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Individual and community behavioral responses to natural disasters

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Abstract
How do people and communities respond to catastrophes? A natural disaster is a type of external, quasi-random and unexpected catastrophic shock that generates psychological, social and economic implications. Using detailed county level administrative data of charitable contributions, crime and natural hazards in the USA in the recent decade, we empirically identify and quantify the causal effect of natural disasters on prosocial and antisocial behavioral reactions. Our main finding is that while monetary contributions decline in the local affected community in the aftermath of natural disasters, the neighboring and more distant communities react by increasing their charitable giving. Additionally, we find that in the affected community, natural disasters effect crime negatively, dispelling popular conceptions regarding looting, and that while federal assistance crowds out charitable contributions, it does not change the residents reaction to natural disasters.

Keywords Natural hazards · Charitable giving · Crime · Panel data · Natural disasters · Philanthropy · Prosocial behavior · Antisocial behavior · United States

1 Introduction

Between 2004 and 2015, over 10,000 natural disasters of different intensities occurred in the USA and claimed more than 8300 lives, caused more than 46,500 injuries and created property damages estimated at more than 100 billion dollars (in 2015 dollars). Natural

Authors are listed alphabetically.

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disasters, like mass shootings and terror attacks (i.e., extreme stress events), are a type of external, random and unpredictable shock that have a psychological, social and economic impact, generating fear and stress. Natural disasters often occur in a geographically constricted area and claim a physical price that creates an emotional shock and economic instability among individuals who are exposed to the traumatic event.[1] Following natural disasters, many regions face substantial loss of wealth, infrastructure, physical and ecosystem damages that affect local administration, governmental and public institutions, as well as individuals and households. Following disasters, a loss of important attachments and deterioration of social and community resources are common (Bonanno et al. 2010). Cutter (2016) emphasized the importance of social capital and the dynamics within communities in enhancing disaster resilience in the USA. The shock and stress created by these events may affect the social behavior within, as well as outside, the affected community (Belasen and Polachek 2009; Berrebi and Yonah 2016; Bonanno et al. 2007; Schlenger et al. 2002; Schuster et al. 2001; Silver et al. 2002; Spencer et al. 2016).

The relatively high rate of casualties and damages associated with natural disasters demands responses beyond that which are typically supplied by the government, which might also be slow to react (Shughart 2006). This gap is partially filled by both individuals and nonprofit organizations dealing with the consequences of these events and their related aspects. For the most part, the aid organizations rely on contributions (such as support for victims, physical and post-trauma rehabilitation and compensation for the loss of income and infrastructure). Behavioral reaction to traumatic events may not be restricted to providing aid to the victims and the affected communities but could potentially have a broader impact on prosocial and antisocial behavior as a whole, including people's attitude toward philanthropy, as we show in the theory and conceptual framework section.

Evidence tends to show that looting and antisocial behaviors are relatively rare phenomena in American disasters (Barsky et al. 2006). Studies repeatedly show that the social effect immediately following a disaster is usually demonstrated by cooperation within the community and social solidarity (Dacy and Kunreuther 1969; De Alessi 1967; Douty 1972). In recent studies, such as Aldrich and Meyer (2015) underline the importance of social support in communities' resilience following a disaster. On the other hand, in the aftermath of a more recent disaster caused by Hurricane Katrina, a number of media reports made references to looting that emerged from New Orleans and the surrounding heavily impacted areas (Barsky et al. 2006). Nevertheless, long-standing assertions in sociological literature on disasters portray widespread looting as a myth, and Tierney et al. (2006) argued that these reports were greatly exaggerated by the media.

The behavioral reaction to disasters is not restricted to the affected region only. The associated media coverage distributes and amplifies its impact far beyond the immediate victims and the surrounding community. The media coverage of disasters was found to have a large impact on donations to relief agencies (Brown and Minty 2008). Gifts of resources to victims of disasters are common, and charity from individuals outside the affected community and within the community are well documented.[2] Moreover, several institutions (e.g., the Red Cross, Salvation Army, etc.) exist specifically for the purpose

[1] A traumatic event is defined by its capacity to evoke terror, fear, helplessness or horror in the face of a threat to life or a serious injury (American Psychiatric Association, 1994. *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC).

[2] In certain cases, the deterioration of wealth and its effect on the affected community is so great as to yield a decrease in charity within the community affected (De Alessi 1967).

of facilitating such charity. Interestingly, no dramatic rise in prices was recorded in disaster zones, as one might have expected due to the scarcity of available resources. On the contrary, the price of essential goods in some cases shortly declined, and shelter and food were offered to the victims for free or below market price (Dacy and Kunreuther 1969; De Alessi 1967). The cooperation and generally selfless acts by victims and others nearby is strikingly evident (Cavallo et al. 2014; Douty 1972; Hirshleifer 1983; Lindell and Prater 2003; Samuels and Puro 1991).

This study aims to identify and quantify the relationship between natural disasters and philanthropic behavior, toward all charitable causes, of households and individuals in the USA. While many studies of natural disasters focused on the physical and psychological effect on the victims and the disruptions of the community life, we focus on the effect of natural disasters on donations in both local and broader distance communities.[3] Using longitudinal data with multiple treatment periods and differing treatment intensities across time and space in a fixed effects approach, we analyze natural disasters by date, geographic location, category, magnitude and other characteristics, along with data about charitable giving to nonprofit organizations following these events.

The goal of this research is to contribute to a growing body of the literature on philanthropy that addresses the willingness of people to make contributions, and to improve our knowledge and understanding of pro- and antisocial behavior following catastrophes and specifically natural disasters. Beyond its academic contribution, the findings and insights of this research will allow us to better advise policy makers, professionals and organizations who deal with recovery of individuals and communities following traumatic events. Previous research either studied a single case such as hurricane Katrina (Chamlee-Wright and Storr, 2010; Shughart, 2006), or focused on the recipient organizations which received contributions (Pena et al., 2014). The analysis herein is, to the best of our knowledge, the first attempt to empirically use spatial and temporal variations to systematically investigate the effects of natural disasters on prosocial and antisocial behavior, and specifically on philanthropy, in multiple comparative settings beyond the immediately affected community, over a relatively long period.

2 Theory and conceptual framework

Traumatic events trigger a wide variety of behavioral responses. While some individuals react by holding back on their financial activity (including charitable giving) following stressful events, others may express more generosity by increasing their giving due to solidarity and empathy with the victims. To explain the potentially feasible range of behavioral outcomes expected following natural disasters, we rely on two classes of theories: the Social Support Model and increased Religiosity, which may predict increases in charitable giving following natural disaster events, and the Stress Theory and the Conservation of Resources model (COR), which may predict a decline in giving.

The Social Support Model aims to explain social and psychological behavior in the immediate post-disaster period (Barrera 1998; Kaniasty 2012). Natural disasters elicit an outpouring of immense mutual help where immediately after the impact, communities of victims, professional supporters and empathetic witnesses rally to rescue, protect and assist

[3] We refer to philanthropic donations as monetary donations to qualified organizations in the USA by individuals who itemize deductions.

each other (Kaniasty 2012). This model suggests that a high level of social support counteracts and mitigates the negative social and psychological effects of potentially traumatic and stressful events. According to both theories, people would potentially increase their charitable giving due to heightened feelings of compassion and empathy toward their fellow men and women.

Increased Religiosity is a two-step mechanism, where religiosity increases charitable contributions, and natural disasters strengthen people's religious convictions. Thus, when a natural disaster strikes, people's increased religiosity is translated, among other things, to more prosocial behavior in general and charitable contributions in particular (Bekkers and Schuyt 2008; Margolis and Sances 2017; Sinding Bentzen 2019).

