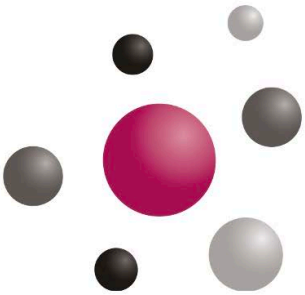

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Political Consequences of Natural Disasters: Accidental Democratization?

Oskar Rydén, Marina Povitkina, Sverker C. Jagers, and Martin Sjöstedt

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Political Consequences of Natural Disasters: Accidental Democratization?*

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Abstract

As the consequences of climate change become stronger, the question of how this affects politics becomes more important. In this paper, we investigate the effect of natural disasters, which are increasing in frequency and intensity, on core democratic institutions – free and fair elections, political competition, civil society participation, and freedom of expression. While most studies find a positive association between natural disasters and democratization, they do not specify exactly which political processes disasters trigger. We use disaster data from EM-DAT and data on democratic institutions from V-Dem to investigate whether disasters can bring political changes conducive to democracy on a sample of 170 countries over 1960-2019. Our results show that a country experiencing a natural disaster also experiences improvements in freedom of expression, civil society participation, and some aspects of political competition – but only in the short term. This indicates that disasters open a window of opportunity for democratization, but societies need to react to secure this trend.

Introduction

In 1985 then politically authoritarian Mexico experienced a powerful earthquake that killed thousands of people and left millions severely affected. The tremendous losses spurred media attention and unprecedented criticism of the government, highlighting incompetence, neglect, and corruption (Walker, 2009). In the end, the ruling party was forced to recognize the opposition groups, which came to play a significant part in the successful recovery efforts (Gawronski & Olson, 2013). In a different part of the world, when East Pakistan was hit by the Bhola cyclone, in 1970, elections in that same year brought strong political representation from the affected areas, increasing political tensions (Hossain, 2018). Similarly, the 1999 Marmara earthquake in Turkey led to increased activity among humanitarian and civil society actors attempting to aid the disaster situation (Kubicek, 2002). These and several other cases show that natural disasters tend to have a political impact and may open a possibility for processes that resemble signs of democratization such as the strengthening of the government opposition, civil society mobilization, and media freedom, and do it in ways that might not have been possible before the disasters.

This conjecture manifests in previous research reporting positive associations between countries experiencing natural disasters and their short-term increases in democracy scores, implying that natural disasters can initiate or strengthen democratization processes (Ahlerup, 2013; Aidt & Leon, 2016; Brückner & Ciccone, 2011; Rahman et al., 2017b, 2017a). However, while insightful, these studies do not inform us on which aspects of democracy change in the wake of disasters and whether these changes indeed bring the potential for democratization. This paper aims to address this gap and investigate the effect of disasters on various democratic institutions by testing several theoretically derived hypotheses concerning the potential short-term democratizing consequences of natural disasters.

In this vein, we consult both previous literature and several case studies to determine a set of democratic institutions that natural disasters may affect. We theorize that natural disasters have the potential to affect all aspects of democracy, including political participation and contestation, i.e. electoral institutions, the freedom of association for parties and civil society groups, and freedom of expression, including media and press freedom. However, the effect of disasters on these processes is not straightforward, making them more relevant to investigate than aggregated democratic scores.

We test our expectations using data from the EM-DAT International Emergency Event Database (Guha-Sapir, 2020) to measure the occurrence of natural disasters, and data from the Varieties of Democracy (V-Dem) project (Coppedge, Gerring, Knutsen, Lindberg, Teorell, Alizada, et al., 2021) to measure various aspects of democracy. Our analysis documents positive associations between natural disaster occurrence and increases in freedom of association for civil society organizations and the freedom of expression, weaker associations between natural disasters and changes in political competition, and no association between disasters and electoral institutions. The positive changes post-disaster are, however, short-term, and while they open a window of opportunity for political change, they do not bring democratization. Societies need to react to secure positive democratic developments.

The article contributes to the current body of knowledge both by conceptualizing the relationship between natural disasters and democratic institutions (Pelling & Dill, 2010) as an example of external shocks and regime instability and by empirically investigating these links. Given that climate change is likely to increase the frequency and intensity of human exposure to weather-related hazards (Hoegh-Guldberg et al., 2018), the article provides important insights into how climate change, without adequate adaptation to decrease vulnerability, may affect various aspects of democracy (Mechler & Bouwer, 2015; O'Brien et al., 2006).

Previous Research

Unnatural disasters

Natural disasters are the products of an interaction between a natural hazard and the vulnerability of exposed communities (Noy & Yonson, 2018). To result in a natural disaster with destructive outcomes, natural hazards such as high wind speed, high precipitation, high temperatures, seismic activity or combinations of them must occur in locations relatively vulnerable to such hazards such that exposure exceeds local adaptive capacity (Perry, 2007). Thus, hazards, together with the location vulnerability contribute to a natural disaster, see Figure 1 (Adger et al., 2005; Persson & Povitkina, 2017; Sjöstedt & Povitkina, 2017).

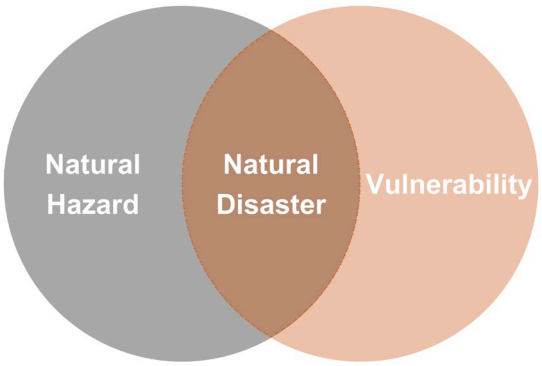

Figure 1: The relationship between natural hazards, vulnerability, and natural disasters.

The benefit of adopting a *social or consequential* definition of a *natural disaster* emphasizing *disastrous impact* rather than *extreme hazard* (O'Keefe et al., 1976) for the purposes of our paper is that implies adverse effects on individual livelihoods (Slettebak, 2012) and this is more likely to trigger political changes than pure extreme hazard that may not affect people.

Figure 2 shows that the yearly total of different natural disasters around the world used to increase over time, peaked around 2000, and has since been decreasing, though is still at high historical levels. Forecasts of the negative effects of climate change indicate a higher frequency of some extreme weather events in the future, but efforts to decrease vulnerability are also increasing. If the vulnerability reduction efforts exceed the adverse effects, we might expect a decrease in the number of natural disasters or at least stability in their numbers (Adger & Brooks, 2003).

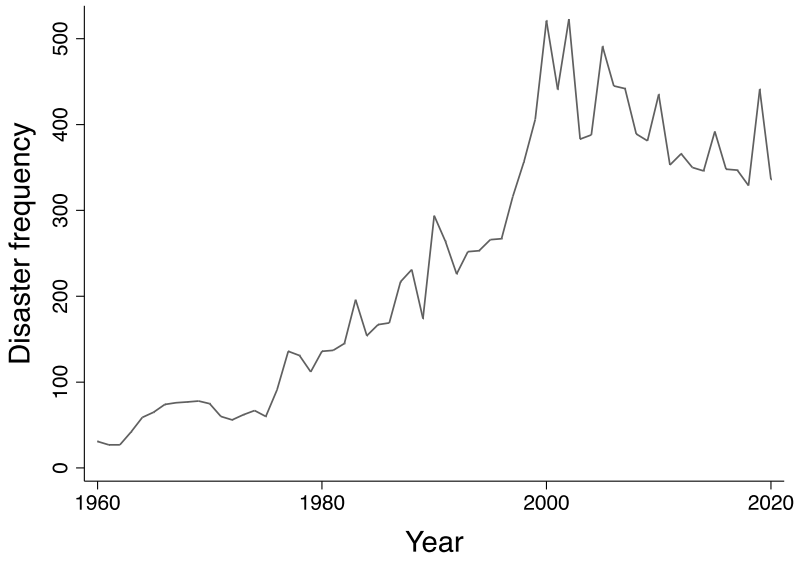

Figure 2: Frequency of natural disasters per year, 1960-2020. *Source: EM-DAT (2021)*

Natural disasters and democracy

Natural disasters carry a potential for political change by disrupting processes and institutions that preserve the political status quo (Pelling & Dill, 2010). Previous quantitative work on the effects of natural disasters and extreme weather on democratic institutions documents associations between the two (e.g., Ahlerup, 2013; Aidt & Leon, 2016; Brückner & Ciccone, 2011; Rahman et al., 2017b, 2017a). These studies argue that natural disasters can initiate processes that constitute a threat to the incumbent and may spur regime change. These "positive" effects of disasters on democracy are further supported by qualitative work (e.g., Olson & Gawronski, 2003). Simultaneously, some work shows that natural disasters can also trigger change toward authoritarianism and repression (Ahlerup, 2013; Apodaca, 2017; Gawronski & Olson, 2013) or find no relationship between regime instability and natural disasters at all (e.g., Omelicheva, 2011).

The related literature on the role of shocks and crises in regime instability provides similar competing verdicts. Political leaders can use crisis as an excuse to contract democratic freedoms (Levitsky & Ziblatt, 2018), resulting in democratic backsliding (Lührmann & Rooney, 2021). At the same time, various forms of external shocks have also been associated with autocratic breakdowns and democratization (Geddes, 1999; Teorell, 2010). Hence, existing empirical studies vary in how they view the potential for democratization in the face of external shocks.

How can we understand these disparate findings? One problem is that previous research on the connection between natural disasters and democratization has exclusively viewed democracy as a monolithic concept (e.g., Cáceres & Malone, 2015). However, democracy implies a set of political institutions (Dahl, 1971; Held, 2006; Sartori, 1987), and each may potentially be affected by natural disasters in different ways, inviting further theorizing. The variation in the effect of disasters on various democratic institutions could have led to contrasting conclusions, depending on the definition of democracy and the data used.

The conceptual multidimensionality and the varying empirical results impede informed theory-building. Hence, we still do not know what aspects of democracy get potentially affected when disasters strike and in which direction changes might occur. Below, we first develop and then test expectations about how natural disasters can have different effects on different aspects of democracy.

Theory

When defining democracy, we take a point of departure in the seminal work by Dahl (1971) in which he outlines the minimal conditions necessary for "the rule of the people" to be exercised. According to Dahl (1971), democratic institutions include two key dimensions – participation that presupposes universal suffrage, and contestation that implies a constitutional guarantee of elections to key public offices, freedom and fairness in elections, freedom for political parties and civil society to organize, including the freedom to run for public office, freedom of expression, especially criticism of the government, and availability of alternative information sources not controlled by the government.

The situation after a natural disaster is often uncertain for the government. Political leaders face decisions regarding both the post-disaster management and their own political survival (Apodaca, 2017; Flores & Smith, 2013; Noll, 1996). As the political situation at the time of a disaster receive increased attention, in combination with a spike in political activity, institutions might be more susceptible to change (Acemoglu & Robinson, 2001; Birkmann et al., 2010; Ghimire, 2018; Pelling & Dill, 2010). As natural disasters often coincide with a state of emergency that grants the executive extended powers, political leaders might also be in a more effective position to trigger change (Bjørnskov & Voigt, 2018; Lührmann & Rooney, 2021).

To manage any perceived threats, incumbents, preferring to keep political power, can attempt to alter the institutional framework that facilitates the operation of any actor that may contribute to their

political removal (Aidt & Leon, 2016; de Mesquita & Smith, 2009). Alternatively, due to a temporary loss of control (or general lack of capacity to control the actors of change), the combination of bottom-up processes can spur institutional change outside the government's control or awareness (cf. Börzel & Risse, 2010; Roland, 2004). Through the interaction between bottom-up initiatives and top-down operations, there are two different pathways from natural disasters to institutional change. First, there is an *accommodating* pathway, where incumbents allow for bottom-up initiatives to exist for reasons of limited capacity, strategy, or evolving preferences (cf. Birkmann et al., 2010; Pierskalla, 2010). The second pathway is *repressive,* when the government sees bottom-up initiatives as illegitimate threats and adopts repressive measures to ensure regime survival (Olson & Gawronski, 2010; Wood & Wright, 2016).

We suggest that disasters can influence all aspects of democracy conceptualized by Dahl (1971) through these processes. However, since most countries have practiced universal suffrage over the period of our data availability, we do not explore this aspect of democracy and only focus on aspects related to political contestation (Figure 3). In the following section, we theorize how disasters may affect democratic institutions through these pathways.

