in whether these political factors can explain differences in countries' emitting behavior and whether changes in these political factors are associated with changes in emissions.[8] To assess how relevant it is to include both within- and between-units variation in the analysis, I estimate the intra-class correlation coefficient (ICC). The ICC showed that 78% of the variation in the data comes from the between-country sample. Modeling between-sample information is therefore crucial to understand the underlying relationship between the variables of interest. At the same time, accounting for the remaining 22% of variation incorporates information about the over-time developments, which between-estimator is unfit to model.

The most appropriate approach to model both variation between countries and changes within countries over time is the within-between estimator (Bell and Jones 2015). It models the hierarchical structure of the data and provides separate estimates for the variation between countries and for developments over time within states. Following the Bell and Jones (2015) guidelines, I mean-center all time-varying variables after listwise deletion of all missing values in the dataset and calculate deviations from country means for each of the centered variables. In estimating the general linear model, I include both country means and deviations from country means of each time-varying independent variable instead of their raw values. I use robust clustered standard errors to account for the hierarchical structure of errors and year fixed effects in the within-equation to account for the effects of global economic crises on the extent of production (and consequently – CO_2 emissions).

The model builds on the following equation:

$$lnY_{it} = \beta_0 + \beta_1(x_{it} - \overline{x_i}) + \beta_2\overline{x_i} + \beta_3 z_i + (u_i + e_{it}) \quad (1)$$

where i stands for country, t is for year, β_0 is an intercept, x is a vector of independent time-varying variables, z is a vector of time-invariant variables, u is an error term in the between-part, and e is an error term in the within-part of the equation.

Between-estimator is deemed a reliable technique for analyzing the determinants of CO_2 emissions, as it fits the features of the CO_2 data

(Stern 2010). Adding the fixed-effects element does not make the between-part less (or more) reliable, however, adds valuable information on the developments over time.

Results

Table 1 presents the results for Equation (1). Model 1 shows the estimates of the relationship between democracy and CO_2 emissions per capita, controlling for economic, demographic, and geographical factors. The results are negative and significant in both within- and between-parts of the equation, indicating that more democracy is associated with lower emissions per capita both in within- and between-country samples. In Model 2, I estimate the association between the inversed measure of corruption and the emission levels. The results in the within-part are insignificant, while the results in the between-part are negative and significant, implying that countries with lower levels of corruption emit less. Model 3 shows the estimates of the relationship between democracy and CO_2 emissions per capita while controlling for corruption. Results in the between-part remain relatively stable, while in the within-part of the equation corruption becomes significant with a positive sign, implying that as countries become less corrupt, emissions increase.[9]

By modeling interaction effects in Model 4, I explicitly test whether the association between democracy and CO_2 emissions is conditional on the levels of corruption. The interaction term is negative and statistically significant in the between-part of the equation, which implies that democracy and absence of corruption decrease each other's effect on CO_2 emissions when effects are positive and increase each other's effect when the effects are negative. Neither of the constituent parts of the interaction effect is significant. It implies that when the democracy score is zero, corruption does not have a significant association with CO_2 emissions. Similarly, when the corruption indicator is zero, the effect of democracy is insignificant. In the within-part, the interaction term is insignificant but the constituent parts are significant. This implies that when one of the indicators is at 0 (which in this case is at mean as the variables are centered), the effect of the other indicator is significant. In the cases of both within-part and between-part, there are strong enough reasons to continue investigating conditional effects more closely by examining marginal effects. I plot the conditional marginal effects in Figures 1 and 2.

Figure 1 presents the interactive relationship between corruption and democracy in their association with CO_2 emissions in the between-country sample. The vertical axis on the left shows the magnitude of the marginal effect, while the vertical axis on the right shows the distribution of cases for the variable on the horizontal axis. Figure 1(a) shows that among countries

Table 1. Relationship between democracy, corruption, and carbon dioxide emissions.