The Stress Theory describes the cause of psychological stress in the context of a relationship between the individual and the environment, which is perceived as threatening his or her resources and endangering his or her well-being (Lazarus and Folkman 1984). Lazarus and Folkman discuss the "concept of vulnerability" as related to adequacy of resources. Vulnerability is described as a potential threat that is turned into an active threat when one's resources actually are put in jeopardy. According to the COR model (Hobfoll 1989), resources include both material and psychological resources, and a potential or actual loss of these resources results in stress. In such cases, people strive to protect their resources, including holding back on their charitable giving activity.

Economists and social scientists who have studied disasters assert that the classical economic theory fails to explain why prices fail to rise post-disaster in the disaster region, as would be suggested by simple supply and demand analysis.[4] The marginal utility of gifting theory suggests that disasters introduce short-run structural changes in individuals' utility function toward greater charity (De Alessi 1967; Dacy and Kunreuther 1969). In the aftermath of a natural disaster, the wealth and the welfare of some individuals within the affected community decrease. Assuming that individuals derive utility from increasing the welfare of others (warm glow), a gift of a dollar yields more utility to a donor after a disaster than before. According to economic theory, individuals will increase their charity gifts until, at the margin, equilibrium conditions are restored.

These theories provide the basis for the potential mechanisms that generate our observed aggregated behavioral responses of individuals. Our data, culled as an aggregation of individual-level charitable contributions at the county level, is well suited for this research.

Based on the mechanisms and the theories described above, we would expect a complex behavioral reaction by individuals as a response to the stress generated by natural disasters. Theory alone does not provide a definitive behavioral prediction. The effect of natural disasters on charitable giving is theoretically ambiguous and should be determined empirically.[5]

[4] The classic economic theory would suggest that shortage in supply of goods would lead to an increase in prices, given demand remains the same.

[5] In this study, our specifications rely on reduced form models. Such models do not allow to pinpoint the exact underlying mechanisms at play, and therefore, several possible mechanisms remain partially or entirely plausible.

3 Related literature

Many studies examine the effects of a particular event or disaster that when combined can be described as a series of case studies. Early sociological studies showed that extreme events enhance social cohesiveness and result in an emergence of strong altruistic norms in the immediate aftermath of natural disasters. They indicated that stress caused immediately following a natural disaster generates consensus regarding life values, solidarity, community and prosocial behavior, while disagreements and conflicts are suspended (Barton 1969; Dynes and Quarantelli 1971; Dynes 1970; Fischer 1998; Quarantelli and Dynes 1985; Tierney 2001). Several scholars described this phenomenon as ''post-disaster utopia", "altruistic community phase" or "post-crisis benevolence" (Erikson 1976; Kaniasty and Norris 2004). These studies and others provide considerable evidence that social bonds are produced or enhanced during disasters and that altruism plays an important role (Barton 1969; Drabek and Key 1986).

On the other hand, recent studies have challenged the prosocial concept and presented conflicting results. Tilcsik and Marquis (2013), in a study examining the effect of mega human-made and natural disasters on philanthropic spending of *Fortune* 1000 firms between 1980 and 2006, linked the effect to the magnitude of the event. A negative effect was found in the case of highly destructive disasters which offset the altruistic mechanism. In the event of a severe natural disaster, significant physical and economic damage is caused which may limit the philanthropic capacity of local firms, who may be more preoccupied with the impact of the disaster on their own operations.[6] Furthermore, major disasters may compromise not only the philanthropic capacity of the firms, but also the overall philanthropic infrastructure of the community and the individuals, as was the case during Hurricane Katrina (Muller and Kräussl 2011; Tilcsik and Marquis 2013). However, charitable giving by individuals differs from corporate philanthropy in many ways. The motivation of a firm to donate is influenced by unique considerations such as the stock exchange market trends, corporate social responsibility policy, reputation, publicity and advertisement, and investor relations. Therefore, these studies may be less relevant to our purpose. Taylor (1976) in his research on the Xenia tornado in 1974 found that both stress and positive reactions were evoked among the exposed population. Erikson (1976) showed that survivors experienced a sense of loss of communality and connection, based on a study of the Buffalo Creek dam break which took place in 1972. Later studies on Hurricane Katrina show conflicting results regarding looting in the impacted areas (Barsky et al. 2006; Tierney et al. 2006). Pena et al. (2014), using linear, dynamic panel data, studied the effect of natural disasters on US nonprofit organizations' net assets and revenue.[7] Although positive effects of disaster events on nonprofit activity were examined, the extent to which this relates to charitable giving by private donors, as opposed to firms and governmental sources (who may increase funding to certain charities) remains a question of interest.

[6] Loayza et al. (2012) argue this notion. They conclude that disasters do affect economic growth, but not always negatively, with effects that differ across types of disasters, economic sectors and developing and developed countries. A meta-analyses study by Lazzaroni and Bergeijk (2014) indicates that disasters have a negative impact in average in terms of direct costs.

[7] Nonprofits' net assets and revenue found to be positively correlated with disaster event damage levels.

Due to the tendency to study single events, the current literature lacks contemporary longitudinal analyses that could be used to study changes in philanthropic behavior associated with natural disasters. Research on other types of traumatic events, such as terror attacks and mass shootings, shows that the psychological effects are not limited to the direct victims and communities. Accordingly, residents near the afflicted communities and even those living far away can be affected (Berrebi and Yonah 2016; Bonanno et al. 2007; Schlenger et al. 2002; Schuster et al. 2001; Silver et al. 2002). Psychological proximity was the main factor associated with stress reactions in the general population (Shultz et al. 2014), and collective traumas following such events have been observed to have public health effects, particularly with respect to stress-related symptoms (Holman et al. 2014). It is therefore valuable to further evaluate the spatial impact of natural disasters in relation to prosocial and particularly philanthropic behavior.

Based on the conceptual framework and the literature review, we address the following questions: What is the relationship between natural disasters and charitable giving? Do we observe different responses based on the type of disaster? Is the relationship between natural disasters and donations dependent on socio-demographic characteristics? Is the formal government (and welfare institutions) response to natural disasters crowding-out private philanthropy? Can natural disasters have an opposing effect based on the proximity to the incident? What is the magnitude, if any, of crime and antisocial behavior sparked by natural disasters?

4 Data

To analyze the relationship between natural disasters and philanthropy in the USA, we constructed a panel dataset consisting of charitable contributions of household and individual tax itemizers, at a county level, for each year from 2004 to 2015, and merged it with economic, demographic and natural disasters data at the county level.

4.1 Philanthropy data

The data about philanthropy in the USA were retrieved from the IRS Statistics of Income (SOI) division.[8] The data are based on the mandatory annual tax returns submitted by US citizens, at the zip code level aggregated to the county level.[9] The data contain, for each county, detailed information including, but not limited to, the adjusted gross income of all individuals and households who itemize deductions,[10] the number of itemized returns reporting contributions, and the amount of charitable contributions made to qualified organizations, as reported to the IRS.[11]

[8] https://www.irs.gov/statistics/soi-tax-stats-individual-income-tax-statistics-zip-code-data-soi.

[9] We followed SOI's recommendations and instructions to aggregate the data to the county level.

[10] In 2015, total charitable contributions by individuals and households were estimated at $264.58 billion, 82% of which was itemized (Giving USA 2016). Any interpretation of our findings should be limited to those individuals who itemize deductions.

[11] Form 1040, Schedule A.