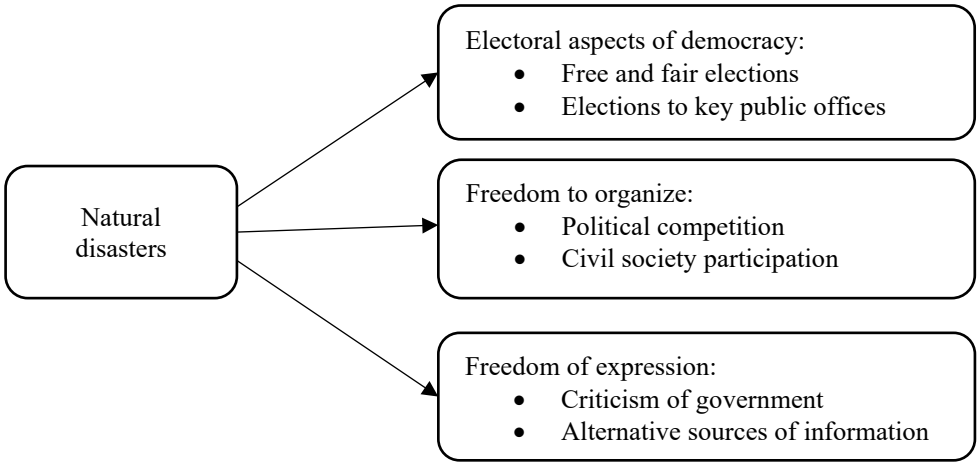

Figure 3: The relationship between natural disasters and democratic institutions.

Natural disasters and electoral aspects of democracy

The impact of natural disasters on the electoral aspects of democracy is not straightforward. On the one hand, natural disasters occurring during the scheduled elections may disrupt the plans to conduct elections in the first place, challenging the principle of election regularity (James & Alihodzic, 2020; Morley, 2017). They may affect voter turnout and question the legitimacy of elections altogether if

many people are unable to vote or the electoral infrastructure is damaged (Rudolph & Kuhn, 2018; Zelin & Smith, 2023). Moreover, disasters may distort the allocation of resources from elections to disaster relief and thereby, affect the campaign financing. This might leave fewer resources to actors challenging the incumbents and hamper fairness principles and political contestation (Blankenship et al., 2021).

At the same time, natural disasters, like other emergencies, may affect a sense of unity and solidarity (Boittin et al., 2020), reducing social and political tensions and focusing pre-electoral debates on important public policy issues. By exposing weaknesses in the incumbents' strategies to protect vulnerable populations, natural disasters may affect voting preferences toward more accountable and responsible candidates, shaping the outcomes of elections but also contributing to free and fair elections (Cole et al., 2012; Cooperman, 2022; Drury & Olson, 1998; Gasper & Reeves, 2011). Similarly, disasters may reveal weaknesses in the electoral infrastructure and spur reforms towards improving access to electoral ballots, voter registration, transportation to the polling stations, improved communication systems, and monitoring during election times (Morley, 2017). Moreover, natural disasters may bring international aid and international attention, with more international observers during the election times that help cleaner elections and electoral integrity (e.g., Hyde, 2007). We hypothesize that:

H_1. A higher number of natural disasters is associated with strengthened electoral aspects of democracy.

While we hypothesize changes in electoral integrity and freedom and fairness of elections post-disaster, we recognize that larger institutional changes in constitutional guarantees for elections to key public offices usually take time and are unlikely to happen in the wake of a disaster. Therefore, we do not expect a substantial change in electoral constitutional order immediately post-disaster.

Natural disasters and freedom to organize

Political competition

If people connect a natural disaster to a political failure, through media or otherwise, there are good reasons to expect an increase in the political mobilization of opposition actors (Cohen & Werker, 2008; Olson & Gawronski, 2010). This is because political mobilization originating from disappointments with preventive measures and relief efforts implemented by the government decreases the opportunity costs for various political behaviors aimed at challenging the government. Previous work indeed argues

that a natural disaster can act as a "political spark" that interrupts everyday politics, through positive associations with protests (Drury & Olson, 1998; Nardulli et al., 2015), political engagement (Fair et al., 2017) , and political participation (Sinclair et al., 2011). Additionally, others also argue that natural disasters can be associated with shifts in support for political parties during election periods (Bechtel & Hainmueller, 2011; Eriksson, 2016; Hossain, 2018) and that party systems can be transformed (Akarca & Tansel, 2016).

The direct damage of a natural disaster is always more or less localized (Walch, 2018), although the indirect losses might ripple through society and become more ubiquitous depending on the disaster type (Keating et al., 2017; Pelling et al., 2002). Nonetheless, this concentrated spatial dimension of natural disasters can translate into immediate regionalized or local political consequences. For example, some argue that a natural disaster can increase the tensions between national and local political interests (Cohen & Werker, 2008), with plausible implications for political competition within countries between different levels of political authority (Hossain, 2018).

When politicized, a natural disaster can help mobilize and potentially empower existing or novel political actors across various jurisdictions (local, regional, and national). The increase in such activity may be interpreted as a threat to the incumbent's political survival, prompting a coercive response to make it harder for the political initiatives, motivated by the natural disaster, to operate. However, if the government is permissive of – or is unable to address – this potential activity in how actors use their voice to contest the status quo, it can end up increasing the level of political competition. We hypothesize that:

H_2. A higher number of natural disasters is associated with higher political competition.

Civil society

In the wake of natural disasters, civil society and communal initiatives often mobilize to aid in disaster relief, helping those in need and containing the scope of direct damage (Calo-Blanco et al., 2017; Kubicek, 2002; McSweeney & Coomes, 2011; Rodríguez et al., 2006). Immediately post-disaster, this type of mobilization is mainly a response to adversities, but such mobilization waves can help strengthen civil society and local initiatives overall by facilitating coordination between people and providing a host movement that can include other visions (Walker, 2009) or providing a signal to other movements that this can be a permissive time to act ("demonstration effect" in Kitschelt, 1986).

It is plausible that the incumbent can interpret a spike in civil society activity as a potential threat to their claimed legitimacy, incentivizing contractions of democratic liberties (Kubicek, 2002; Way, 2014), which might lead to a negative effect of disasters on the freedom to organize. However, if governments are unable or unwilling to provide disaster relief, they should typically not prevent civil society actors from helping, as it might also undermine government legitimacy (Olson & Gawronski, 2010). Civil society mobilization is also likely to happen faster than government responses (Aldrich & Meyer, 2015). Thus, it can prove difficult for governments to suppress civil society or voluntary-based relief even if they would like to. These processes may spur a spike in civil society activity and increase freedom for civil society to organize. We therefore hypothesize that:

H_3. A higher number of natural disasters is associated with higher civil society participation.

Natural disasters and freedom of expression

Natural disasters are also likely to attract media attention. These events constitute newsworthy information for both domestic and international press. The media can communicate the magnitude of direct damage to humans and resources, which can increase both international attention and humanitarian relief (Drury et al., 2005; Strömberg, 2007). They can also link the destructive effects of disasters to the lack of government effectiveness in both disaster preparation and the implementation of relief efforts, which can impact public perception of whether the government can secure public goods provision, potentially revealing corruption and incompetence (Choe & Raschky, 2016; Cuny, 1983).

Even if criticism of the government was not a norm before natural disasters, these catastrophic events call for investigative inquiries and might generate deviations from previous media practice, opening a window of opportunity for such criticism (Olson & Gawronski, 2003). In turn, this can serve as a foundation for more substantial increases in media freedom and freedom of expression overall. If a government feels threatened by the upturn in media coverage, it may provide incentives for repressive measures to reduce media freedom and control how citizens and the international community perceive the event (Apodaca, 2017; Lührmann & Lindberg, 2019), but may also stimulate accountability (Besley & Burgess, 2002). Accordingly, we hypothesize that:

H_4. A higher number of natural disasters is associated with higher freedom of expression.

Data and Method

Dependent variables

To measure various democratic institutions discussed in the theory chapter, we use data from the V-Dem project (Coppedge, Gerring, Knutsen, Lindberg, Teorell, Alizada, et al., 2021; Pemstein et al., 2021). V-Dem is advantageous for our purposes, as it provides nuanced measurements of all democratic aspects that we hypothesize might change after the disaster, also following Dahl's (1971) definition of democracy. It also has a comprehensive availability across countries and over time. The V-Dem indices are generated with a Bayesian item response measurement model, estimated from multiple expert-coded survey questions, adjusted for both expert agreement and measurement error (Coppedge, Gerring, Knutsen, Lindberg, Teorell, Marquardt, et al., 2021; Pemstein et al., 2021).

To measure *electoral aspects of democracy*, we use two indices: 1) the Clean Elections Index and 2) the Elected Officials Index. The Clean Election Index measures electoral management body capacity and autonomy from the government, the accuracy of the voter registry, presence of vote buying and other voting irregularities, instances of government intimidation and other electoral violence, and an expert evaluation of whether elections were free and fair. The Electoral Officials Index is a composite measure of constitutional guarantees of elections to key public offices. It includes 15 indicators and boils down to a measure of whether the chief executive is appointed through popular elections directly or indirectly.

To gauge the extent of *political competition,* we use the thick Freedom of Association Index, which measures the extent to which political parties are banned, barriers to forming a political party, whether oppositional parties have autonomy and independence from the ruling regime, whether the elections are multiparty, and repression of and control over entry and exit of civil society organizations (CSOs).

To measure the extent of *civil society participation,* we use the Civil Society Participation Index, which taps upon the extent to which policymakers consult important CSOs, whether CSO participation is voluntary, widespread, and not state-sponsored, whether consultancy groups can influence the choice of the candidates competing in elections, and if women are allowed to participate in CSOs.

To measure *freedom of expression*, we use two indices: the Freedom of Expression Index and the Alternative Sources of Information Index. The first measures government censorship of media, harassment of journalists, media self-censorship, freedom of discussion for men and women, and

freedom of academic and cultural expression. The second measures whether the media criticizes the government, whether major print and broadcast media represent a wide range of political perspectives, and whether there are media bias against oppositional actors.

We also test the effects of natural disasters on indicators constituting these indices - actual questions that experts replied without further aggregation to indices. We do this to gain a more nuanced understanding of which societal and political processes disasters affect. To make our study comparable to others in the field, we also test the effect of natural disasters on the aggregate level of democracy, operationalizing it with the Electoral Democracy Index from V-Dem, which consists of indices measuring freedom of expression and access to alternative information, freedom of association, clean elections, elected officials, and suffrage extent.

All higher-level indices vary from 0 to 1, while lower-level indicators range from -5 to 5, apart from lower-level indicators of the Elected Officials Index. In all cases, higher values mean "more democratic". Expert survey questions for all variables are available in the V-Dem Codebook (Coppedge, Gerring, Knutsen, Lindberg, Teorell, Altman, et al., 2021).

Independent variables

To operationalize our conceptualization of natural disasters as outcomes of natural hazards in interaction with vulnerability, we use data from EM-DAT, an internationally coordinated and standardized data effort by the Centre for Research on the Epidemiology of Disasters (CRED) (Guha-Sapir, 2020). Compared to other sources of disaster data, EM-DAT taps into more deadly and catastrophic events due to their threshold criteria (Gall et al., 2009, p. 803). CRED codes an event as a natural disaster if it has caused: 1) ten or more deaths, 2) 100 or more people affected, injured, or rendered homeless, or, 3) the authorities call for international assistance or declare a state of emergency.

Research on institutional vulnerability using EM-DAT found an association between higher death tolls/number of affected post-disaster and weaker democratic institutions (Kahn, 2005; Persson & Povitkina, 2017; Strömberg, 2007). Therefore, predicting changes in democratic institutions by using death tolls as a disaster intensity measure presents an endogeneity issue. Further, it is difficult to measure death tolls or economic loss post-disaster, making these numbers untrustworthy (Albala-Bertrand, 2014; Pelling et al., 2002). To have a more exogenous measure of natural disasters, we follow Ahlerup (2013) and use *the count of events* or *disaster frequency*. As there are more country-years when a disaster did not occur, we also create a dichotomous variable measuring whether at least one disaster

occurred in a country each year. This allows us to disentangle the variation that comes from countries that experienced a disaster each year and countries that were hit several times per year.

As we aim to estimate the immediate consequences of disasters, we evaluate the change in democratic institutions in the same year as disasters occur. We also consider whether these changes are visible to the experts evaluating democratic institutions. For example, disasters that occurred late in the year, i.e., November-December, might influence democratic institutions in January-February of the next year and the experts will only code these changes one year after the disaster hits. Therefore, we subtract disasters that occurred in November or December from the number of disasters in the same year and code these numbers into the following year.

Some natural disasters, mostly droughts and epidemics, last more than one year, and we code the occurrence of such disasters only in the year when they first hit (if they occur before November, see above). This is because, over time, a regime has an opportunity to adapt to the disaster and become more resilient.

We also use an alternative measure of disaster occurrence - an expert-coded measure capturing whether a government has declared a state of emergency due to the occurrence of a natural disaster from V-Dem. The variable is binary, where "1" corresponds to a declared state of emergency due to a natural disaster.