	Model 1	Model 2	Model 3	Model 4
Within-part				
Democracy	−0.018†		−0.028*	−0.030**
	(0.010)		(0.011)	(0.011)
Corruption (inversed)		0.035	0.046*	0.044*
		(0.021)	(0.022)	(0.022)
Democracy*Corruption				−0.016
				(0.011)
ln GDP per capita	0.432***	0.422***	0.425***	0.423***
	(0.097)	(0.096)	(0.096)	(0.096)
Urban Population	0.008	0.007	0.008	0.008
	(0.006)	(0.006)	(0.006)	(0.006)
Population Density	0.429†	0.477*	0.497*	0.510*
	(0.230)	(0.228)	(0.227)	(0.228)
ln ME per capita	0.527†	0.535†	0.603*	0.601*
	(0.280)	(0.284)	(0.287)	(0.286)
Oil production per capita	0.001	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)
Between-part				
Democracy	−0.115***		−0.070†	0.101
	(0.034)		(0.036)	(0.069)
Corruption (inversed)		−0.102***	−0.078**	0.062
		(0.024)	(0.026)	(0.062)
Democracy*Corruption				−0.028**
				(0.010)
ln GDP per capita	1.056***	1.061***	1.109***	1.142***
	(0.142)	(0.136)	(0.143)	(0.146)
Urban Population	0.019**	0.016**	0.018**	0.017**
	(0.006)	(0.006)	(0.006)	(0.006)
Population Density	0.020	0.004	0.012	−0.003
	(0.053)	(0.053)	(0.053)	(0.052)
ln ME per capita	0.011	0.042	0.061	0.054
	(0.317)	(0.329)	(0.327)	(0.327)
Oil production per capita	−0.013†	−0.003	−0.012	−0.013†
	(0.008)	(0.005)	(0.007)	(0.007)
Latitude	1.422***	1.603***	1.566***	1.685***
	(0.384)	(0.389)	(0.382)	(0.372)
Kyoto ratification	−0.235***	−0.223***	−0.238***	−0.238***
	(0.060)	(0.061)	(0.059)	(0.059)
Island Dummy	0.004	0.017	0.045	0.036
	(0.166)	(0.176)	(0.172)	(0.157)
Constant	−9.280***	−9.202***	−9.491***	−10.439***
	(0.901)	(0.869)	(0.906)	(0.997)
Observations	5 299	5 299	5 299	5 299
Number of countries	144	144	144	144
R^2 within	0,312	0,315	0,324	0,327
R^2 between	0,870	0,874	0,877	0,885
Year FE	yes	yes	yes	yes

Robust standard errors in parentheses, *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, † $p < 0.1$. Dependent variable: CO_2 emissions per capita (ln). All variables in the within-part are lagged one year. GDP: gross domestic product; ME: merchandise exports; ln: natural logarithm; FE: fixed effects.

with relatively low corruption (that score above 6 on a 10–0 scale, which is the level of Slovakia), more democratic countries emit less. The histogram clarifies that these countries comprise around 35% of the total sample. Among

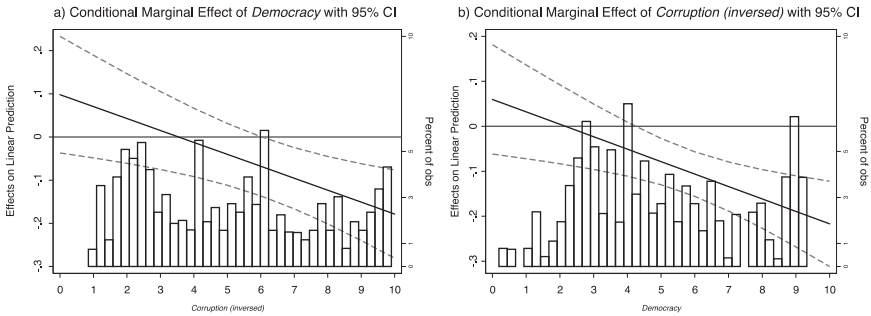

Figure 1. Marginal effect plots illustrating conditional effects of (a) democracy and (b) corruption (inversed) on CO_2 emissions per capita in the between-sample with 95% confidence intervals.