4.2 Natural disasters data

Natural disasters data were obtained from the Storm Events Database of the National Centers for Environmental Information (NOAA).[12] Contrary to its name, this database includes not only storms but all other significant weather events ("…storms and other significant weather phenomena that have sufficient intensity to cause loss of life, injuries, significant property damage and/or disruption of commerce; rare and unusual weather phenomena that generate media attention; other significant meteorological events such as record maximum or minimum temperatures…"). Each observation in this dataset is a natural hazard event, and each listing provides detailed information for every hazard, including date, location, number of individuals killed or injured and property damage caused by the event. We define natural disasters as natural hazards which have caused at least one casualty.

Other county-level variables included in our analysis were chosen based on the theories and mechanisms described above and are the adjusted gross income (***AGI***) of all individuals and households who submitted tax returns (retrieved from the SOI); the number of residents (***Population***), share of residents below the poverty line (% ***Poor***) and ***Unemployment rate*** as reported by the Bureau of Labor Statistics; the share of adults holding a ***BA*** (or equivalent) degree or higher, as reported by the Census Bureau; ***Republican*** is an indicator variable which equals 1 if the majority of the county's residents voted for the republican presidential candidate in the most recent relevant elections.

Table 1 presents a summary of households' charitable contributions, natural disasters' statistics as well as other county characteristics in our sample, over the period 2004 to 2015. County's average annual contributions were a little over 59 million dollars, and the mean adjusted gross income was almost 3 billion dollars.[13]

Table 2 summarizes the nation-wide number of events, victims and property damage caused by natural disasters on an annual basis as well as total charitable contributions, adjusted gross income, the number of itemizing individuals and households and GDP by year.

During the sample period (2004–2015), over 10,000 natural disasters of different intensities occurred in the USA and have claimed more than 8300 lives, caused more than 46,500 injuries and created property damages estimated at more than $100 billion. The deadliest years, in terms of annual fatalities, were 2005 and 2011 (1373 and 1286 fatalities, respectively). In 2005, the mega event hurricane Katrina occurred, while 2011 is characterized by a sequence of disaster events—the 2011 Atlantic hurricane season and the 2011

[12] https://www.ncdc.noaa.gov/stormevents/.

[13] All monetary variables are indexed by the CPI to 2015 dollars.

Table 1 Summary statistics

	Mean	SD	Min	Max
Charitable contributions ($K)	59,313	239,348	0	7,352,734
Natural disasters In	0.29	0.81	0	19
Natural disasters Out	848.37	218.47	239	1327
Adjusted gross income ($*K*)	2,896,603	10,684,665	533	333,116,736
Unemployment rate (%)	6.73	2.87	1.12	28.85
BA or higher (%)	18.89	8.61	3.20	78.80
Poverty rate (%)	15.42	5.97	2.39	57.80
Population (*K*)	98.67	315.38	0.07	10,123.25
Republican county (=1)	0.77			
$N=37{,}137$				

Monetary variables are in 2015 terms. (*K*) denotes variables is in thousands

Super Outbreak. 2005 was the costliest year in terms of financial damage caused by natural disasters—estimated at over 41 billion dollars—with damages in New Orleans (situated in Orleans parish in Louisiana) alone estimated at over 4.3 billion dollars. We observe a large decline in charitable contributions and adjusted gross income in 2008, probably due to the global financial crisis, and these measures bounce back to pre-recession levels only in 2015. Interestingly, following the financial crisis, the number of individuals and households reporting charitable contributions on their tax returns has decreased, and has not yet returned to its original level. Also of note is that the drop in contributions, income and number of donors (itemizers) is much larger in magnitude than the respective drop in GDP, suggesting that charitable contributions is a luxury good (Evans et al. 2017). Between 2007 and 2009, the total charitable contribution amounts dropped by more than 19%, the number of itemizers by more than 8%, while GDP only fell by 3.76%.

Our main variable of interest is the number of natural disasters within each county and its' effect on charitable contributions. Our analysis includes all 3134 counties and county equivalents in the mainland USA. The following maps in Fig. 1 show the spatial distribution of natural disasters and charitable contributions in US counties during our sample period: The relatively high variance across space (as well as over time) contributes to our ability to identify the effect of natural disasters on contributions.

In the next section, we further analyze the relationship between natural disasters and philanthropy using econometric multivariate panel regression models in order to better identify this relationship.

Table 2 Economic indicators and natural disasters in the USA, 2004–2015

Year	Contributions amount ($*K*)	Adjusted gross income ($*K*)	# Itemizers[a]	GDP ($*K*)	Contributions/ GDP (%)	# Natural disasters	Fatalities due to Natural disasters	Financial damage due to natural disasters ($*K*)
2004	189,197,056	8,225,386,060	39,368,580	15,322,246,422	1.23	625	286	4,241,666
2005	200,774,464	8,657,135,202	40,332,224	15,821,992,715	1.27	641	1373	41,857,408
2006	195,738,776	9,075,392,441	40,423,972	16,242,885,712	1.21	824	545	2,895,384
2007	195,824,150	9,514,143,418	39,763,830	16,517,970,165	1.19	936	636	3,752,294
2008	169,862,474	8,725,368,149		16,198,312,683	1.05	1190	757	13,816,229
2009	166,187,395	8,323,259,104	36,452,873	15,958,845,394	1.04	926	460	1,901,578
2010	177,427,872	8,677,556,397	37,456,471	16,292,117,773	1.09	1117	632	4,698,200
2011	167,747,342	8,680,165,716	37,155,683	16,376,223,928	1.02	1327	1286	10,628,571
2012	180,903,063	9,168,133,648	36,569,140	16,719,133,718	1.08	902	653	11,909,612
2013	177,669,048	9,057,736,186	35,786,410	17,075,799,607	1.04	732	545	4,545,856
2014	185,929,062	9,531,494,792	35,371,550	17,542,703,009	1.06	791	507	1,354,234
2015	195,756,309	9,951,872,681	35,852,280	18,219,297,000	1.07	793	623	785,993

All monetary variables in 2015 terms

Data are unavailable in 2008 due to SOI's data policy change at this year

[a]# Itemizer donors is measured by the number of tax returns reporting charitable contributions

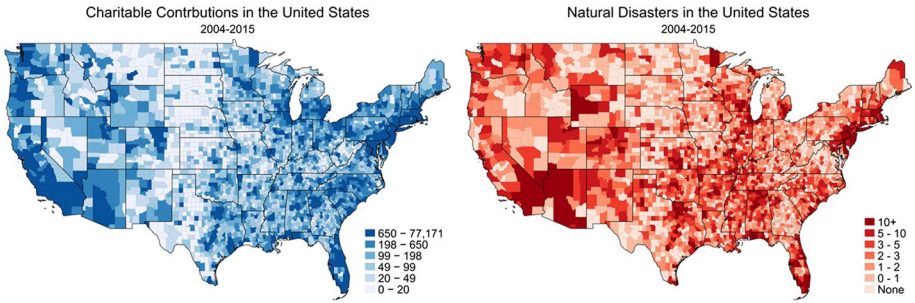

Fig. 1 Natural disasters and charitable contributions in USA counties 2004–2015

5 Empirical strategy

To study the relationship between natural disasters and the scope of giving, we use the spatial and temporal variation in philanthropic contributions and natural disasters within and across US counties in a comparative setting. This approach allows us to statistically investigate the variation in philanthropy in disaster stricken counties (treatment group) in comparison with other non-affected counties (control group) across time, while controlling for other relevant economic, demographic and political variables, and while controlling for the counties' and period's particularities. Our main empirical strategy utilizes lags of explanatory variables in order to ascertain the chronological order of events. Accordingly, philanthropic donations in any given year are explained via natural disaster events in the preceding year (and controlled for with covariates of that preceding year).[14] Formally, our main Panel Fixed Effects model specification is:

$$D_{it+1} = \alpha ND_{it} + \beta \sum ND_{i \neq jt | r \leq 3000} + \gamma X_{it} + \mu_i + \tau_t + \epsilon_{it+1}$$

where D_{it+1} is the scope of giving by all philanthropists in county i in year $t+1$. ND_{it} is the number of natural disasters in county i at year t. $ND_{i \neq jt | r \leq 3000}$ is the number of natural disasters in counties bordering or nearing county i within a radius of up to 3000 km. X_{it} is a vector of socioeconomic, demographic and political control variables that vary across time and space. μ_t is a geographical fixed effect unique to county i, and τ_t is a year fixed effect. Accordingly, our main coefficients of interest are α and β. While α is the coefficient for the direct effect of natural disasters on the locally affected community, the β coefficient allows us to test the effect of natural disasters that occur outside the local community, on charitable giving. Ideally, we would have estimated a model in which β captures the effect of all natural disasters which occur at year t outside county i, yet this is technically impossible as it would be collinear with the time fixed effects. Therefore, limiting the radius and aggregating events to a distance of 3000 km from the affected county solve the collinearity problem while keeping the basic approach that allows us to estimate the effect of natural disasters on philanthropy in counties outside of the victim county.[15] Standard errors

[14] A contemporaneous model was estimated as well, yielding qualitatively similar results, and is available upon request from the authors.

[15] This approach is practical as more than 95% of counties are located at a distance of up to 3000 km from each other.

are clustered at the county level, as this is the level in which treatment of natural disaster events are applied (Abadie et al. 2017).

In order to achieve a valid causal estimate of α and β, natural disasters must be exogenous to charitable contributions. Naturally, as these events are caused by "nature," they are clearly exogenous. However, natural disasters do not occur uniformly across counties their effect might not be uniform as well. County fixed effects allow us to control for time-invariant features such as geographical location and meteorological underpinnings, which makes the remaining within county variation in natural disasters likely exogenous. Additionally, an earthquake might cause much more damage in a low-income county than in a high-income one, as high-income counties are allegedly better equipped with institutions, building quality and emergency services that deal with such occurrences. It could be argued that such factors are independent of natural disasters within the USA, as all counties have similar building regulations and emergency services. County fixed effects and our socioeconomic control variables also allow us to control for such plausible differences and thus identify the causal effect of natural disasters on prosocial behavior. A remaining potential concern for causal identification could arise from the possibility of migration due to natural disasters, which in turn changes the distribution of individuals' characteristics within counties over time. Our analysis, detailed in section 2 of the online appendix, suggests that it is reasonable to dismiss any remaining concern over this issue.

Since our data are aggregated at the county level, it is subject to risk of an ecological fallacy. The mean charitable contribution in a county does not represent the actual distribution of monetary donations by each or some representative individuals or households. However, counties are relatively small units and are homogeneous on several dimensions, such as culture, economic activity, religiosity and political division. Analyzing the relationship between natural disasters and charitable giving at the county level allows us to better analyze factors for which differences are only indicative at the county level. Using our administrative data at hand, it seems impossible to completely eliminate ecological fallacy concerns. We alleviate it by running several robustness checks such as analyzing the relationship between natural disasters and charitable giving based on different variations of the dependent and the explanatory variables. It should also be noted that our main focus in this study is on the average national-level phenomena and not on the effect of natural disasters on any particular group or individual.

Overall, our approach strengthens the validity of our causal identification, which enables us to draw inferences with respect to the effect of natural disasters on pro- and antisocial behavior.

6 Empirical results

6.1 Main specification

Table 3 reports the results for our baseline model in which we estimate the effect of lagged natural disaster events on the scope of charitable giving by US donors. We use our longitudinal data to exploit both spatial and temporal variations, as well as to include year and county fixed effects, to further reinforce evidence of a link between the severity of natural disasters and philanthropy.

The first row of Table 3 shows the coefficient for the effect of natural disasters within the affected county, while the second row presents the coefficient for this effect in all other

Table 3 The effect of natural disasters on charitable contributions

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Contributions amount (K) ($t+1$)							
Natural disasters	−1816.1***	−1790.9***	−1873.9***	−1871.5***	−1960.4***	−1956.4***	−1956.9***	−1959.6***
	(697.5)	(689.7)	(640.0)	(638.1)	(699.8)	(699.8)	(699.7)	(699.6)
Natural disasters out		118.3***	115.8***	109.7***	114.7***	113.7***	113.8***	113.5***
		(24.23)	(23.32)	(22.86)	(24.02)	(23.91)	(24.01)	(23.99)
AGI			0.00572**	0.00566**	0.00465*	0.00466*	0.00467*	0.00466*
			(0.00275)	(0.00275)	(0.00281)	(0.00281)	(0.00282)	(0.00282)
Unemployment rate (%)				−733.6***	−812.3***	−823.8***	−837.6***	−841.7***
				(185.5)	(209.1)	(210.4)	(212.6)	(213.2)
Population					164.1	166.9	166.7	168.4
					(182.6)	(183.1)	(183.2)	(183.8)
BA or higher (%)						−554.7***	−550.9***	−545.1***
						(208.7)	(207.4)	(207.7)
Poverty rate (%)							51.18	55.91
							(91.27)	(90.32)
Republican								1145.3
								(947.0)
Constant	59,701.2***	−41,830.6**	−56,067.0***	−45,617.5**	−62,566.7**	−51,537.7*	−52,382.5*	−53,311.8*
	(205.1)	(20,823.5)	(21,535.7)	(21,581.1)	(29,346.2)	(27,347.8)	(27,919.5)	(28,059.8)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34,036	34,036	34,036	34,036	34,036	34,030	34,030	34,030
R^2 Within	0.00158	0.00875	0.0361	0.0370	0.0412	0.0415	0.0415	0.0416

Standard Errors clustered at the county level in parentheses

*$p<0.1$ **$p<0.05$ ***$p<0.01$

counties in the range of up to 3000 km radius from the affected county. Our preferred specification is presented in column 8 and includes the full set of explanatory variables. The results presented in the table are statistically significant and suggest that natural disasters negatively affect philanthropy within the affected county, while positively affect philanthropic behavior in neighboring and distant counties.[16] Thus, an additional natural disaster event is associated with a mean decrease of 1.96 million USD in charitable contributions in the affected county in the following year. The semi-elasticities of our main explanatory variables in column 8, which estimate the proportional change in charitable contributions for a unit change in *Natural Disasters-In* and *Natural-Disasters-Out* (evaluated at the means) are − .0331 and .0019, respectively, suggesting that an additional natural disaster hitting the county causes a 3.31% reduction in charitable contributions, while a natural disaster hitting outside counties, causes a 0.19% increase in charitable contributions. To put this result into perspective, 1327 natural disaster events occurred in the USA in 2011, an increase of 210 events from the previous year. According to our model, this translates to a reduction of 411.5 million USD in the annual total contributions in all directly affected counties. The average yearly number of natural disaster events between 2004 and 2015 is 900, thus the mean total annual effect of natural disasters on charitable contributions in all directly affected counties is a reduction of approximately 1.7 billion USD.