We introduce several control variables that have been used in previous research (e.g., Ahlerup, 2013). In the main analysis, we include 1) the level of *economic development* proxied by gross domestic product (GDP) per capita in 2015 constant prices, 2) the *population size* in million people, 3) *openness to trade,* and 4) the *size of urban population*, all from the World Bank Development Indicators (World Bank, 2020), and taken from the Quality of Government standard dataset (Teorell et al., 2021). In additional checks, presented in Appendix 5, we also control for the amount of aid a country receives (World Bank, 2020) but do not include it in the main analysis, because of many missing values. GDP per capita, population size, and openness to trade are log-transformed to correct for non-linearity. After listwise deletion, the main models cover 170 countries over the years 1960-2019, with time periods varying by country depending on the independence year. Appendix 1 presents summary statistics for all variables included in our models, while Appendix 2 presents the list of countries included in the analysis after the listwise deletion. We limit our analysis to the years before the COVID-19 pandemic, as worldwide closures due to COVID-19 brought up new concerns about constraining democratic liberties and changes in

democratic institutions. Given that years under COVID restrictions were unique for the world, limiting the sample to pre-COVID provides a cleaner test of our hypotheses.

Method

Our focus is on change in democratic institutions and not full regime transitions ("reform" contra "rupture" in Lueders & Lust, 2017). This is a reasonable choice for at least three reasons. First, we do not consider democracy in purely categorical terms as it is difficult to define a threshold that differentiates between the two categories (e.g., Cheibub et al., 2010; Lührmann et al., 2018). Second, full transitions are difficult to relate to natural disasters per se (e.g., Burke & Leigh, 2010). Third, most contemporary institutional and democratic changes are incremental (Mechkova et al., 2017; Thelen, 1999) and therefore are best captured using continuous indicators. Furthermore, in this paper, our main focus is on the short-term political changes following natural disasters, or on what can happen in the immediate wake of disasters (Katz & Levin, 2016). While we briefly explore the possibility of long-run consequences, we do not systematically investigate whether the effects persist.

To evaluate the potential democratizing effect of disasters, we use an ordinary least squares regression with country and year fixed effects and robust clustered standard errors. Hence, our model adjusts for time-constant factors within countries and common effects cross-sectionally within a given year. While this model controls for omitted variables along each dimension it does not isolate variation along a specific dimension, as a one-way fixed effect model does (Kropko & Kubinec, 2018):

$$y_{it} = \beta_{dis} x_t + \beta_z z_{t-1} + \alpha_i + \gamma_t + \varepsilon_{it}, \qquad (1)$$

where y is the predicted values of various democratic institutions, i stands for country and t represent year. β_{dis} is constant across countries and represents the marginal effect of a one-unit increase in x in year t, x is the number of disasters per country per year, z is a vector of independent variables. α_i and γ_t are country and year fixed effects for all countries and years, while ε_{it} is an error term.

In a two-way fixed effects model, β_{dis} represents the country-specific, i, demeaned data regressed at each time point, t, as a weighted average across all time points. β_{dis} is complicated to interpret substantially but it can be understood as follows: a positive coefficient indicates that, on average, as a country experiences a disaster frequency above its mean over time, compared to another country that is experiencing a frequency closer to or below its mean over time, the former country will have a score on a democracy aspect above its mean over time, compared to the latter country's score on a

democracy aspect in relation to its mean over time, as an average across all years included (Kropko & Kubinec, 2018). Thus, we compare relative variation both within individual countries over time and between multiple countries each year.

We estimate the equation several times. First, we estimate the effect of disaster frequency on democratic institutions, including country-years without disasters. Second, we estimate the effect of having at least one disaster on democratic institutions by introducing a dichotomous measure of disaster occurrence instead of disaster count. Third, we estimate the effect of disaster frequency only in country-years that registered at least one disaster. Fourth, we use the declaration of the state of emergency due to disasters as an alternative measure of disaster occurrence.

Results

In this section, we present the results from our regression models. Table 1 presents the association between natural disasters and the aggregated index of democracy, as well as indices of Clean Elections, Elected Officials Index, Freedom of Association, Civil Society Participation, Freedom of Expression, and Alternative Sources of Information Index. The results show that a positive change in the number of disasters per year is associated with a positive change in all indices. However, the results in Models 2 and 3 for Clean Election and Elected Officials Indices are only significant at 10% and have the weakest explanatory power (R^2). Models 5 and 7 have the largest explanatory power, explaining 44% of the variation in Civil Society Participation and Alternative Sources of Information Indices. One percent change in the number of disasters per year is associated with around 0.02 unit change in the measures of democratic institutions (around 2%).

Table 1. The relationship between disaster frequency and different aspects of democracy. Zero occurrences included.

	Model 1 Electoral democracy index	**Model 2** Clean elections index	**Model 3** Elected officials index	**Model 4** Freedom of association index	**Model 5** Civil society participation index	**Model 6** Freedom of expression index	**Model 7** Alternative sources of information index
Disaster frequency (ln)	0.017**	0.016†	0.020†	0.023***	0.023***	0.029***	0.026***
	(0.006)	(0.009)	(0.011)	(0.007)	(0.006)	(0.006)	(0.007)
GDP per capita (ln)	-0.027	0.008	0.045	-0.090**	-0.025	-0.073*	-0.096**
	(0.027)	(0.038)	(0.049)	(0.033)	(0.030)	(0.031)	(0.029)
Trade (ln)	0.030*	0.035†	0.035	0.051**	0.031†	0.042*	0.029
	(0.014)	(0.019)	(0.026)	(0.019)	(0.018)	(0.019)	(0.019)
Population (ln)	0.000	0.017	0.287**	0.112†	0.078	0.034	0.146*
	(0.044)	(0.058)	(0.086)	(0.066)	(0.056)	(0.061)	(0.064)
Urban population	0.003*	0.004†	-0.002	0.004†	0.002	0.004*	0.002
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	0.295	-0.256	-4.075**	-0.909	-0.776	0.210	-1.230
	(0.736)	(0.972)	(1.483)	(1.082)	(0.889)	(0.987)	(1.043)
Observations	7,041	7,041	7,044	7,044	7,044	7,044	7,044
R-squared	0.394	0.281	0.142	0.421	0.443	0.362	0.435
Number of countries	170	170	170	170	170	170	170
Country fixed effects	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Fixed effects OLS regression of democratic institutions on the ln of number of disasters per year. Zero occurrences are included in the count. Control variables include natural logarithms of the gross domestic product per capita, amount of trade, population size, and a measure of urban population as a percentage of total population. All dependent variables vary on the scale from 0 to 1.

Table 2 presents the results with the dichotomous measure of disaster occurrence as an independent variable. Here we compare years when countries experienced a disaster and when they did not. Having experienced a disaster is associated with a positive change in all democratic institutions under investigation. However, the coefficient for the Clean Elections Index is only significant at 10%.

Table 2. The relationship between disaster occurrence and different aspects of democracy.

	Model 1 Electoral democracy index	**Model 2** Clean elections index	**Model 3** Elected officials index	**Model 4** Freedom of association index	**Model 5** Civil society participation index	**Model 6** Freedom of expression index	**Model 7** Alternative sources of information index
Disaster occurrence	0.013**	0.012†	0.030**	0.020**	0.019***	0.021***	0.024***
	(0.005)	(0.007)	(0.010)	(0.006)	(0.005)	(0.006)	(0.006)
GDP per capita (ln)	-0.025	0.010	0.049	-0.088**	-0.022	-0.071*	-0.093**
	(0.027)	(0.037)	(0.049)	(0.032)	(0.030)	(0.031)	(0.028)
Trade (ln)	0.031*	0.036†	0.038	0.053**	0.033†	0.045*	0.031†
	(0.014)	(0.019)	(0.026)	(0.019)	(0.017)	(0.019)	(0.019)
Population (ln)	0.001	0.018	0.289***	0.114†	0.080	0.036	0.147*
	(0.044)	(0.058)	(0.086)	(0.067)	(0.056)	(0.061)	(0.064)
Urban population	0.003*	0.004†	-0.002	0.004†	0.002	0.004†	0.002
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	0.258	-0.289	-4.146**	-0.965	-0.845	0.141	-1.287
	(0.735)	(0.970)	(1.477)	(1.081)	(0.895)	(0.991)	(1.042)
Observations	7,047	7,047	7,050	7,050	7,050	7,050	7,050
R-squared	0.392	0.280	0.143	0.419	0.442	0.359	0.434
Number of countries	170	170	170	170	170	170	170
Country fixed effects	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. OLS regression of democratic institutions on the disaster occurrence (disaster dummy). Control variables include natural logarithms of the gross domestic product per capita, amount of trade, population size, and a measure of urban population as a percentage of total population. All dependent variables vary on the scale from 0 to 1.

Table 3 presents the results only for the years when countries experienced a disaster, showing an effect of the number of disasters countries experience per year. The association between disaster frequency and all indices is significant, apart from electoral aspects of democracy and the aggregated democracy score. The comparison of Tables 1, 2, and 3 shows that the effects from the number of disasters presented in Table 1 on non-electoral aspects of democracy are both due to disaster occurrence and disaster frequency, but the effect on the aggregated democracy score and electoral democracy aspects only stems from the differences between country years when a disaster occurred and where it did not, rather than from the differences in the number of disasters that occurred.

Table 3. The relationship between disaster frequency and different aspects of democracy. Zero occurrences not included

	Model 1 Electoral democracy index	**Model 2** Clean elections index	**Model 3** Elected officials index	**Model 4** Freedom of association index	**Model 5** Civil society participation index	**Model 6** Freedom of expression index	**Model 7** Alternative sources of information index
Disaster frequency (ln)	0.010	0.007	-0.006	0.015*	0.015*	0.022**	0.019**
	(0.006)	(0.008)	(0.010)	(0.007)	(0.007)	(0.008)	(0.007)
GDP per capita (ln)	-0.033	-0.026	0.046	-0.076†	0.023	-0.059	-0.057
	(0.040)	(0.051)	(0.053)	(0.043)	(0.038)	(0.045)	(0.038)
Trade (ln)	0.006	0.008	0.012	0.034	0.015	0.017	0.000
	(0.023)	(0.031)	(0.041)	(0.031)	(0.033)	(0.034)	(0.032)
Population (ln)	0.054	0.020	0.460***	0.208**	0.123†	0.131†	0.245***
	(0.055)	(0.069)	(0.100)	(0.076)	(0.063)	(0.073)	(0.071)
Urban population	0.004†	0.006*	-0.003	0.004	0.002	0.005	0.002
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Constant	-0.427	-0.032	-6.721***	-2.461†	-1.873†	-1.325	-2.933*
	(0.965)	(1.211)	(1.695)	(1.297)	(1.022)	(1.226)	(1.183)
Observations	3,955	3,955	3,957	3,957	3,957	3,957	3,957
R-squared	0.403	0.323	0.166	0.430	0.437	0.358	0.408
Number of countries	166	166	166	166	166	166	166
Country fixed effects	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Fixed effects OLS regression of democratic institutions on the ln of number of disasters per year among countries that are hit by disasters. Zero occurrences are not included in the count. Control variables include natural logarithms of the gross domestic product per capita, amount of trade, population size, and a measure of urban population as a percentage of total population. All dependent variables vary on the scale from 0 to 1.

Table 4 presents the results for the models where we include a dichotomous measure of the declaration of the state of emergency due to natural disasters from V-Dem as an independent variable. The results indicate that the declaration of emergency due to natural disasters is associated with positive changes in democratic institutions. This nuances the results by Lührmann and Rooney (2021), who found a negative effect from a declaration of emergency, without distinguishing the reasons behind it, and the level of democracy. To explore the differences between our results and the results by Lührmann and Rooney (2021) further, we performed an analysis with the declaration of the state of emergency for other reasons and the results varied. We detected a negative effect of declaring a state of emergency on democratic institutions if the state of emergency was declared due to an armed conflict or mass protest, no effect from a declaration of a state of emergency due to terrorist attacks, and a positive

effect from a declaration of the state of emergency because of natural disasters on all aspects of democracy apart from the Elected Officials Index and Civil Society Participation Index. The results for a declaration of a state of emergency due to other reasons are available upon request.

Table 4. The relationship between the declarations of the state of emergency and different aspects of democracy.

	Model 1 Electoral democracy index	**Model 2** Clean elections index	**Model 3** Elected officials index	**Model 4** Freedom of association index	**Model 5** Civil society participation index	**Model 6** Freedom of expression index	**Model 7** Alternative sources of information index
State of emergency due to a natural disaster	0.219**	0.260*	0.197	0.175*	0.115	0.232**	0.179*
	(0.079)	(0.105)	(0.145)	(0.075)	(0.081)	(0.082)	(0.084)
GDP per capita (ln)	-0.025	0.011	0.047	-0.089**	-0.023	-0.071*	-0.094**
	(0.026)	(0.037)	(0.049)	(0.032)	(0.030)	(0.031)	(0.028)
Trade (ln)	0.030*	0.035†	0.037	0.052**	0.033†	0.044*	0.031
	(0.013)	(0.019)	(0.026)	(0.019)	(0.017)	(0.019)	(0.019)
Population (ln)	0.003	0.020	0.292***	0.116†	0.082	0.038	0.149*
	(0.044)	(0.058)	(0.086)	(0.066)	(0.056)	(0.061)	(0.064)
Urban population	0.003*	0.004†	-0.002	0.004†	0.002	0.004*	0.002
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	0.225	-0.329	-4.171**	-0.988	-0.859	0.108	-1.310
	(0.729)	(0.965)	(1.475)	(1.079)	(0.896)	(0.989)	(1.042)
Observations	7,047	7,047	7,050	7,050	7,050	7,050	7,050
R-squared	0.396	0.284	0.142	0.419	0.441	0.361	0.434
Number of countries	170	170	170	170	170	170	170
Country fixed effects	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Fixed effects OLS regression of democratic institutions on the declarations of the state of emergency due to natural disasters. Zero declarations of state of emergency are included in the count. Control variables include natural logarithms of the gross domestic product per capita, amount of trade, population size, and a measure of urban population as a percentage of total population. All dependent variables vary on the scale from 0 to 1.