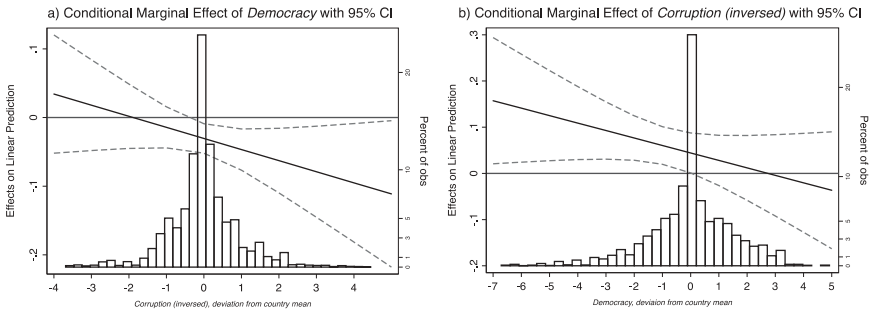

Figure 2. Marginal effect plots illustrating conditional effects of (a) democracy and (b) corruption (inversed) on CO_2 emissions per capita in the within-sample with 95 per cent confidence intervals.

countries that have high corruption and score below 6, there is no significant relationship between democracy and CO_2 emissions. Both democratic and non-democratic regimes seem to perform similarly if corruption is high.

Figure 1(b) indicates that among countries that score more than 4.5 on the 0–10 democracy scale, which is about the level of Romania, countries with lower corruption produce lower CO_2 emissions per capita. The histogram specifies that such democratic and semi-democratic regimes comprise 55% of the total sample. In countries that score below 4.5 and can be classified as autocracies, the effect of corruption is insignificant. Thus there is no statistically significant difference between the emitting behavior of autocracies with high and low corruption.

Figure 2 illustrates the conditional marginal effects of democracy and corruption on CO_2 emissions per capita in the within-country sample. The horizontal axis is now variables' yearly deviations from their country means over the time period covered in the analysis. The value of zero represents a

country mean, while observations clustered around zero represent countries that remained relatively stable on the corruption and democracy variables across the years under investigation.

Figure 2(a) shows that democratic developments are associated with a decrease in CO_2 emissions when countries had lower corruption relative to their average over the years under investigation. The cases when corruption levels were lower than countries' average comprise 42% of the total sample; these cover both years when countries experienced a decrease in corruption and years before countries had an increase in corruption. In the additional 23% of the cases in the sample, the positive association between democracy and emission reductions seems to hold even when corruption levels remained relatively stable. Many of these countries that had no or relatively few changes in their levels of corruption since 1970 are Western developed nations. The effect of democracy on CO_2 emissions seems to be insignificant when countries experience higher corruption relative to their average corruption levels. Figure 2(b) shows that when countries experience lower democracy levels than their average, decrease in corruption is associated with higher emissions. Such cases comprise about 40% of the sample, as frequency distribution on the x-axis shows.

As a general pattern, the results show that the effects of democracy and corruption on CO_2 emissions are complementary. More democracy is associated with lower CO_2 emissions in low-corruption contexts and the lower the level of corruption, the stronger the negative association between democracy and emissions. The investigation of over-time changes additionally shows that positive effects of democratization are only pronounced in years when countries experience lower corruption relative to their average corruption levels over the time period or when institutions remain stable. This implies that the positive effect of democracy appeared when countries either decreased their corruption levels or before their corruption level increased in the years under investigation.

Similarly, lower corruption is associated with lower CO_2 emissions when countries have reached some level of democratic development. As democracy becomes stronger, the association between relatively uncorrupt institutions and CO_2 emission reductions intensifies. Over-time investigation adds that when countries became authoritarian or when democratic institutions weakened, decreasing corruption was only associated with higher emissions. The same relationship applies for the years of democratic transition before democratic institutions strengthened.

Discussion and conclusions

National-level carbon dioxide emissions depend on a multitude of factors, including countries' economies, geography, demographics, and, not least, politics. The aim of this study has been to focus specifically on the political

determinants of CO_2 emissions and revisit the findings reported in previous literature indicating that the amount of countries' CO_2 emissions is associated with their level of democracy. Here, I instead argue that while democratic institutions shape preference aggregation within a polity and favor environmental commitments, the benefits of democracy for climate change mitigation are limited in the presence of corrupt institutions, which obstruct coercive capacity, extractive capacity of the state, actors' compliance, and pro-climate policy-making. To test this claim, I investigate whether the association between democracy and CO_2 emissions is conditional on the levels of corruption.