In order to compute the total effect of natural disasters on charitable giving, recall that the mean county's natural disaster is 0.29 (Table 1), while the mean total disasters in the neighboring and surrounding counties (not including the directly affected counties) is 848.3. Thus, the total effect on a national scale is \$95,713 K ($= -1959.6 \times 0.29 + 113.5 \times 848.3$). Hence, the total effect of natural disasters on charitable giving in all counties translates to an increase of 95.7 million USD in donations on average.[17]

These findings show that the local community reacts differently to natural disasters when compared to the surrounding communities, by reducing charitable contributions. Theory suggests that when one's resources are at jeopardy, she or he will strive to protect and conserve their resources (COR model) which includes financial resources. Empathy tends to diminish and a decrease of prosocial behavior becomes plausible. Researchers often distinguish between humanly caused disasters, technological hazards and natural disasters. It is hypothesized that the perception of an event will shape reactions to it, and the cause of a disaster might influence the degree to which the victims are blamed for their plight (Zagefka et al. 2011). Our data do not differentiate between the potential sources that initiated the natural disasters. Nevertheless, our findings suggest an overall increased-donations effect following disasters that strengthens for more distant communities, and therefore support the notion that individuals are more likely to donate to those perceived as "innocent" victims rather than those victims that can be blamed for their misfortune (Berrebi and Yonah 2020; Campbell et al. 2001; Cheung and Chan 2000).

Considering the other covariates, we see that as expected, income is positively related to charitable giving and the scope of giving increases as counties' Adjusted Gross Income is higher, and counties with higher shares of unemployment are negatively associated with giving. These findings are in line with previous literature about philanthropy (Bekkers and Wiepking 2007). Interestingly, the predicted covariate for the education variable

[16] As our data are aggregated at the county level, one should be careful extrapolating our findings on the individual level.

[17] This is an approximation, as each county is also the neighbor of its neighbors. The spatial econometrics literature shows that our approach is a reasonable approximation (Elhorst 2014).

(***BA or higher (%)***) is found to be negative, suggesting that county's average contribution decreases as the share of higher education in the county increases.[18] We measure educational attainment at the county level by using the share of the population with college degrees or higher. However, since our data are aggregated at the county level, one should be careful when interpreting this finding, as our dependent variable does not represent the scope of giving by an individual, but rather the county's average contribution in a given year.[19]

The political affiliation variable ***"Republican"*** in our main specification model represents counties where the majority of voters voted for a Republican candidate in the most recent presidential election. The political affiliation coefficient is statistically insignificant, suggesting that on average, after controlling for county fixed effects and other covariates, there is no statistically significant relationship between political preferences at the county level and charitable giving.[20]

6.2 Crime

As described in the theoretical section, catastrophic events may evoke solidarity and empathy toward the victims, but also might result in a decline in prosocial behavior. Moreover, the chaos and vulnerability of social structure, institutions and governance might incite an antisocial response. In the wake of natural disasters, reports about looting and other types of crime are often spread through the media and social networks, for example: "It's a burglars paradise," a policeman was quoted in the New York Times after hurricane Sandy (2012). In this section, we investigate the relationship between natural disasters and antisocial behavior. Table 4 presents six different models to test the effect of natural disasters on various types of crimes, thus in each model, we use a different crime indicator as our dependent variable. The information about the number and type of crime is collected and reported by the FBI at the county level in its annual publication—Uniform Crime Reporting Program (UCR). The dependent variable in model 1 includes all types of criminal acts, while models 2 and 3 are restricted to violent and property crimes, respectively.[21] In order to ascertain the chronological order of events, all the explanatory variables are lagged, thus ensuring that natural disasters occur before the criminal acts. However, the effect of natural disasters on crime could be immediate and transitory. In order to test this, models 4–6 repeat the analysis in models 1–3, but with contemporaneous explanatory and dependent variables.

[18] This does not mean that counties with higher share of college graduates contribute less. It is rather more likely that our fixed effect model is not suitable for testing variables with relatively low within county variation. For a detailed discussion, see section 1 of the online appendix.

[19] For example, an ecological fallacy could occur if highly educated individuals increase their donations, but at the same time, counties with a higher share of highly educated people also tend to suffer from more severe economic downturn than those with lower education pulling the average contribution down. If that were the case the decrease in contributions in these counties should not be attributed to the highly educated individuals.

[20] Much like the cautionary note following the education variable discussion. This analysis does not suggest that republican counties contribute the same amount. It is rather more likely that our fixed effect model is not suitable for testing variables with relatively low within county variation. For a detailed discussion, see section 1 of the online appendix.

[21] Violent crimes include murder, rape, robbery and aggravated assault. Property crime includes burglary, larceny and motor vehicle thefts.

Table 4 Natural disasters effect on crime

Dependent variable:	(1) Crime rate ($t+1$)	(2) Violent crime rate ($t+1$)	(3) Property crime rate ($t+1$)	(4) Crime rate (t)	(5) Violent crime rate (t)	(6) Property crime rate (t)
Natural disasters	−0.0985*	0.000314	−0.0989*	−0.0775	0.00107	−0.0786
	(0.0590)	(0.0116)	(0.0515)	(0.0582)	(0.0105)	(0.0517)
Natural disasters out	0.0144***	0.00125***	0.0132***	0.0201***	0.00190***	0.0182***
	(0.00173)	(0.000280)	(0.00160)	(0.00174)	(0.000287)	(0.00161)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	30,953	30,953	30,953	34,075	34,075	34,075
R^2 Within	0.0208	0.0126	0.0196	0.0242	0.0136	0.0229

Standard Errors clustered at the county level in parentheses

*$p<0.1$ **$p<0.05$ ***$p<0.01$

Our results show that crime rate (per 1000 persons) is negatively associated with natural disasters in the victimized county. In all our models, the coefficient of natural disasters in the county are either negative or statistically insignificant, indicating, if anything, a decrease in criminal activity in the aftermath of disasters. These results do not depend on the type of crime analyzed and hold true for crime altogether as well as violent and property crimes separately. A possible explanation for this phenomenon could be that the unrest and disarray brought by natural disasters also impact the tendency to report crimes to the authorities, as both residents and authorities re-prioritize following such events. However, the fact that the estimated coefficients are negative in all models, including those where disasters occurred strictly in the year before reporting and the negative and statistically insignificant coefficient for violent crimes (where reporting is more likely), suggests that these results are unlikely to be driven by an omitted reporting bias. The negative and sometimes null effect we find also support previous studies' claims that looting following natural disasters is uncommon, and reports of its spread are exaggerated by the media (Barsky et al. 2006; Tierney et al. 2006). Interestingly, the coefficients for the effect of natural disasters on crime rates in the neighboring counties is positive in all specifications. These results could be due to spatial spillover of criminal activity from the affected county to the surrounding counties, with criminals reallocating their efforts to surrounding areas which were less affected by natural disasters. As security personnel may be divested away from unaffected counties to affected counties, causing a reduction in crime in directly affected counties, the relative vacuum in the neighboring counties can be exploited by criminals (Berrebi and Ostwald 2013; Enders and Sandler 2003; Lakdawalla and Zanjani 2005). In total, the effect of natural disasters on crime is positive, yet it stems not from the natural disasters directly hitting the county but rather due to the increase in criminal activity outside the county affected by natural disasters. In order to compute the total effect of natural disasters on charitable giving, recall that the mean county's natural disaster is 0.29 (Table 1), while the mean total disasters in the neighboring and surrounding counties (not including the directly affected counties) is 848.3. Thus, the total effect on a national scale is an increase of 12.2 crime cases (per 1000 persons) ($=-0.0985\times0.29+0.0144\times848.3$).

The semi-elasticities of our main explanatory variables in column 1, which estimate the proportional change in crime rate for a unit change in *Natural Disasters-In* and *Natural-Disasters-Out* (evaluated at the means) are $-.0058$ and .0007, suggesting that an additional natural disaster hitting the county causes a 0.58% reduction in crime rate, while a natural disaster hitting outside counties, causes a 0.07% increase in crime rate.