To nuance our understanding of changes in democratic institutions post-disaster further, we explore which of the more specific indicators related to elections, civil society participation, political competition, and freedom of expression natural disasters affect. For this, we use indicators that constitute complex indices in the main analysis and several other variables from the V-Dem dataset related to the democratic institutions under our focus. Such analysis unpacks which exact political processes change in the aftermath of disasters. Figures 4-6 present coefficient plots for the effect of disaster frequency on various dependent variables – democratic institutions, while Appendix 3 presents extended regression tables.

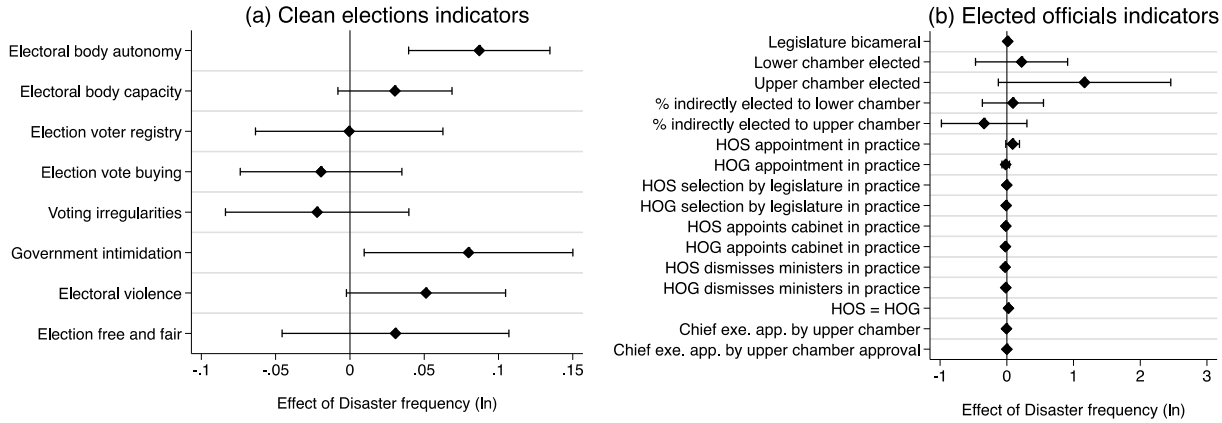

Figure 4. The effects of natural disaster frequency on elections-related aspects of democracy: (a) indicators of the Clean Election Index; (b) indicators of the Elected Official Index, with 90% confidence intervals. *Note:* All indicators range from worst to best with positive effects being movement towards democratization. HOS = head of state, HOG = head of government.

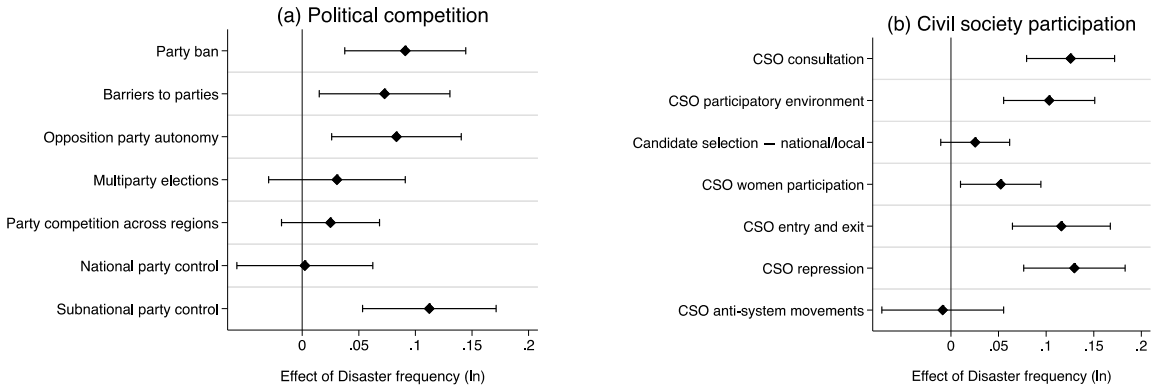

Figure 5. The effect of natural disaster frequency on freedom-of-association-related aspects of democracy: (a) political competition; (b) civil society participation, with 90% confidence intervals. *Note:* All indicators range from worst to best with positive effects being movement towards democratization. CSO = civil society organizations

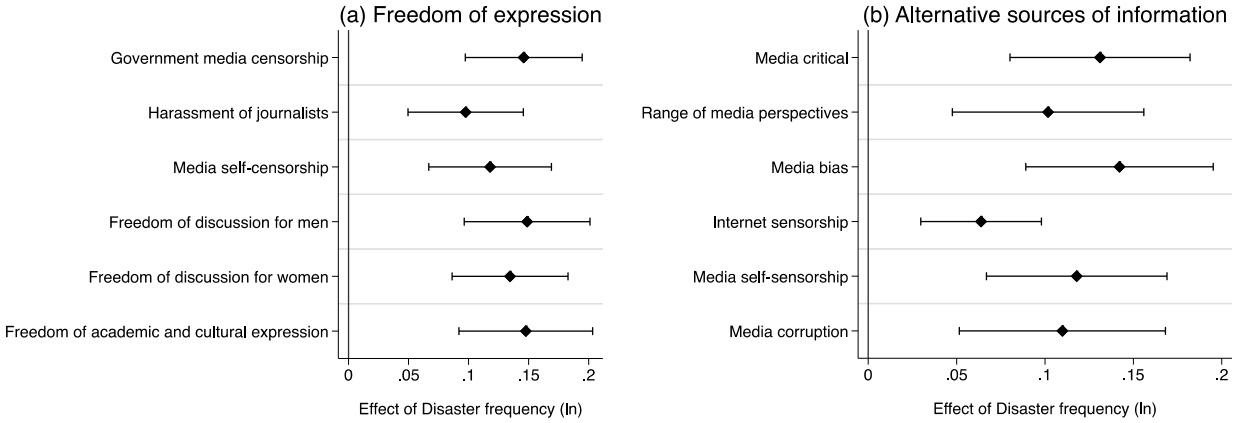

Figure 6. The effect of natural disaster frequency on various aspects of (a) freedom of expression and (b) alternative sources of information, with 90% confidence intervals. *Note:* All indicators range from worst to best with positive effects being movement towards democratization.

The figures show that among electoral aspects of democracy, higher disaster frequency only has an association with an increased electoral management body autonomy from the government and reduced government intimidation during elections. All other elections-related indicators remain on average unaffected by disasters. As for aspects related to political competition, more disasters are associated with the ease of bans on political parties, lower barriers to forming a political party higher autonomy and independence of oppositional parties from the ruling regime, and higher autonomy to sub-national policymaking. Moreover, higher disaster frequency is associated with a higher extent of civil society

consultation by the politicians, an increase in the extent to which participation in civil society is voluntary, widespread, and not state-sponsored, increase in the ability of women to participate in CSOs, and lower government repression and control over the entry, and exit of CSOs. Disasters, however, do not have an association with whether elections become multiparty, whether there is party competition across regions, national party control, whether candidate selection for elections is centralized, and the presence of anti-system CSO movements. Remarkably, higher disaster frequency also correlates with all aspects of media freedom and freedom of expression.

We also undertook exploratory steps to test the long-term term effects of natural disasters on democratic institutions by introducing various lags of disaster frequency and disaster occurrence. The results, presented in Appendix 4, show that natural disasters have the strongest effect on democratic institutions in their wake and immediately after. As time passes, their effect diminishes a few years after the disaster and disappears completely after 3-4 years.

Discussion

Our analysis shows that countries experiencing a disaster have short-term improvements in some key democratic institutions – freedom of association, including some aspects of political competition and civil society participation, freedom of expression, and availability of alternative sources of information. How can we understand these associations? The literature argues that improvements in democratic institutions post-disaster might stem from induced uncertainty over incumbents' political survival and decreased opportunity cost for various political behaviors aimed at contesting the current political arrangements, leading to an increase in power-sharing (e.g., Ahlerup, 2013). While insightful, these arguments do not shed light on which exact processes get affected and how. Our article fills this gap by synthesizing theoretical arguments and providing empirical evidence on whether and how disasters affect specific aspects of democracy.

First, we hypothesized, with some reservations, that natural disasters might create preconditions for electoral institutions to improve. While we find evidence for an increased autonomy of electoral management body from the government and decreased government intimidation during the elections in the years when countries get hit by natural disasters, we do not see changes in any other electoral aspects of democracy, neither related to clean elections nor constitutional guarantees for elections to the key offices. This might imply that such external shocks are not strong enough to influence electoral

institutions or that it takes a longer time for electoral institutions to change, possibly indirectly, through changes in other democratic institutions.

Second, we hypothesized and found a positive association between the occurrence of natural disasters and changes in *political competition*. We record ease of bans on political parties, lower barriers for parties to form, higher autonomy of oppositional parties from the ruling regime, and higher autonomy to sub-national policy-making post-disaster. However, we do not find any association between natural disasters and party competition across regions or ease of national party control.

Third, we expected that civil society is likely to experience an uptick in its activity due to engagement with direct damage containment. We find support for such expectations in our results. Natural disasters are associated with a decrease in government control over entry and exit of CSOs, government repression of CSOs, an increase in government consultation with CSOs, and an improved CSO participatory environment. However, there is no association between natural disasters and the activity of anti-system CSOs. Taken together, results for civil society and political competition imply that in the aftermath of a disaster, if activities of civil society and political actors are not interpreted as a signal of eroding government legitimacy, countries tend to experience improvements in the strength of civil society and ease for political actors to organize. It remains to be investigated if such changes can persist over the long term (see Appendix 4 for the first exploratory results), either due to the inability to handle the pressure from civil society and political actors or if the opportunity costs for suppressing these movements are too high.

Fourth, we hypothesized and found strong support for the relationship between natural disasters and freedom of expression. The occurrence of natural disasters is associated with positive changes in all aspects of freedom of expression and media freedom, including lower media and internet censorship by the government, less self-censorship by the media itself, more criticism of the government by the media, less biased and more critical and representative media, more media plurality, less bias against government opposition, and less media corruption. This can be because natural disasters generate newsworthy information for the media to report about, including government management before, during, and after the disaster. It might be that government actions seeking to silence this critique come at higher political costs compared to non-disaster times (Olson & Gawronski, 2010). Instead, more media freedom post-disaster can spur an increase in media freedom in general.

We would like to emphasize that we do not make claims of *intentional* democratization. It might be that actors intentionally change institutions as a response to the political situation (Rahman et al., 2017a). It could also be though that political changes are unintended products of disaster responses (cf. Karapin & Feldman, 2016), and they only *resemble* democratization. Treisman (2017) made the argument that many democratization episodes stem from miscalculations or errors leading up to "democracy by mistake". It seems reasonable that the uncertainty around periods of natural disasters can contribute to this type of unintended consequences.

As many natural hazards will become more frequent and intense due to climate change (Hoegh-Guldberg et al., 2018), there is reason to expect higher pressure from natural disasters on the political status quo. Building on our findings, one could understand this as beneficial for democratization. However, since we only examine short-term consequences of disasters, our results only imply that *natural disasters open a window of opportunity and carry the potential to bring about political change,* and the direction of this change will depend on the antecedent conditions and agency after the event (Pelling & Dill, 2010; Rinscheid et al., 2019; Soifer, 2012). The exploratory investigation of potential long-term effects showed that this window of opportunity is rather short-lived and one should not be overly optimistic about the effect of disasters on democracy. This is especially important given previous findings that partial changes in democratic institutions might be associated with subsequent violence and conflict (Regan & Bell, 2010).

In addition, we would like to note that while we find, similar to previous research, improvements in aggregated democracy scores in the immediate aftermath of natural disasters, we cannot infer that disasters move countries towards regime change. This is because aggregate democracy scores consist of many components and while we find strong associations between disasters and many of them, it is beyond the scope of this study to evaluate which of these components are necessary and/or sufficient for a regime change. Instead, what we can infer is short-lived political changes towards democracy in several of its important aspects, and we invite future research to further investigate their long-term political consequences.