In pursuing this aim, I analyze the emitting behavior of countries across the globe over time and estimate a within-between regression, which takes into account the variation between countries and simultaneously accounts for the developments in countries over time. Such investigation brings a number of insights into the political factors behind the differences in CO_2 emissions between countries and the political drivers of emission reduction within states.

The results of this study show that after taking into account the common economic, geographical, and demographic explanations of CO_2 emissions, political factors still make a difference. In accordance with most previous results, my findings show that more democratic countries do tend to emit less. However, this is only true for those democracies where corruption is low. When corruption is high, democracy does not seem to make a difference for the level of emissions, all else equal. It does not matter for the level of emissions whether a country has free elections, freedom of the press, and freedom of association if the executive, judicial and legislative branches of the state do not function well and are drenched in corruption and clientelism. In such a case, democracies do not seem to do any better than authoritarian regimes, where decision-making power is in the hands of a narrow elite. To exemplify, the results imply that it makes no difference for the national levels of CO_2 emissions if a country is a democratic and corrupt Jamaica or an authoritarian and corrupt Azerbaijan.

The results also show that a political system with a low level of corruption is not a universal cure. Lower corruption seems to matter only for the levels of CO_2 emissions in democratic regimes and the level of corruption does not seem to play a role if a country is authoritarian. For example, being democratic and relatively non-corrupt Austria is more beneficial for lower CO_2 emissions than being democratic but moderately corrupt Slovakia. However, at the same time, being an authoritarian regime with relatively low-corrupt institutions, such as Saudi Arabia, does not seem to be associated with lower emissions than being an authoritarian and corrupt regime, such as Yemen.[10]

While we can only gain insights about the associational relationship between democracy, corruption, and CO_2 emissions from the between-country estimates, the analysis of changes over time brings us closer to causal claims. The results from the within-part of the analysis show a similar picture to the between-part: positive changes in democracy are associated with the reduction in emission levels only when countries experience relatively low levels of corruption. When corruption levels in countries are low relative to what these countries experienced on average over the time period under investigation, steps toward democracy go together with steps toward climate change mitigation. When corruption is relatively high, more democracy does not seem to make a difference for emission control.

To exemplify the mechanisms of how corruption can affect CO_2 emissions in democracies, I turn to the cases of Brazil and Germany, both established democracies with regular free and fair elections, full suffrage, extensive freedoms of association and expression, but with different levels of corruption. In Brazil, the main source (two-thirds) of the country's CO_2 emissions is deforestation. Therefore, targeting deforestation is the main strategy toward CO_2 emission reductions (Jänicke and Weidner 1997, Watts 2017). As is common for democracies, Brazil is cooperative in international climate agreements and included reduction of emissions from deforestation into national environmental plans in 2005. While national legislation is in place and forests have been officially protected since 1993, with further strengthening of laws, illegal logging has continued, often with the agreement of local authorities, who receive bribes for issuing allowances for land clearance. Corrupt public officials are known to distribute land illegally to large-scale agricultural businesses, gold mining initiatives, as well as for the construction of dams and roads, and then subsequently change the laws to cover their actions (Abranches 2013, Vidal 2017, Watts 2017). This contributes to the large-scale deforestation and subsequent release of CO_2.

In Germany, the main sources of CO_2 emissions are energy industries, transport, manufacturing and construction (Appunn 2017). Therefore, reducing CO_2 emissions is connected to the shift toward cleaner production and energy efficiency. As has Brazil, Germany has adopted multiple policies targeting CO_2 sources, including a Renewable Energy Act to favor producers of renewable energy, and Ecological Tax Reform, which increased fuel taxes and stimulated technological innovations (Eichhammer *et al.* 2001). In contrast to Brazil, however, absence of corruption in Germany ensured effective enforcement of emission standards, and strong and independent monitoring and audit, resulting in high compliance from the emitting companies (Desai 2002). These and other factors led Germany to decrease its CO_2 emissions by 27% between 1990 and 2015 (Appunn 2017); strong

democratic institutions as well as absence of corruption have contributed to the development of long time horizons within the political regime and favored commitments to the long-term goal of reducing CO_2 emissions. Meanwhile, democratic Brazilian governments also adopted the necessary policies for CO_2 emission reductions, but corrupt institutions hampered successful implementation, contributing to the government's inability to reduce CO_2 emission from its main source.