6.3 Counties' characteristics

In Table 5, we test whether communities with different characteristics respond differently to natural disasters. We use several indicators at the county level to proxy for wealth, religious diversity, income inequality and their surrounding's exposure to natural disasters. Counties were divided into two categories: those below the mean level of these indicators, and those above. This allows us to distinguish between the effect of natural disasters on different types of population. In column 1, we test the effect of natural disasters on contributions in wealthy counties, as the share of population with a subprime credit score (<660) is low. The interaction coefficient is positive, statistically significant and slightly larger than the raw coefficient (in row 1), indicating that while the average direct effect of a natural disaster in the victimized counties is negative, wealthier communities respond differently by increasing contributions. Individuals and communities' resources are not limited to

Table 5 Natural disasters and county characteristics—wealth, religious diversity and income inequality

Dependent variable:	(1)	(2)	(3)	(4)
	Contributions amount (K) ($t+1$)			
Natural disasters in	−3688.1***	−3210.0***	−3092.9***	17154.1***
	(1184.0)	(1156.0)	(1051.9)	(4917.2)
Natural disasters out	113.7***	113.0***	112.6***	119.1***
	(23.93)	(24.04)	(23.99)	(24.18)
Credit score < 660 (% of pop) below mean	1999.5			
	(1853.2)			
Natural disasters in × credit score < 660 (% of pop) below mean	3749.9**			
	(1663.9)			
Natural disasters in × income inequality below mean		2901.1**		
		(1182.1)		
Natural disasters in × religious diversity below mean			3126.7***	
			(1073.0)	
Natural disasters in × natural disasters out				−20.84***
				(5.179)
Control variables	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Observations	34,027	33,934	34,030	34,030
R^2 Within	0.0442	0.0426	0.0427	0.0607

Standard errors clustered at the county level in parentheses

*$p<0.1$ **$p<0.05$ ***$p<0.01$

their current income but also capital and wealth. However, wealth is harder to measure, as administrative data on it is rare or private. This different response by relatively wealthier counties might be explained simply by their higher level of available economic resources, making them less vulnerable to the threat of natural disasters on their economic well-being and therefore less likely to be subject to the conservation of resources effect.

In column 2, we investigate the link between income inequality, natural disasters and charitable contributions.[22] Income inequality is defined as the ratio between the mean income of the highest quintile and the lowest quintile. For example, in 2014, the income inequality in New York, NY, was 40.7 (i.e., the average income of the highest quintile was more than 40 times larger than that of the lowest quintile), while in Houston, TX, it was 10.4. The estimated interaction coefficient shows that counties with a relatively low level of income inequality respond differently to natural disasters. Counties with high income inequality decrease their charitable contributions in response to natural disasters much more than counties with low income inequality. This might be due to higher community cohesion, social connections, etc., in low income inequality communities (Wilkinson and Pickett 2009).

In column 3, we use data from the 2010 American Religious Census (Bacon et al. 2018) conducted by the Association of Statisticians of American Religious Bodies (ASARB) to investigate differing responses to natural disasters by religiosity. The census contains information on the number of religious establishments and adherents of over 236 religious bodies—from different Christian denominations to Jewish, Muslim and Eastern religions such as Buddhism, in all US counties in 2010.[23] In column 2, we construct an index of religious diversity of eight religious groups[24] (based on Simpson 1949), which can be interpreted as "the chance that two randomly selected religious adherents belong to different faiths." The estimated coefficient indicates that counties with low religious diversity are less sensitive to the effect of natural disasters and are less likely to decrease their charitable contributions in response. An explanation for this result might be similar to the effect on low income inequality counties: The lower the religious diversity, the higher the social cohesion.[25]

In column 4, we test whether the effect of an additional disaster differs dependent on the level of natural disasters occurring outside the county. In this specification, the coefficient of *Natural Disasters In* becomes positive, *Natural Disasters Out* remains positive and the interaction coefficient is negative. In our sample, there is no combination of *Natural Disasters In* and *Natural Disasters Out* that yields a total negative effect. Moreover, since *Natural Disasters Out* is never 0 (its' minimum value is 239), the marginal effect of a *Natural Disasters In* becomes negative when the number of *Natural Disasters Out* is higher or equal to 824, which is the median value of *Natural Disasters Out* in the model sample,

[22] Column 2 does not include a separate coefficient for income inequality as the data are only available for a limited number of time periods. Consequently, the variation of this variable within counties is very low (SD = 1.25) compared to the variation between counties (SD = 3.16). We therefore chose to use the level of this variable in 2014 as a measure of each county's income inequality. Thus, in our analysis, this variable is time-invariant, and is collinear with the county fixed effects.

[23] There is no coefficient for the religious diversity index as there is no temporal variation at the county level, and the data were collected only for 2010. The variable is thus time-invariant and collinear with the county fixed effects.

[24] The religious groups are: Catholics, Eastern Orthodox Christians, Eastern Religions (Buddhism, Hinduism, etc.), Jews, Mormons, Muslims, Protestants and others.

[25] Due to lack of temporal variation in our religiosity variables, we are unable to test the mechanism that natural disasters affect charitable contributions by their effect on religiosity.

and is positive below that. Thus, for approximately half the counties, the interaction model suggests that the marginal effect of a *Natural Disasters In* remains negative as in our main model specification, and in these cases, an additional disaster, in or out, induces a negative effect on charitable contributions (the negative interaction coefficient). This result can be interpreted as the relative generosity toward outside communities given one's relative misery. In other words, it is only once the situation outside the community becomes so bad relative to their own (with the threshold being the median) that there will be a tendency to reduce within contributions at the expense of outside contributions.

6.4 Governmental aid

There is no consensus among scholars who have studied the relationship between private donations and government funding, with respect to the direction or the magnitude of this relationship. The question of whether an increase in government expenditure increases or decreases individuals' and households' private contributions (i.e., crowding-in and crowding-out, respectively) is important for academic research, as well as for professionals and policy decision making.[26] A meta-analysis study of the crowding-out hypothesis by de Wit and Bekkers (2016), show that two-thirds of previous estimates found a negative correlation (crowding-out), while about one-third of the estimates found a positive correlation (crowding-in). They concluded that the results of these studies were shaped by the research methods that were used.

In the USA, the President has the prerogative to approve a disaster declaration.[27] The presidential disaster declaration will allocate federal aid and funding to local governments, businesses and individuals in the affected area. Cash grants and low-interest loans are provided by the Federal Emergency Management Agency (FEMA) through the Small Business Administration (SBA). County-level data about disaster related loans were retrieved from the SBA website, and it includes, for each county-year, the number of grants (loans) and the principal amount of loans in USD.[28]

It is possible that the negative effect of natural disasters on local philanthropic donations is affected by the crowding-out properties resulting from expectations for public intervention. These expectations are further reinforced following governmental announcements of disaster relief programs and interventions. In this case, theory suggests that the severe economic damages associated with the catastrophic event combined with expectations that relief will be provided through public agencies could undermine tendencies to increase charitable giving. We utilize the variation in natural disasters and federal assistance to empirically separate out these intertwined effects. In Table 6, we investigate the crowding-out effect of SBA grants on charitable contributions.

In columns 1 and 2, we include variables indicating the number of grants received in a county, and the principal amount in USD, respectively. The estimated coefficients are negative and statistically significant, supporting the crowding-out hypothesis. An additional SBA grant reduces donations by 1.09 million USD on average, and an additional 1000

[26] For example, can the private sector replace government support to charities (Khanna and Todd 1998).

[27] Formally, a governor must first request a declaration, and the president may grant or deny it.

[28] https://www.sba.gov/about-sba/sba-performance/open-government/digital-sba/open-data/open-data-sources.