Lastly, there are indeed real-world examples of the changes in political institutions post-disaster, both towards and away from democracy. Returning to our introductory example, Bhola cyclone in East Pakistan in 1970 had a regionalized impact, causing 250-500,000 deaths. The political ignorance of the central government towards the victims of this natural disaster led to dramatic effects in the following 1970 election, favoring the regionalist party "representing" the area that was most negatively affected

by the storm. However, this then sparked a sequence of events that led to a liberation war, international involvement, and finally the independence of Bangladesh (Hossain, 2018). On the other hand, the earthquake in Guatemala in 1976 generated communal and civic mobilization. Later on, when mobilization blended with political groupings, it was perceived as a security threat by the state which responded with repression and violence (Gawronski & Olson, 2013). In Mexico in 1985, an earthquake revealed the political incompetence and neglect occurring within the government, which contributed to both social and political mobilization, and provided critical journalists with content and motivation to further demand accountability from the regime for its incompetence, corruption, and fraudulent information (Gawronski & Olson, 2013). The Mexican example contrasts Turkey's experiences with an earthquake in 1999 where the humanitarian consequences led to increased activity of humanitarian actors and civil society actors trying to contain the disaster. The government first accepted this activity but eventually imposed stricter controls on both humanitarian and civil society organizations including vocally criticizing these actors for their help in containing the adversities (Kubicek, 2002).

Concluding Remarks

The aim of this paper has been to test theoretically derived hypotheses concerning the potential short-term democratizing consequences of natural disasters. We have provided arguments, theoretical justification, examples from real-world cases and empirical results in support of the view that the occurrence of natural disasters is indeed associated with at least short-term changes in some core democratic institutions.

Departing from the need for disaggregating the broad concept of democracy, we argued that all democratic institutions are sensitive to these shocks. Our results lend support to the theoretical expectations that as disasters occur, countries on average experience an increase in civil society participation, freedom of expression, and some aspects of political competition. There is, however, weak evidence that disasters impact electoral institutions of democracy, especially those that are fixed by the constitution and that take more time to change. Overall, our findings imply that natural disasters can interfere with the social and political status quo in the short term and highlight the need for a more detailed analysis of the effects of these events on political institutions.

As several natural hazards are likely to constitute a more severe threat following climate change (O'Brien et al., 2006), there is also an increased risk for the affected countries to experience political

volatility, conditional upon accepting the premises laid out in this paper. Future research should investigate under which circumstances the relationship between natural disasters and political volatility is most plausible (e.g., Omelicheva, 2011) but study more long-lasting effects of natural disasters on various aspects of democracy. It will also be a task for the international community (e.g., United Nations, 2015) and relevant elite actors to prevent adverse changes and to assist political and democratic processes during the post-disaster period for a more long-lasting change toward democracy.

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Appendix 1. Summary Statistics and Correlations

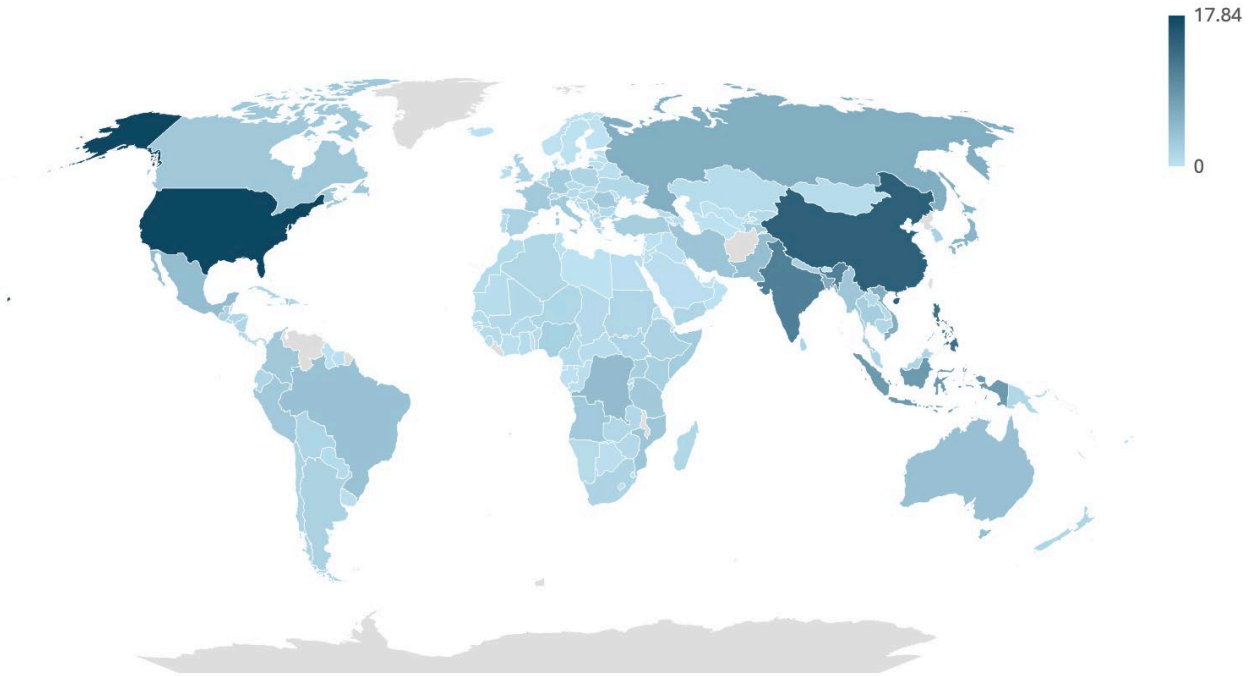
Table 1.1. Summary statistics

Variable	Obs	N of countries	Mean	Std. dev.	Min	Max
Disaster frequency (ln)	7,359	182	0.649	0.730	0	3.784
Disaster occurrence	7,359	182	0.546	0.498	0	1
State of emergency due to natural disasters	7,044	170	0.020	0.072	0	1
Electoral democracy index	7,041	170	0.465	0.284	0.007	0.919
Clean elections index	7,041	170	0.475	0.349	0	0.987
Elected officials index	7,044	170	0.791	0.393	0	1
Freedom of association index	7,044	170	0.579	0.323	0.022	0.949
Civil society participation index	7,044	170	0.596	0.274	0.028	0.99
Freedom of expression index	7,044	170	0.597	0.314	0.015	0.993
Alternative sources of information index	7,044	170	0.592	0.317	0.012	0.978
GDP per capita (ln)	7,359	182	8.233	1.430	5.099	11.630
Trade (ln)	7,359	182	4.132	0.645	-3.863	6.081
Population (ln)	7,359	182	15.786	1.854	9.233	21.065
Urban population	7,359	182	51.189	23.894	2.193	100

Table 1.2. Correlations between variables

	Disaster frequency (ln)	Disaster occurrence	State of emergency due to natural disasters	Electoral democracy index	Clean elections index	Elected officials index	Freedom of association index	Civil society participation index	Freedom of expression index	Alt. sources of info index	GDP per capita (ln)	Trade (ln)	Population (ln)	Urban population
Disaster frequency (ln)	1.00													
Disaster occurrence	0.81	1.00												
State of emergency due to natural disasters	0.03	0.04	1.00											
Electoral democracy index	0.16	0.14	0.09	1.00										
Clean elections index	0.12	0.10	0.06	0.95	1.00									
Elected officials index	0.11	0.12	0.08	0.61	0.55	1.00								
Freedom of association index	0.18	0.19	0.13	0.91	0.81	0.60	1.00							
Civil society participation index	0.21	0.18	0.08	0.85	0.77	0.44	0.85	1.00						
Freedom of expression index	0.18	0.17	0.11	0.93	0.83	0.55	0.92	0.89	1.00					
Alternative sources of information index	0.22	0.21	0.11	0.87	0.77	0.52	0.91	0.87	0.92	1.00				
GDP per capita (ln)	-0.03	-0.06	-0.03	0.59	0.63	0.23	0.41	0.42	0.45	0.39	1.00			
Trade (ln)	-0.26	-0.19	0.03	0.16	0.18	0.12	0.17	0.14	0.14	0.08	0.30	1.00		
Population (ln)	0.59	0.42	-0.15	0.01	0.01	0.01	0.00	0.03	0.00	0.06	-0.05	-0.52	1.00	
Urban population	0.01	-0.01	-0.09	0.48	0.52	0.21	0.36	0.32	0.37	0.33	0.83	0.25	0.04	1.00

Figure 1.1. Average number of disasters per country per year over 1970-2019



The following countries experienced no natural disasters over the period of investigation: Bahrain, Malta, United Arab Emirates, and Malaysia.

Appendix 2. List of Countries Included in the Analysis

Table 2.1. Countries included in the analysis in Tables 1, 2 and 4 (170)

Albania
Algeria
Angola
Azerbaijan
Argentina
Australia
Austria
Bahrain
Bangladesh
Armenia
Barbados
Belgium
Bhutan
Bolivia
Bosnia and Herzegovina
Botswana
Brazil
Solomon Islands
Bulgaria
Myanmar
Burundi
Belarus
Cambodia
Cameroon
Canada
Cabo Verde
Central African Republic
Sri Lanka
Chad
Chile
China
Colombia
Comoros (the)
Congo (the)
DR Congo
Costa Rica
Croatia
Cuba
Cyprus
Czechia
Benin
Denmark
Dominican Republic
Ecuador
El Salvador
Equatorial Guinea
Ethiopia
Eritrea
Estonia
Fiji
Finland
France
Djibouti
Gabon
Georgia
Gambia (the)
Germany
Germany
Ghana
Greece
Guatemala
Guinea
Guyana
Haiti
Honduras
Hungary
Iceland
India
Indonesia
Iran
Iraq
Ireland
Israel
Italy
Côte d'Ivoire
Jamaica
Japan
Kazakhstan
Jordan
Kenya
South Korea
Kuwait
Kyrgyzstan
Laos
Lebanon
Lesotho
Latvia
Libya
Lithuania
Luxembourg
Madagascar
Malaysia
Maldives
Mali
Malta
Mauritania
Mauritius
Mexico
Mongolia
Moldova
Montenegro
Morocco
Mozambique
Oman
Namibia
Nepal
Netherlands (the)
Vanuatu
New Zealand
Nicaragua
Niger (the)
Nigeria
Norway
Pakistan
Panama
Papua New Guinea
Paraguay
Peru
Philippines (the)
Poland
Portugal
Guinea-Bissau
Timor-Leste
Qatar
Romania
Russia
Rwanda
Saudi Arabia
Senegal
Serbia
Seychelles
Sierra Leone
Singapore
Slovakia
Viet Nam
Slovenia
Somalia
South Africa
Zimbabwe
Spain
South Sudan
Sudan (the)
Sudan (before split)
Suriname
Eswatini
Sweden
Switzerland
Syrian Arab Republic
Tajikistan
Thailand
Togo
United Arab Emirates
Tunisia
Turkey
Turkmenistan
Uganda
Ukraine
North Macedonia
Egypt
United Kingdom
Tanzania
United States
Burkina Faso
Uruguay
Uzbekistan
Yemen
Zambia
France
Malaysia
Pakistan

Table 2.2. Countries included in the analysis in Table 3 (166)

Albania
Algeria
Angola
Azerbaijan
Argentina
Australia
Austria
Bangladesh
Armenia
Barbados
Belgium
Bhutan
Bolivia
Bosnia and Herzegovina
Botswana
Brazil
Solomon Islands
Bulgaria
Myanmar
Burundi
Belarus
Cambodia
Cameroon
Canada
Cabo Verde
Central African Republic
Sri Lanka
Chad
Chile
China
Colombia
Comoros (the)
Congo (the)
DR Congo
Costa Rica
Croatia
Cuba
Cyprus
Czechia
Benin
Denmark
Dominican Republic
Ecuador
El Salvador
Equatorial Guinea
Ethiopia
Eritrea
Estonia
Fiji
Finland
France
Djibouti
Gabon
Georgia
Gambia (the)
Germany
Germany
Ghana
Greece
Guatemala
Guinea
Guyana
Haiti
Honduras
Hungary
Iceland
India
Indonesia
Iran
Iraq
Ireland
Israel
Italy
Côte d'Ivoire
Jamaica
Japan
Kazakhstan
Jordan
Kenya
South Korea
Kuwait
Kyrgyzstan
Laos
Lebanon
Lesotho
Latvia
Libya
Lithuania
Luxembourg
Madagascar
Malaysia
Maldives
Mali
Mauritania
Mauritius
Mexico
Mongolia
Moldova
Montenegro
Morocco
Mozambique
Oman
Namibia
Nepal
Netherlands (the)
Vanuatu
New Zealand
Nicaragua
Niger (the)
Nigeria
Norway
Pakistan
Panama
Papua New Guinea
Paraguay
Peru
Philippines (the)
Poland
Portugal
Guinea-Bissau
Timor-Leste
Qatar
Romania
Russia
Rwanda
Saudi Arabia
Senegal
Serbia
Seychelles
Sierra Leone
Singapore
Slovakia
Viet Nam
Slovenia
Somalia
South Africa
Zimbabwe
Spain
South Sudan
Sudan (the)
Sudan (before split)
Suriname
Eswatini
Sweden
Switzerland
Syrian Arab Republic
Tajikistan
Thailand
Togo
Tunisia
Turkey
Turkmenistan
Uganda
Ukraine
North Macedonia
Egypt
United Kingdom
Tanzania
United States of America
Burkina Faso
Uruguay
Uzbekistan
Yemen
Zambia
France
Pakistan

Appendix 3. Analysis with Disaggregated Indicators

In Appendix 3, we present extended regression results behind the coefficients plots in Figures 4-6 in the main text. Section 3.1 presents the results for the effect of natural disasters on electoral aspects of democracy, Section 3.2 – for the effect of natural disasters on freedom of association, including political competition and civil society participation, Section 3.3 – for the effect of disasters on freedom of expression and availability of alternative sources of information.