My findings do not imply that democracy is unimportant. They rather emphasize that to reach their full potential in influencing CO_2 emission reductions, democratic institutions need to be accompanied by a relatively uncorrupt public administration, relatively uncorrupt executive and legislature, as well as a judicial system free from political influence. As, with the Paris accord, the world has reached the highest level of climate commitment so far, the focus should now lie on improving implementation, which corruption severely undermines by corroding the capacity of democratic governments to act.

Notes

1. There is a number of factors that can influence climate commitments in democracies, such as the number of veto players in decision-making, whether a polity is parliamentary or presidential, whether the representation of the interests follows corporatist or pluralist rules, and so on. To test the micro-mechanisms of the decision-making processes, however, is beyond the scope of the study. I focus here on democratic institutions that create a framework for all other processes to unfold and shape the rules of preference aggregation in a broad sense.
2. CO_2 reduction policies can serve as a mediator in the relationship between democracy and CO_2 emissions. Due to poor data availability, I do not model the mediating effect of policies and estimate the conditional effect of democracy without mediation. Omitting such intermediary effect, however, does not pose a severe treat to the results. Effect of democracy on emissions can only appear if a sizable portion of the relationship is mediated by policy initiatives (given controls for the potential confounders), and absence of the effect is only plausible if policies are absent (or in case of the null-effect). Therefore, omitting policy mediation increases the likelihood of receiving false negative rather than false positive results.
3. To capture only anthropogenic emissions, CO_2 emissions from forest fires are excluded from the aggregated measure.
4. For more information about the indicator and questions aggregated in the composite measure, see Coppedge *et al.* (2016b).
5. The measurements of both democracy and corruption depend on the theories that data collecting organizations use in developing strategies for operationalizing these concepts. The potential risk is that measures can diverge depending on the different conceptualizations used. Measures developed by the V-Dem project are particularly useful for my analysis not only due to a broader coverage, but also for theoretical reasons. V-Dem's *democracy* measure uses a thin definition of electoral democracy that does not

capture the extent of rule of law (which correlates with corruption), unlike definitions used by other democracy indicators, such as Freedom House and Polity IV. Using a democracy definition that does not conflate with corruption allows for separating their effects in the interaction more clearly. The advantage of V-Dem's *corruption* measure is that it captures the multidimensional concept of corruption and accounts for corrupt practices in all branches of government relevant for environmental outcomes, while other indicators are narrower.

6. In additional model checks, I also included squared term of GDP per capita in the list of predictors. The interaction effect between democracy and corruption does not appear significant when the squared term of GDP per capita is included, however, the interaction effect between democracy and corruption can be partially captured by this squared term. If this is the case, it would indicate that democracy and corruption have also an indirect effect on CO_2 emissions, that goes through GDP per capita, and moderate the GDP-CO_2 relationship. However, it is beyond the scope of this study to comprehensively test such moderation.
7. Ideally, the list of control variables should also include energy efficiency of the economy; however, these data are not yet openly available for the number of countries and time points that could match the availability of data on political variables.
8. The between-effects estimation is convenient to evaluate the long-term effect of the countries' accumulated experience with democracy and corruption on CO_2 emissions. By reducing the variation to the mean score across years under investigation, between-effects average out changes over time. For example, only countries that have long experience with democracy receive high scores on the mean values. Countries that have experienced regime shifts or only democratized recently can have the same low score; however, their accumulated experience with the democratic institutions favorable for CO_2 emission reduction can still be comparable.
9. This finding might seem surprising, however, as further models indicate, it is more relevant to interpret the effect of corruption on CO_2 emissions in conjunction with the effect of democracy rather than independently. Marginal effects plot on Figure 2(b) shows that the positive association between a decrease in corruption and CO_2 emissions is in fact only noticeable in non-democratic countries. This result can indicate multiple trends in authoritarian regimes, one of them being that lowering corruption might increase economic growth (see *e.g.* Knutsen 2013), which in turn drives CO_2 emissions upwards.
10. It is difficult, however, to make inferences about the relationship between CO_2 emissions and corruption in authoritarian regimes, because there are too few relatively uncorrupt autocracies for a sound statistical comparison.

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