Table 6 Natural disasters and federal assistance

Dependent variable:	(1)	(2)	(3)	(4)
	Contributions amount (K) ($t+1$)			
Natural disasters in	−1785.8***	−1840.1***	−1779.4***	−1758.0***
	(683.5)	(681.4)	(532.8)	(537.3)
Natural disasters out	111.8***	112.7***	111.8***	112.5***
	(23.12)	(23.68)	(23.40)	(23.94)
# SBA Grants	−1098.5**		−1097.3*	
	(530.4)		(566.5)	
Funds from SBA(K)		−1.527**		−1.510**
		(0.708)		(0.740)
Natural disasters in × # SBA grants			−0.516	
			(45.09)	
Natural disasters in × funds from SBA(K)				−0.00967
				(0.0630)
Control variables	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Observations	34,030	34,030	34,030	34,030
R^2 Within	0.0536	0.0564	0.989	0.989

Standard errors clustered at the county level in parentheses

*$p<0.1$ **$p<0.05$ ***$p<0.01$

USD in the principal amount of SBA loans reduces donations by 1500 USD. This holds even when we account for the direct effect of natural disasters on charitable contributions.[29]

In columns 3 and 4, we test whether counties that received SBA grants and loans respond differently to natural disasters by including an interaction term between natural disasters and SBA grants and loans. While the coefficients of the natural disasters, SBA grants and principal amounts remain virtually unchanged from the previous two models, the non-statistically significant interaction coefficients suggest that counties which received federal monetary assistance do not respond differently to natural disasters than counties which did not receive such grants.

6.5 Philanthropy variations

Theory suggests that there might be substitution between different types of philanthropic and prosocial behaviors. Table 7 presents seven different variations for measuring our dependent variable—philanthropy. Column 1 presents our main specification model (similar to column 8 of Table 3) for comparison.

The decrease in donations (as seen in column 1) might be due to smaller amounts contributed by existing donors in the affected county. However, it is possible that catastrophic

[29] When models 1 and 2 are estimated with the number of victims of natural disasters instead of number of events, the federal assistance coefficients remain virtually identical. The results are available upon request.

Table 7 Dependent variable variations

Dependent variable:	(1) Contributions amount (K) ($t+1$)	(2) #Itemizer donors ($t+1$)[a]	(3) Contributions amount per capita ($t+1$)	(4) Contributions amount per donor ($t+1$)	(5) Generosity ($t+1$)	(6) Contributions amount (K) ($t+2$)	(7) Volunteer hours (M) ($t+1$)
Natural disasters	−1959.6***	−188.6*	−3.418***	−19.52**	−0.00318*	−1454.5**	0.606**
	(699.6)	(105.7)	(1.223)	(7.912)	(0.00162)	(739.2)	(0.290)
Natural disasters out	113.5***	8.123***	0.266***	1.216***	0.000336***	68.42***	−0.211***
	(23.99)	(1.202)	(0.0282)	(0.224)	(0.0000515)	(16.66)	(0.0112)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34,030	30,944	34,030	30,740	34,030	30,923	34,047
R^2 Within	0.0416	0.139	0.0285	0.0140	0.00666	0.0568	0.0241

Data are unavailable in 2008 due to SOI's data policy change at this year

Standard Errors clustered at the county level in parentheses

*$p<0.1$ **$p<0.05$ ***$p<0.01$

[a]#Itemizer donors is measured by the number of tax returns reporting charitable contributions

events drive current individuals who previously engaged in philanthropy to exit the giving circles. The SOI data include in addition to the annual total monetary contribution amounts in each county, the number of individuals and households who reported charitable contributions. This is a measure of the number of donor households in each county. The negative and statistically significant coefficient in Column 2 indicates that each additional natural disaster event relates to a decrease in the number of donors on average. In other words, natural disasters not only decrease the scope of giving by current donors, but also decrease the number of individuals and households engaging in philanthropic activity.

In columns 3 and 4, the dependent variables are in a per capita basis. We show that even when data are normalized by the counties' total population and by the donors' population, natural disasters are associated with a statistically significant decrease in charitable giving. The estimated coefficient indicates that a natural disaster is associated with a $3.4 decrease in contributions per capita, and a $19.5 decrease in contributions per donor.[30] For example, an additional natural disaster in Los Angeles, CA, translates to a direct decrease of 34 million USD in charitable contributions in that county.

In column 5, we use the amount contributed and the adjusted gross income to create a new variable of contributions relative to income which we define as "county's generosity." Although our data are not detailed enough to investigate the generosity of individual philanthropists since it lacks crucial information about their wealth, using annual income and charitable giving provide a proxy measurement at the county level. The estimated coefficient is negative and statistically significant, indicating that on average natural disasters relate not only to a decrease in charitable giving, but also to a decrease in contributions as a share of the reported income.

In column 6, we test whether the effect of a disaster lasts beyond one calendar year. The model presented tests whether a more appropriate way to estimate the effect of natural disasters on prosocial behavior would be to use aggregates over longer periods. Accordingly, assuming that the effect could last longer than 1 year, we measured the effect on the scope of accrued donations in the subsequent 2 years. Although the estimated coefficient is slightly smaller than in our main model result, it is still negative and statistically significant indicating that contributions decrease even 2 years after the traumatic event. It is plausible that individuals and communities in the affected area feel vulnerable for a relatively long period, and as the recovery process may take several years, it negatively influences the prosocial behavior in the local community for the long term.

In column 7, we use the amount of volunteering hours reported in each state (by year) retrieved from "Volunteering in America."[31] Since the data are available only at the state level, we allocated to each county the value in its state. The estimated coefficients indicate that natural disasters are associated with a relative increase in the number of volunteers. This result is in line with Freeman's (1997) study, finding evidence for labor supply substitution effect in hours volunteered relative to charitable donations.

Catastrophic events such as natural disasters create a need for a variety of non-professional assistance possibilities. Providing shelter, collecting and delivering food and clothes to the vulnerable communities are a few examples that allow non-skilled individuals the opportunity to provide basic services and elementary goods to a massive

[30] One should be careful interpreting this finding as a relationship between natural disasters and charitable giving on the individual level, since the data are aggregated on the county level and is subject to "ecological Fallacy" risk.

[31] Unlike the monetary data which were retrieved from administrative datasets, volunteering data are based on surveys and questionnaires and therefore may be subject to a survey bias.

population in stress in the aftermath of devastating events. In this case, it is possible that individuals might prefer to contribute time rather than dollars, as they might believe that volunteering their time will be more impactful than monetary donations. Other studies that investigated the trade-off between giving time and money are scarce and yielded mixed results (Bekkers 2001; Freeman 1997; Lee et al. 1999; Reed et al. 2016). A common belief is that volunteering has a significant role in the development of a healthy society. Indeed, in many cases, volunteer activity is crucial, and in the case of natural disasters, the need for both professional and non-professional volunteers is salient.

In this section, we have provided further evidence to our main model results that natural disasters decrease monetary contribution in the affected county by testing the relationship between natural disasters and prosocial behavior over several different variations of the dependent variable. We show that the decrease in prosocial behavior in the aftermath of a natural disaster is not restricted to a decrease in the monetary donations contributed, but the number of individuals who engage in philanthropic activity decreases as well. In addition, we provide an indication of an increase in the time of individuals engaging in volunteering activity following these events.

6.6 Main variable variations

In this section, we use different variations of our main explanatory variable of interest, natural disasters, to test the robustness of our preferred model's results presented in column 8 of Table 3. Table 8 presents five variations in addition to our preferred model. All models include the number of natural disaster events outside the affected county as a control variable. In column 1, we repeat our main model, where natural disasters are measured in terms of the number of events, where at least one fatality or injury occurred as a result of a natural hazard.