3.1. Natural disasters and electoral aspects of democracy

In addition to the aggregate index capturing cleanness of elections (ID: v2xel_frefair; 0-1), we perform a set of regressions for each of the indicators included in the index: 1) autonomy of electoral management body from the government (ID: v2elembaut), 2) capacity of electoral management body (ID: v2elembcap), 3) accuracy of voter registry (ID: v2elrgstry), 4) presence of vote buying (ID: v2elvotbuy), 5) presence of other voting irregularities (ID: v2elirreg), 6) instances of government intimidation (ID: v2elintim), 7) other electoral violence (ID: v2elpeace), and 8) a measure capturing whether elections were free and fair (ID: v2elfrfair). Table 3.1.1 presents correlations between the indicators.

Table 3.1.1 Correlation between indicators related to cleanness of elections.

	v2elembaut	v2elembcap	v2elrgstry	v2elvotbuy	v2elirreg	v2elintim	v2elpeace	v2elfrfair
v2elembaut	1.00							
v2elembcap	0.72	1.00						
v2elrgstry	0.80	0.68	1.00					
v2elvotbuy	0.61	0.69	0.64	1.00				
v2elirreg	0.79	0.76	0.77	0.83	1.00			
v2elintim	0.82	0.68	0.75	0.68	0.83	1.00		
v2elpeace	0.44	0.64	0.52	0.67	0.65	0.63	1	
v2elfrfair	0.88	0.71	0.80	0.64	0.85	0.90	0.55	1

Table 3.1.2 presents the regression results. The results are insignificant for all indicators apart from the measure of electoral management body autonomy and (at 10% level) – instances of government intimidation during elections. This may imply that post-disaster governments in less lose grip on electoral management bodies which results in them having higher autonomy and have less capacity for harassment and intimidation of opposition actors during elections.

Table 3.1.2 Natural disasters and democracy aspects related to clean elections.

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
	EMB autonomy	EMB capacity	Election voter registry	Election vote buying	Election other voting irregularities	Election government intimidation	Election other electoral violence	Election free and fair
Disaster frequency (ln)	0.087**	0.030	-0.000	-0.019	-0.022	0.080†	0.051	0.031
	(0.029)	(0.023)	(0.038)	(0.033)	(0.037)	(0.042)	(0.032)	(0.046)
GDP per capita (ln)	-0.238†	0.127	-0.103	0.162	-0.077	-0.004	0.227†	-0.261
	(0.128)	(0.129)	(0.131)	(0.214)	(0.210)	(0.216)	(0.129)	(0.194)
Trade (ln)	0.077	0.044	0.086	0.072	0.156*	0.167*	0.060	0.227**
	(0.090)	(0.056)	(0.057)	(0.125)	(0.072)	(0.068)	(0.052)	(0.073)
Population (ln)	-0.046	0.545*	0.226	-0.824*	-0.626*	-0.768*	-0.808**	-0.532†
	(0.284)	(0.221)	(0.246)	(0.329)	(0.291)	(0.380)	(0.255)	(0.292)
Urban population	0.013	0.004	0.006	0.005	0.016	0.015	0.006	0.029**
	(0.009)	(0.007)	(0.008)	(0.012)	(0.010)	(0.015)	(0.009)	(0.010)
Constant	1.518	-9.735**	-3.608	10.469†	8.564†	10.324	10.067*	7.601
	(4.684)	(3.534)	(4.088)	(5.589)	(4.851)	(6.361)	(4.030)	(4.819)
Observations	7,039	7,039	1,928	1,928	1,928	1,928	1,928	1,928
R-squared	0.364	0.358	0.287	0.093	0.104	0.168	0.098	0.233
Number of countries	170	170	165	165	165	165	165	165
Country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Fixed effects OLS regression of political competition and contestation on the ln of number of disasters per year. Zero occurrences are included in the count. Control variables include natural logarithms of the gross domestic product per capita, amount of trade, population size, and a measure of urban population as a percentage of total population. All dependent variables vary on the scale from -5 to 5, where higher values mean "better" (more democratic) outcomes.

We also explore changes in electoral institutions guaranteeing elections to key public offices post-disaster, by using indicators of the elected officials index (ID: v2x_elecoff): 1) whether the legislature is bicameral (ID: v2lgbicam), 2) percentage of the lower (or unicameral) chamber directly elected (ID: v2lgello), 3) percentage of the upper chamber directly elected (ID: v2lgelecup), 4) percentage of indirectly elected legislators to lower chamber (ID: v2lginello), 5) percentage of indirectly elected legislators to upper chamber (ID: v2lginelup), 6) how head of state is appointed (ID: v2expathhs), 7) how head of government is elected (ID: v2expathhg), 8) whether approval of the legislature necessary for the appointment of the head of state (ID: v2exaphos), 9) whether approval of the legislature necessary for the appointment of the head of government (ID: v2exaphogp), 10) whether the approval of the head of state necessary for the appointment of cabinet ministers (ID: v2exdfcbhs), 11) whether the approval of the head of government necessary for the appointment of cabinet ministers (ID: v2exdjcbhg), 12) whether head of state can dismiss cabinet ministers (ID: v2exdfdmhs), 13) whether

head of government can dismiss cabinet ministers (ID: v2exdfdshg), 14) whether head of state is also head of government (ID: v2exhoshog), 15) whether the approval of the upper chamber (together with the lower chamber) necessary for the appointment of the chief executive (ID: v2exapup), 16) whether the implicit approval of the upper chamber (together with the lower chamber) necessary for the appointment of the chief executive (ID: v2exapupap).

Tables 3.1.3 and 3.1.4 present the regression results and none of the results are statistically significant apart from an indicator measuring whether head of state is also head of government. This indicates that after disaster democracies do not experience changes in constitutional guarantees for elections to key public offices with the exception that some seem to have switched to presidentialism.

Table 3.1.3. Natural disasters and democracy aspects related to guarantees for elections to key public offices.

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
	Legislature bicameral	Lower chamber elected	Upper chamber elected	Percentage of indirectly elected legislators lower chamber	Percentage of indirectly elected legislators upper chamber	HOS appointment in practice	HOG appointment in practice	HOS selection by legislature in practice
Disaster frequency (ln)	0.013	0.221	1.164	0.091	-0.341	0.087	-0.018	-0.002
	(0.018)	(0.417)	(0.778)	(0.277)	(0.386)	(0.062)	(0.034)	(0.005)
GDP per capita (ln)	0.075	0.760	-4.431	0.439	6.415	-0.002	-0.020	0.009
	(0.078)	(2.116)	(6.816)	(1.761)	(5.332)	(0.274)	(0.183)	(0.017)
Trade (ln)	-0.014	-1.810	7.831†	3.143	-2.658	0.077	0.035	-0.019
	(0.043)	(2.245)	(4.683)	(2.271)	(3.942)	(0.150)	(0.094)	(0.024)
Population (ln)	0.574***	1.489	6.343	4.032	-0.683	1.543**	-0.099	-0.053
	(0.128)	(5.122)	(5.726)	(3.459)	(5.955)	(0.474)	(0.252)	(0.052)
Urban population	0.001	-0.015	0.010	-0.121	-0.092	-0.013	0.009	-0.000
	(0.005)	(0.121)	(0.128)	(0.080)	(0.151)	(0.015)	(0.013)	(0.001)
Constant	-7.987***	71.940	-55.360	-70.593	9.006	-18.464*	6.510	0.880
	(2.154)	(89.240)	(114.220)	(64.907)	(99.421)	(8.096)	(4.636)	(0.796)
Observations	7,043	6,503	2,612	6,503	2,612	7,044	4,215	2,367
R-squared	0.132	0.035	0.076	0.043	0.046	0.147	0.046	0.041
Number of countries	170	170	98	170	98	170	135	105
Country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Fixed effects OLS regression of political competition and contestation on the ln of number of disasters per year. Zero occurrences are included in the count. Control variables include natural logarithms of the gross domestic product per capita, amount of trade, population size, and a measure of urban population as a percentage of total population.

Table 3.1.4. Natural disasters and democracy aspects related to guarantees for elections to key public offices (cont.)

	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16
	HOG selection by legislature in practice	HOS appoints cabinet in practice	HOG appoints cabinet in practice	HOS dismisses ministers in practice	HOG dismisses ministers in practice	HOS = HOG	Chief executive appointment by upper chamber	Chief executive appointment by upper chamber implicit approval
Disaster frequency (ln)	-0.010	-0.015	-0.022	-0.025	-0.016	0.024*	-0.006	0.000
	(0.012)	(0.020)	(0.015)	(0.018)	(0.013)	(0.010)	(0.008)	(0.000)
GDP per capita (ln)	-0.078†	-0.056	-0.056	0.055	-0.007	0.076	0.246	0.000
	(0.041)	(0.111)	(0.080)	(0.096)	(0.056)	(0.051)	(0.161)	(0.000)
Trade (ln)	0.140**	-0.144**	0.033	-0.091†	0.007	0.018	0.049	0.000
	(0.042)	(0.051)	(0.086)	(0.048)	(0.047)	(0.022)	(0.057)	(0.000)
Population (ln)	-0.038	0.203	-0.067	0.399	-0.174†	-0.145	-0.419	0.000
	(0.076)	(0.218)	(0.173)	(0.252)	(0.094)	(0.096)	(0.284)	(0.000)
Urban population	0.005	-0.003	0.006	-0.003	0.006	-0.003	0.002	0.000
	(0.003)	(0.007)	(0.005)	(0.006)	(0.003)	(0.003)	(0.003)	(0.000)
Constant	0.946	-1.522	1.261	-5.908	2.902†	2.049	4.416	0.063
	(1.268)	(3.586)	(2.797)	(4.169)	(1.552)	(1.525)	(3.380)	(0.000)
Observations	3,422	7,044	4,215	7,044	4,215	7,044	979	979
R-squared	0.142	0.052	0.053	0.058	0.049	0.058	0.393	
Number of countries	115	170	135	170	135	170	40	40
Country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Fixed effects OLS regression of political competition and contestation on the ln of number of disasters per year. Zero occurrences are included in the count. Control variables include natural logarithms of the gross domestic product per capita, amount of trade, population size, and a measure of urban population as a percentage of total population.

3.2. Natural disasters and freedom of association

3.2.1. Political competition

In addition to the aggregated index capturing the freedom of association (ID: v2x_frassoc_thick; 0-1) in the main analysis, we perform a set of regressions for each of the indicators included in the index: 1) the extent to which political parties are banned (ID: v2psparban), 2) the extent of barriers for forming a political party (ID: v2psbars), 3) the extent to which oppositional parties are autonomous and independent from the ruling regime (ID: v2psoppaut), and 4) a measure of multiparty elections (ID: v2elmulpar). We also investigate the effect of disasters on additional three measures capturing aspects of competition: 5) the extent to which the major parties have support across all regions of a country (ID: v2pscomprg), 6) the extent to which the national government is controlled by a coalition or a single party (ID: v2psnatpar), and 7) the extent to which a single-party dominates sub-national policy-making (ID: v2pssunpar). Table 3.2.1.1 presents correlation between these indicators.

Table 3.2.1.1. Correlation between indicators related to political competition

	v2psparban	v2psbars	v2psoppaut	v2elmulpar	v2pscomprg	v2psnatpar	v2pssunpar
v2psparban	1.00						
v2psbars	0.82	1.00					
v2psoppaut	0.80	0.90	1.00				
v2elmulpar	0.79	0.85	0.85	1.00			
v2pscomprg	0.13	0.25	0.28	0.24	1.00		
v2psnatpar	-0.11	-0.24	-0.23	-0.23	-0.23	1.00	
v2pssunpar	0.53	0.68	0.70	0.65	0.28	-0.45	1

Table 3.2.1.2 presents the results for the relationship between natural disaster frequency and political competition. The results show that higher disaster frequency is associated with a lower extent of party bans, lower barriers to forming new parties, more autonomy and independence of oppositional parties from the ruling regime, and lower control over subnational politics by a single party. There is, however, no evidence in support of associations between the disaster frequency and changes in party competitiveness across regions, party control of national government, and whether the parties are actually allowed to compete in the national elections.

Table 3.2.1.2. The relationship between disaster frequency and political competition

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
	Party ban	Barriers to parties	Opposition parties autonomy	Elections multiparty	Party competition across regions	National party control	Subnational party control
Disaster frequency (ln)	0.091**	0.073*	0.083*	0.031	0.025	0.002	0.112**
	(0.032)	(0.035)	(0.035)	(0.036)	(0.026)	(0.036)	(0.036)
GDP per capita (ln)	-0.705***	-0.335*	-0.381*	-0.540***	-0.042	0.384*	-0.395*
	(0.160)	(0.158)	(0.181)	(0.138)	(0.136)	(0.157)	(0.193)
Trade (ln)	0.185†	0.178†	0.200*	0.163*	0.053	0.105	0.142
	(0.098)	(0.094)	(0.096)	(0.063)	(0.059)	(0.152)	(0.094)
Population (ln)	0.684†	0.664*	0.605	0.300	0.441*	0.488	0.056
	(0.373)	(0.321)	(0.366)	(0.289)	(0.220)	(0.405)	(0.343)
Urban population	0.017†	0.010	0.023*	0.026**	-0.006	0.002	0.018
	(0.010)	(0.010)	(0.011)	(0.009)	(0.007)	(0.011)	(0.011)
Constant	-6.382	-8.524	-7.631	-2.268	-5.941†	-10.580	0.676
	(6.062)	(5.258)	(5.979)	(4.736)	(3.537)	(6.745)	(5.433)
Observations	7,044	7,044	6,911	1,928	7,029	7,006	7,044
R-squared	0.392	0.345	0.339	0.398	0.077	0.045	0.270
Number of countries	170	170	168	165	170	170	170
Country fixed effects	0.091**	0.073*	0.083*	0.031	0.025	0.002	0.112**
Year fixed effects	yes	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Fixed effects OLS regression of political competition and contestation on the ln of number of disasters per year. Zero occurrences are included in the count. Control variables include natural logarithms of the gross domestic product per capita, amount of trade, population size, and a measure of urban population as a percentage of total population. All dependent variables vary on the scale from -5 to 5, where higher values mean "better" (more democratic) outcomes.

3.2.2. Natural disasters and civil society participation

In addition to the aggregated index of civil society participation (ID: v2x_cspart; 0-1) in the main analysis, we also perform a set of regressions for the index components: 1) the extent to which policymakers are consulting important civil society organizations (ID: v2cscnsult), 2) whether participation in civil society is voluntary, widespread and not state-sponsored (ID: v2csprtcpt), 3) an indicator of how centralized candidate selection is (ID: v2pscnslnl) and 4) if women are impeded from participating in civil society organizations (ID: v2csgender). We also, use additional three measures capturing: 5) the extent to which the government controls the entry and exit of civil society organizations (ID: v2cseeorgs), 6) the extent to which the government actively represses civil society organizations through violent, legal or material means (ID: v2csreprss), 7) the existence of anti-system movements among civil society organizations (ID: v2csantimv). Table 3.2.2.1 presents correlation between the indicators and Table 3.2.2.2 presents the results.

Table 3.2.2.1. Correlation between indicators related to civil society participation.

	v2cscnsult	v2csprtcpt	v2pscnslnl	v2csgender	v2cseeorgs	v2csreprss	v2csantimv
v2cscnsult	1.00						
v2csprtcpt	0.73	1.00					
v2pscnslnl	0.49	0.49	1.00				
v2csgender	0.59	0.51	0.40	1.00			
v2cseeorgs	0.75	0.74	0.46	0.61	1.00		
v2csreprss	0.79	0.71	0.47	0.65	0.87	1.00	
v2csantimv	-0.38	-0.24	-0.34	-0.40	-0.36	-0.47	1

Table 3.2.2.2. The relationship between the number of disasters and the civil society participation

	Model 1 CSO consultation	**Model 2** CSO participatory environment	**Model 3** Candidate selection-national/local	**Model 4** CSO women's participation	**Model 5** CSO entry and exit	**Model 6** CSO repression	**Model 7** CSO anti-system movements
Disaster frequency (ln)	0.126***	0.103***	0.025	0.052*	0.116***	0.130***	-0.009
	(0.028)	(0.029)	(0.022)	(0.025)	(0.031)	(0.032)	(0.039)
GDP per capita (ln)	0.052	-0.192	-0.195†	-0.155	-0.380*	-0.264†	-0.227
	(0.126)	(0.165)	(0.115)	(0.100)	(0.151)	(0.143)	(0.185)
Trade (ln)	0.227**	0.116	0.056	0.078	0.228*	0.282**	-0.066
	(0.084)	(0.099)	(0.050)	(0.052)	(0.101)	(0.086)	(0.101)
Population (ln)	0.247	0.156	0.412†	0.248	0.143	-0.055	0.583†
	(0.283)	(0.312)	(0.246)	(0.166)	(0.307)	(0.326)	(0.310)
Urban population	0.009	0.010	0.010	0.003	0.013	0.009	-0.016
	(0.009)	(0.011)	(0.008)	(0.005)	(0.010)	(0.010)	(0.012)
Constant	-5.486	-1.796	-5.520	-2.789	-0.716	1.526	-7.108
	(4.631)	(5.033)	(3.915)	(2.684)	(4.825)	(5.300)	(5.156)
Observations	7,044	7,044	7,044	7,044	7,044	7,044	7,044
R-squared	0.304	0.336	0.358	0.480	0.385	0.310	0.065
Number of countries	170	170	170	170	170	170	170
Country fixed effects	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Fixed effects OLS regression of civil society participation on the ln of number of disasters per year. Zero occurrences are included in the count. Control variables include natural logarithms of the gross domestic product per capita, amount of trade, population size, and a measure of urban population as a percentage of total population. All dependent variables vary on the scale from -5 to 5, which higher scores referring to 'better' outcomes.

In terms of civil society participation, the general pattern in the above analysis shows positive relationship between disaster frequency and aspects of civil society participation, with variation in magnitude. Hence, all other factors included in the model equal, an increase in the frequency of natural disasters is associated with an increase in most aspects of civil society participation. More specifically, we find evidence that a higher disaster frequency is associated with lower government control over the entry and exit of CSOs, lower government repression of CSOs, higher consultation of CSOs, and better participatory environment for CSOs, with the largest association between higher disaster frequency and lower government repression of CSOs. That is, for all outcomes except the strength of anti-system movements and whether CSOs have a say in the selection of candidates for elections, a higher disaster frequency seems to be associated with a change towards a stronger civil society.

3.3. Natural disasters and freedom of expression

Apart from the aggregated index of freedom of expression (ID: v2x_freexp; 0-1) in the main analysis, we estimate the effect of disasters on the components of the index: 1) the extent to which governments try to censor print and broadcast media (ID: v2mecenefm), 2) the extent to which legitimate journalistic investigations are responded to with harassments from the government or other actors with power (ID: v2meharjrn), 3) media self-censorship (ID: v2meslfcen), 4) freedom of discussion for men (ID: v2cldiscm) and women (ID: v2cldiscw), 5) Freedom of academic and cultural expression (ID: v2clacfree). Table 3.3.1 presents correlation between the indicators.

Table 3.3.1. Correlation between indicators included in the freedom of expression index

	v2mecenefm	v2meharjrn	v2meslfcen	v2cldiscm	v2cldiscw	v2clacfree
v2mecenefm	1.00					
v2meharjrn	0.85	1.00				
v2meslfcen	0.85	0.84	1.00			
v2cldiscm	0.85	0.84	0.82	1.00		
v2cldiscw	0.86	0.84	0.82	0.95	1.00	
v2clacfree	0.86	0.82	0.82	0.88	0.87	1.00

We also perform analysis for indicators capturing the availability of alternative sources of information. In addition to the aggregated index of the extent of how accessible alternative information is (ID: v2xme_altinf; 0-1) in the main analysis, we also perform a set of separate regressions for the index components: 1) the extent to which the media criticizes the government (ID: v2mecrit), 2) the plurality of political perspectives covered in media (ID: v2merange), and 3) the extent to which the media is biased against oppositional actors (ID: v2mebias). We also use additional three measures related to freedom of media capturing, 4) the extent to which governments try to censor content on the internet (ID: v2mecenefi), 5) the extent to which the media self-censors politically sensitive content (ID: v2meslfcen), 6) the extent to which the media accepts bribes to manipulate news information (ID: v2mecorrpt). Table 3.3.2 presents correlations between the indicators.

Table 3.3.2. Correlation between indicators included in the alternative media index

	v2mecrit	v2merange	v2mebias	v2mecenefi	v2meslfcen	v2mecorrpt
v2mecrit	1.00					
v2merange	0.84	1.00				
v2mebias	0.85	0.88	1.00			
v2mecenefi	0.69	0.70	0.72	1.00		
v2meslfcen	0.85	0.80	0.84	0.71	1.00	
v2mecorrpt	0.75	0.68	0.72	0.63	0.74	1.00

Table 3.3.3. The relationship between the number of disasters and freedom of expression

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
	Government censorship of media	Harassment of journalists	Media self-censorship	Freedom of discussion for men	Freedom of discussion for women	Freedom of academic and cultural expression
Disaster frequency (ln)	0.146***	0.098***	0.118***	0.149***	0.135***	0.148***
	(0.029)	(0.029)	(0.031)	(0.032)	(0.029)	(0.034)
GDP per capita (ln)	-0.137	-0.314*	-0.308*	-0.297†	-0.381**	-0.165
	(0.159)	(0.122)	(0.147)	(0.157)	(0.138)	(0.150)
Trade (ln)	0.165†	0.115	0.140	0.259**	0.215*	0.287**
	(0.087)	(0.079)	(0.094)	(0.088)	(0.083)	(0.096)
Population (ln)	-0.136	0.179	0.114	-0.108	-0.334	-0.431
	(0.295)	(0.279)	(0.283)	(0.303)	(0.292)	(0.297)
Urban population	0.014	0.013	0.011	0.023*	0.024**	0.015
	(0.010)	(0.009)	(0.010)	(0.010)	(0.009)	(0.009)
Constant	1.952	-1.226	-0.390	2.163	6.295	6.286
	(4.902)	(4.324)	(4.556)	(4.984)	(4.759)	(4.972)
Observations	7,044	7,044	7,044	7,044	7,044	7,044
R-squared	0.290	0.305	0.310	0.328	0.349	0.307
Number of countries	170	170	170	170	170	170
Country fixed effects	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Fixed effects OLS regression of freedom of expression on the ln of number of disasters per year. Zero occurrences are included in the count. Control variables include natural logarithms of the gross domestic product per capita, amount of trade, population size, and a measure of urban population as a percentage of total population. All dependent variables vary on the scale from -5 to 5.

Table 3.3.4. The relationship between the number of disasters and alternative media

	Model 1 Print/broadcast media critical	**Model 2** Print/broadcast media perspectives	**Model 3** Media bias	**Model 4** Internet censorship effort	**Model 5** Media self-censorship	**Model 6** Media corrupt
Disaster frequency (ln)	0.131***	0.102**	0.142***	0.064**	0.118***	0.110**
	(0.031)	(0.033)	(0.032)	(0.021)	(0.031)	(0.035)
GDP per capita (ln)	-0.306*	-0.461***	-0.466***	-0.370*	-0.308*	-0.226†
	(0.144)	(0.132)	(0.138)	(0.172)	(0.147)	(0.131)
Trade (ln)	0.109	0.118	0.106	0.114*	0.140	0.091
	(0.091)	(0.090)	(0.093)	(0.050)	(0.094)	(0.071)
Population (ln)	0.455	0.534†	0.565†	-0.130	0.114	0.214
	(0.301)	(0.314)	(0.321)	(0.235)	(0.283)	(0.275)
Urban population	0.008	0.006	0.008	-0.005	0.011	0.010
	(0.009)	(0.010)	(0.009)	(0.011)	(0.010)	(0.008)
Constant	-5.279	-5.393	-6.016	5.360	-0.390	-2.350
	(4.999)	(5.054)	(5.257)	(4.538)	(4.556)	(4.534)
Observations	7,044	7,044	7,044	3,952	7,044	7,044
R-squared	0.361	0.401	0.396	0.033	0.310	0.286
Number of countries	170	170	170	166	170	170
Country fixed effects	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Fixed effects OLS regression of alternative media on the ln of number of disasters per year. Zero occurrences are included in the count. Control variables include natural logarithms of the gross domestic product per capita, amount of trade, population size, and a measure of urban population as a percentage of total population. All dependent variables vary on the scale from -5 to 5, with higher scores referring to 'better' outcomes.

Tables 3.3.3 and 3.3.4 present the results for the relationship between natural disaster frequency and freedom of expression/availability of alternative sources of information. The coefficients are positive in all models implying that there is an increase in freedom of expression and freedom of media post-disaster in all aspects measured by V-Dem. Our empirical evidence suggests that more disasters per year are associated with less government censorship of news media, less media self-censorship, less harassment of journalists, more freedom of expression for men and women and more academic and cultural expression. In addition, more disaster frequency is associated with more media coverage being critical towards the government, more politically representative media, less bias against government opposition, less internet censorship, less media self-censorship when reporting on politically sensitive issues, and less corruption in media for manipulating news.

Appendix 4. A Note on Long-term Effects of Natural Disasters.