In column 2, we test the effect of the number of victims (fatalities and injuries) on charitable contributions. This variation provides a measure for the magnitude of the event. For example, in 2005, in Orleans Parish, Louisiana, hurricane Katrina was a single event that claimed 638 fatalities. The estimated coefficient is statistically significant and negative, suggesting that a one standard deviation increase in victims from natural disasters (20.2), decreases charitable contributions by 1.5 million USD.

In column 3, we test the effect of significant natural disasters on the scope of charitable giving. For this purpose, we define a new independent variable—natural disasters which caused financial damages estimated at more than 1 million USD. Throughout our sample period, 1055 significant disasters occurred. The estimated coefficient is much larger than in our main model, suggesting that the effect of such disasters is stronger than the effect of a typical natural disaster.

In column 4, we focus on meteorological natural disasters, as defined by the Integrated Research on Disaster Risk (IRDR) "Peril Classification and Hazard Glossary."[32] Meteorological disasters are extreme weather and atmospheric conditions including extreme storms, extreme temperature and fog. These events constitute more than two-thirds of all natural disasters and have claimed more than 75% of the total victims during our sample period. As such, these events could potentially be the main driving force behind our main

[32] http://www.irdrinternational.org/2014/03/28/irdr-peril-classification-and-hazard-glossary/.

Table 8 Main variable variations

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
	Contributions amount (K) ($t+1$)					
Natural disasters—events	−1959.6***					
	(699.6)					
Natural disasters—victims		−74.70*				
		(40.27)				
Natural disasters—financial damage Over 1 M $			−3372.7**			
			(1453.1)			
Natural disasters—meteorological				−1345.9**		
				(549.3)		
Natural hazards					−94.33***	
					(31.58)	
SHELDUS natural hazards						−195.7**
						(88.28)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34030	34,030	34,030	34,023	34,030	34,030
R^2 within	0.0416	0.0367	0.0382	0.0402	0.0389	0.0373

Hazards are all extreme climate events registered by the NCDC

SHELDUS is an alternative dataset of natural hazards at the county level

Standard Errors clustered at the county level in parentheses

*$p<0.1$ **$p<0.05$ ***$p<0.01$

model results. The estimated coefficient is negative and statistically significant; however, it is smaller (in absolute terms) than in our main model, indicating that such events are not the sole driving force behind our results, emphasizing the importance of all types of natural disasters.

In column 5, we use natural hazards, as reported in the NOAA "Storm-Events" database. These include extreme weather phenomena which caused no injuries or fatalities in addition to natural disasters (our primary explanatory variable). As expected, the estimated coefficient is negative and statistically significant, yet much smaller in absolute terms than in our main model. Thus, all natural hazards have an effect on charitable contributions, yet natural disasters, which have more impact on human lives and livelihoods have a much stronger effect.

In column 6, we use natural hazards from another widely used dataset—Spatial Hazard Events and Losses Database for the United States (SHELDUS) from Arizona State University.[33] SHELDUS is an annual county-level database of climatological, geophysical, hydrological and meteorological natural hazards and perils in the USA. Using this alternative

[33] Hazards and Vulnerability Research Institute (2016): https://cemhs.asu.edu/sheldus.

data source for natural hazards allows us to verify that our results are not driven by methodological differences in data collection between the NOAA Storm Events database and other potential sources. Indeed, the estimated coefficient for SHELDUS Natural Hazards is negative and statistically significant, thus lending support that our results are not driven by data-collection peculiarities.

6.7 Falsifications tests

The robustness of our results to multiple specifications, definitions and variations of our covariates have been demonstrated in previous sections. However, to relieve further concerns with respect to the validity of our findings, we supplement our analyses with a different approach, whereby showing that our results are not driven by spurious and un-causal correlations in the data. To do so, we conduct several falsification ("placebo") tests. These results strengthen and support our findings. The results and discussion are presented in section 3 of the online appendix.

7 Conclusions

This study uncovered the effect of natural disasters on individuals' and communities' pro- and antisocial behavior by utilizing the exogenous spatial and temporal variation in natural disasters in the USA for over a decade to estimate its' causal effect. Our empirical strategy allows us to investigate both the reaction to natural disasters which impact an area directly, as well as individuals' response to natural disasters which strike at other communities.

Our main finding is that the local affected community reacts differently to natural disasters when compared to the surrounding communities, by reducing charitable contributions. Natural disasters have a negative impact on the affected communities in terms of reduction in the scope of charitable giving and in the number of individuals and households engaging in philanthropic activity following such events, while the surrounding neighboring communities increase their formal giving. These findings lend support to theories which suggest that when one's resources are at jeopardy, she or he will strive to protect and conserve these resources (COR model) in particular financial resources, which translates to a decrease in prosocial behavior. However, when one's resources are not directly threatened, feelings of empathy and solidarity with the victims increase, which translate into an increase in prosocial behavior (Social Support Model). Our results suggest that the overall effect is positive due to the reaction by those whose resources aren't threatened, as they more than offset the strong direct local negative effect. We further show that social cohesion is a determining factor in the vulnerability of communities to natural disasters, as the reduction in prosocial behavior is strongest among counties with a high level of income inequality, low wealth and low religious homogeneity.

Interestingly, we find that natural disasters not only affect prosocial behavior in the victimized counties, but also antisocial behavior. In the wake of natural disasters, media and social networks often report on looting and other types of crime. However, on the contrary, our analysis shows that crime rate is negatively associated with natural disasters in the victimized communities. Though, there seems to be spillover effects, as natural disasters outside the county do increase crime, and the overall effect seems positive. Regardless, this

Fig. 2 The effect of 1σ increase in natural disasters in & out on

result supports previous studies which argued that looting following natural disasters in directly affected counties is uncommon, and reports about its spread are exaggerated by the media.

Figure 2 illustrates some of our findings—we estimate the combined effect of a one standard deviation increase in natural disasters, both within and outside the county, on the county's charitable contributions per capita, number of donors, crime and property crime rates. The total effect is positive and of significant magnitude in all models and ranges between 13.4 and 14.8% increases:

Additionally, we utilize information on federal assistance issued as special loans by the Small Business Administration to test for a crowding-out effect of private contributions by governmental aid, and find that while there is some evidence for crowding-out whereby federal loans are associated with a reduction in private charitable contributions. However, both counties which received federal assistance and those which did not are negatively affected by natural disasters, and the magnitude of said effect on charitable contributions does not differ between them. Two possible explanations to the apparent non-effect of governmental aid emerge. Either the governmental assistance is not high enough to offset the overall negative effect and risk to the individual's resources and expected income, or alternatively the behavioral reduction response in charitable contributions stems mostly from perceived expected threats to resources, so that even a small increase in uncertainty following natural disasters triggers anxiety, which is enough to cause a decrease in charitable contributions.

Future research on the effect of natural disasters would benefit from individual-level data, which, among other things, will alleviate concerns about ecological fallacy. However, current individual-level datasets mostly come from surveys, which are subject to sampling issues and have insufficient sample sizes and geographical dispersion. A potential candidate for such research is thus administrative individual-level data, for example, from tax records. See, for example, Berrebi and Yonah (2016) who use this to achieve both a significant sample size (more than 150,000 individuals and households) and large geographical

dispersion, and are able to include individual-level data instead of relying on geographical aggregates. Additionally, future research might combine data from both donors and recipient institutions, as it is likely that natural disasters not only effect charitable contributions, but also shift the composition of causes donated to, such as more emphasis on relief and rescue.

This study provides insights for policy makers and professionals in the field of disaster recovery. The apparent threat on resources affects the willingness to engage in prosocial behavior in response to natural disasters. Policy measures to increase individuals' confidence might cause a resurgence in contributions in the directly affected communities, while a viable route to increase overall contributions would be to target fundraising among the non-directly affected neighboring communities.

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