In this paper we are primarily interested in the immediate effect of disasters on democratic institutions. The long-term effect is more difficult to estimate as there are many events that can happen after disasters hit that can be more important for immediate changes in democracy. We nevertheless did the first exploratory steps to test the long-term term effects of disasters by introducing various lags of disaster frequency. In these models, we deleted the occurrences of disasters that lasted more than one year, as they would obscure the effects. Figure 4.1. summarizes the results for this analysis. The regressions are the exact replication of models presented in Table 1 in the main analysis, with the only difference that disaster frequency was lagged 1-5 years and disasters that lasted more than one year are excluded from the calculation of disaster frequency.

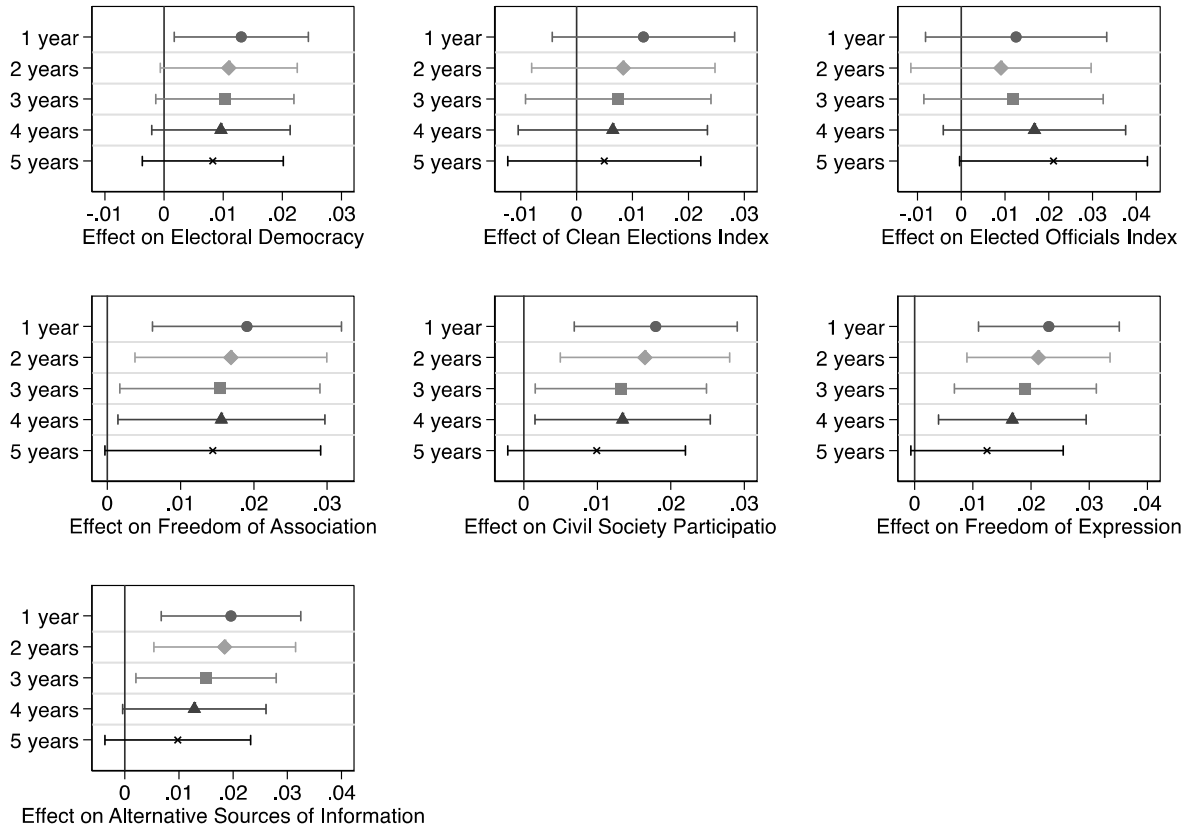


Figure 4.1. The effect of natural disaster frequency lagged 1-5 years on various aspects of democracy with 95% confidence intervals. The regressions control for ln GDP per capita, ln trade, ln population, and urban population. Disasters that lasted more than one year are excluded.

The results show that disasters have the strongest effect on political institutions in their wake and immediately after. As time passes, their effect diminishes a few years after the disaster, and disappears completely after 3-4 years.

Appendix 5. Analysis with Aid as a Control Variable

In this Appendix, we recalculate the analysis with the amount of international aid from the World Developing Indicators (2020) included as a control variable. The results remain robust.

Table 5.1. The relationship between disaster frequency and different aspects of democracy. Zero occurrences included.

	Model 1 Electoral democracy index	**Model 2** Clean elections index	**Model 3** Elected officials index	**Model 4** Freedom of association thick index	**Model 5** Civil society participation index	**Model 6** Freedom of expression index	**Model 7** Alternative sources of information index
Disaster frequency (ln)	0.017**	0.018*	0.023†	0.024**	0.020**	0.025**	0.023**
	(0.005)	(0.008)	(0.013)	(0.007)	(0.006)	(0.008)	(0.008)
GDP per capita (ln)	-0.020	0.012	0.117*	-0.077*	-0.029	-0.075*	-0.098**
	(0.026)	(0.037)	(0.059)	(0.035)	(0.028)	(0.034)	(0.032)
Trade (ln)	0.031*	0.038†	0.031	0.049*	0.030	0.040†	0.028
	(0.014)	(0.020)	(0.028)	(0.020)	(0.019)	(0.021)	(0.021)
Population (ln)	-0.107†	-0.183*	0.272*	0.031	-0.020	-0.071	0.083
	(0.059)	(0.077)	(0.131)	(0.088)	(0.072)	(0.089)	(0.086)
Urban population	0.002	0.003	-0.003	0.002	-0.001	0.003	-0.000
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Aid (ln)	0.016*	0.012	0.039**	0.029**	0.020**	0.027**	0.022*
	(0.006)	(0.009)	(0.014)	(0.009)	(0.007)	(0.009)	(0.009)
Constant	1.543†	2.483*	-4.950*	-0.252	0.420	1.332	-0.652
	(0.928)	(1.227)	(2.161)	(1.411)	(1.135)	(1.397)	(1.385)
Observations	5,208	5,208	5,211	5,211	5,211	5,211	5,211
R-squared	0.444	0.308	0.175	0.482	0.509	0.408	0.502
Number of countries	133	133	133	133	133	133	133
Country fixed effects	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Fixed effects OLS regression of democratic institutions on the ln of number of disasters per year. Zero occurrences are included in the count. Control variables include natural logarithms of the gross domestic product per capita, amount of trade, population size, amount of international aid, and a measure of urban population as a percentage of total population. All dependent variables vary on the scale from 0 to 1

Table 5.2. The relationship between disaster occurrence and different aspects of democracy.

	Model 1 Electoral democracy index	Model 2 Clean elections index	Model 3 Elected officials index	Model 4 Freedom of association thick index	Model 5 Civil society participation index	Model 6 Freedom of expression index	Model 7 Alternative sources of information index
Disaster occurrence	0.008	0.006	0.029*	0.016*	0.014*	0.015*	0.018*
	(0.005)	(0.007)	(0.012)	(0.007)	(0.006)	(0.007)	(0.007)
GDP per capita (ln)	-0.020	0.012	0.119*	-0.076*	-0.028	-0.075*	-0.097**
	(0.026)	(0.037)	(0.059)	(0.035)	(0.028)	(0.034)	(0.032)
Trade (ln)	0.032*	0.038†	0.033	0.050*	0.031†	0.041*	0.029
	(0.014)	(0.019)	(0.028)	(0.020)	(0.018)	(0.020)	(0.020)
Population (ln)	-0.106†	-0.183*	0.276*	0.032	-0.018	-0.070	0.083
	(0.060)	(0.077)	(0.131)	(0.089)	(0.072)	(0.090)	(0.086)
Urban population	0.002	0.003	-0.003	0.002	-0.001	0.003	-0.000
	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Aid (ln)	0.017**	0.012	0.039**	0.029**	0.020**	0.027**	0.022*
	(0.006)	(0.009)	(0.014)	(0.009)	(0.007)	(0.009)	(0.009)
Constant	1.536	2.479*	-5.018*	-0.274	0.389	1.306	-0.673
	(0.936)	(1.230)	(2.158)	(1.424)	(1.146)	(1.412)	(1.393)
Observations	5,212	5,212	5,215	5,215	5,215	5,215	5,215
R-squared	0.442	0.307	0.175	0.480	0.508	0.405	0.500
Number of countries	133	133	133	133	133	133	133
Country fixed effects	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. OLS regression of democratic institutions on the disaster occurrence (disaster dummy). Control variables include natural logarithms of the gross domestic product per capita, amount of trade, population size, amount of international aid, and a measure of urban population as a percentage of total population. All dependent variables vary on the scale from 0 to 1.

Table 5.3. The relationship between disaster frequency and different aspects of democracy. Zero occurrences not included.

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
	Electoral democracy index	Clean elections index	Elected officials index	Freedom of association thick index	Civil society participation index	Freedom of expression index	Alternative sources of information index
Disaster frequency (ln)	0.013*	0.013	-0.007	0.019**	0.018*	0.025**	0.023**
	(0.007)	(0.009)	(0.014)	(0.007)	(0.007)	(0.009)	(0.008)
GDP per capita (ln)	-0.031	-0.030	0.117†	-0.065	0.009	-0.066	-0.066
	(0.037)	(0.050)	(0.066)	(0.044)	(0.033)	(0.046)	(0.042)
Trade (ln)	0.003	0.004	-0.013	0.022	0.013	0.009	-0.007
	(0.025)	(0.032)	(0.045)	(0.034)	(0.035)	(0.037)	(0.035)
Population (ln)	-0.045	-0.165†	0.455**	0.146	0.027	0.044	0.188†
	(0.078)	(0.097)	(0.158)	(0.099)	(0.083)	(0.106)	(0.101)
Urban population	0.003	0.005	-0.002	0.002	-0.002	0.003	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Aid (ln)	0.021*	0.021†	0.071***	0.033**	0.012	0.024*	0.011
	(0.009)	(0.012)	(0.017)	(0.012)	(0.009)	(0.012)	(0.011)
Constant	0.724	2.528	-8.314**	-2.116	-0.374	-0.351	-2.153
	(1.305)	(1.640)	(2.578)	(1.662)	(1.359)	(1.739)	(1.668)
Observations	2,948	2,948	2,950	2,950	2,950	2,950	2,950
R-squared	0.436	0.343	0.210	0.476	0.475	0.382	0.453
Number of countries	128	128	128	128	128	128	128
Country fixed effects	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Fixed effects OLS regression of democratic institutions on the ln of number of disasters per year among countries that are hit by disasters. Zero occurrences are NOT included in the count. Control variables include natural logarithms of the gross domestic product per capita, amount of trade, population size, amount of international aid, and a measure of urban population as a percentage of total population. All dependent variables vary on the scale from 0 to 1.

Table 5.4. The relationship between the declarations of the state of emergency and different aspects of democracy.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
	Electoral democracy index	Clean elections index	Elected officials index	Freedom of association thick index	Civil society participation index	Freedom of expression index	Alternative sources of information index
State of emergency due to a natural disaster	0.204**	0.242*	0.168	0.153*	0.099	0.225**	0.172*
	(0.077)	(0.107)	(0.163)	(0.073)	(0.078)	(0.079)	(0.082)
GDP per capita (ln)	-0.019	0.013	0.117*	-0.077*	-0.029	-0.075*	-0.098**
	(0.025)	(0.037)	(0.059)	(0.035)	(0.028)	(0.034)	(0.032)
Trade (ln)	0.031*	0.037†	0.032	0.049*	0.030	0.040†	0.028
	(0.014)	(0.019)	(0.028)	(0.020)	(0.018)	(0.020)	(0.020)
Population (ln)	-0.102†	-0.178*	0.279*	0.035	-0.016	-0.065	0.087
	(0.060)	(0.078)	(0.132)	(0.089)	(0.073)	(0.090)	(0.087)
Urban population	0.002	0.003	-0.003	0.002	-0.001	0.003	-0.000
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Aid (ln)	0.017**	0.012	0.040**	0.029**	0.021**	0.027**	0.022*
	(0.006)	(0.009)	(0.014)	(0.009)	(0.007)	(0.009)	(0.009)
Constant	1.462	2.388†	-5.056*	-0.319	0.363	1.230	-0.724
	(0.940)	(1.235)	(2.169)	(1.430)	(1.150)	(1.420)	(1.400)
Observations	5,212	5,212	5,215	5,215	5,215	5,215	5,215
R-squared	0.446	0.311	0.175	0.481	0.508	0.408	0.501
Number of countries	133	133	133	133	133	133	133
Country fixed effects	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, † p<0.1. Fixed effects OLS regression of democratic institutions on the declarations of the state of emergency due to natural disasters. Zero declarations of state of emergency are included in the count. Control variables include natural logarithms of the gross domestic product per capita, amount of trade, population size, amount of international aid, and a measure of urban population as a percentage of total population. All dependent variables vary on the scale from 0 to 1.