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Natural Disasters and Preferences for the Environment: Evidence from the Impressionable Years

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Keywords: beliefs formation; natural disasters; environmental policy; impressionable

JEL Codes: P16; Q54; Z18; D90

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March 24, 2022

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1 Introduction

Natural disasters impose a significant and increasing economic cost on the global economy. According to a report released by the UN Office for Disaster Risk Reduction, disaster-hit countries reported direct economic losses of US 2,908 billions of which climate-related disasters accounted for 77% of the total, spread across both developed and developing nations.[1] As a response, targets for tackling climate change have now been instituted across the world. In 2019, at least 120 of 153 developing countries[2] had undertaken activities to formulate and implement national adaptation plans to achieve the global goal on adaptation under the Paris Agreement.[3]

These targets are unlikely to be met without major changes in societal structures that will necessarily require awareness and engagement of the wider public (Spence, 2010). However, public awareness is hampered by the inherent complexity of the climate change phenomenon, reflected in typically much lower levels of concern about climate change than what is expressed by climate scientists, in part due to the public's lack of personal experience with climate impacts (Weber, 2010, 2011). Despite the key role of preferences for the environment in explaining climate policy, little is known about how these preferences are formed and how and why they change over time.Are individual preferences for the environment exogenous? Or can they shaped by the incidence of natural disasters?

This article helps to close this gap by investigating whether experiencing a natural disaster during youth permanently affects how individuals view the need for public spending in improving and protecting the environment, and for developing alternative energy sources. We do so by leveraging the *impressionable years* hypothesis from social psychology which states that core attitudes, beliefs, and values are formed during a period of great mental plasticity in early adulthood and remain largely unaltered thereafter (Krosnick and Alwin, 1989). In particular, we show that natural disasters experienced during the critical years of adolescence permanently changes one's preferences for the environment and helps form more pro-environmental attitudes.

[1] Wallemacq P, Below R, McLean D. UNISDR and CRED report: economic losses, poverty disasters (1998-2017). Brussels: CRED, 2018. The greatest economic losses experienced by the USA have been mainly caused by storms, followed by floods in China, earthquake and tsunami in Japan, and floods in India.

[2] An increase of 29 countries, compared with 2018.

[3] The Paris Agreement's temperature goal is to limit the increase to 1.5 °C (2.7 °F) of the mean global temperature and, moreover, emissions should reach net-zero in the second half of the 21st century.

Consistent with the theories of social psychology, we provide evidence drawn from two different sources. First, relying on pooled cross-sectional data from the 1972 to 2021 General Social Survey (GSS), we explore regional variation of major natural disasters to identify their impact on the formation of preferences for the environment. Using the information on respondents' location when 16 years old, we overcome the omitted variables problem by relying on time- and location-specific shocks. This specification allows us to control for non-linear time-period, and life-cycle and cohort effects, as well as a host of background variables and other time-varying regional characteristics, including level of wealth and differences in environmental policies. People tend not to change beliefs in response to natural disasters experienced in age ranges other than during the early adulthood. Second, we confirm the findings for the US by extending the analysis to a large set of 102 countries, using microdata from the World Value Survey (WVS).

For all our analysis, we use a variety of self-reported measures of preferences for government intervention. To show that subjective measures are a good approximation of underlying behaviour, we also examine the validity of these self-reported measures by comparing them with objective measures of political behaviour, namely party affiliation and voting behaviour in the most recent election. The similarity of our findings on voting and political behaviour confirms that experiencing a recession when young affects real behaviour.

We contribute to two separate strands of the literature. First, a growing body of knowledge uses mainly experimental and survey data to study the role of personal experience and perception of extreme weather events (Akerlof et al., 2013; Spence et al., 2012) and its relation to environmental concerns and support for pro-environment policy (Joireman et al., 2010; Krosnick et al., 2006; Broomell et al., 2015). In particular, evidence shows that extreme weather events are associated with changes in beliefs about climate change and support for green politicians (Rudman et al., 2013), greater willingness to save energy to mitigate climate change (Spence et al., 2011), and increases in charitable giving (Deryugina and Marx, 2021). These effects are enhanced by the media due to greater awareness of climate change (McDonald et al., 2015). Also, mobilization and environmental activism across American communities seem to matter in terms of attitudes and actual local pollution in the long run (Hungerman and Moorthy, 2020). We add to these findings by showing that environmental preferences are mainly formed during the critical years of adolescence and early adulthood, between the ages of 18 and 25 years, and that experiencing natural disasters

in this period permanently changes one's preferences towards the environment.

Second, a burgeoning literature analyses the role of macroeconomic shocks on preference for redistribution, investing behavior and job preferences, among other attitudes, during the impressionable years (Cotofan et al., 2020; Cronqvist et al., 2015).[4] Closer to our paper is the seminal work of Giuliano and Spilimbergo (2014) who show that individuals who have experienced a recession during their formative years believe later in life that success in life depends more on luck than effort, support more government redistribution, and tend to vote for left-wing parties. We add to this literature by showing that attitudes towards the environment are also determined in the same period in a person's life.

This article is organised as follows. Section 2 describes the GSS dataset and the empirical strategy we use for the main analysis. Section 3 reports cross-country evidence from the WVS and Section 4 concludes.

2 Empirical evidence from GSS

To examine individuals preferences about public spending on protecting and improving the environment, we use data from the General Social Survey, or GSS. Conducted by the National Opinion Research Center at the University of Chicago, the GSS is a long running, roughly biennial survey that is nationally representative and interviews roughly 2500 per year, from 1972 to 2018.

The key variables for our analysis are measures of preferences for the environment, as dependent variable, and a regional measure of environmental shock, as an explanatory variable. As measures for preferences for the environment, we use the answers to two questions from the GSS. More specifically, the GSS asks: "We are faced with many problems in this country, none of which can be solved easily or inexpensively. I'm going to name some of these problems, and for each one I'd like you to tell me whether you think we're spending too much money on it, too little money, or about the right amount. Are we spending too much, too little, or about the right amount on (i) *improving and protecting the environment* , and (ii) *developing alternative energy sources*? Answers to these questions are referred to as *Environment* and *Energy*, respectively.

[4]Other works find that individuals who grew up in periods of political repression and war have, respectively, a greater tendency to hide their opinions (Etchegaray et al., 2019) and higher probability to support a strong national defense force (Farzanegan and Fereidouni, 2019). Also, exposure to epidemics significantly reduces trust in scientists (Eichengreen et al., 2021).

Environment is available from 1973 up to 2018, while *Energy* is available from 2010 to 2018. The motivation in using these variables is that if an individual experience a climatic shocks when young, this may translate into more pro-environmental attitudes and preferences, leading to greater support for higher spending on the environment and in developing alternative energy sources.

One concern when interpreting these questions on environment policy is whether they are an accurate measure of underlying preferences. If self-reported preferences for the environment reflect underlying preferences, then they should correspond to actual political behavior. We examine the validity of self-reported measures by looking at two different measures of political behavior corresponding to the following questions: *voting democrat* (whether the respondent voted for a Democratic presidential candidate in the most recent election) and democrat *party identification*.[5]

As a measure of environmental shock we use data from the Disaster Declarations Summary by Federal Emergency Management Agency (FEMA).[6] It comprises yearly county-level information on disasters that occurred in the U.S. from 1953 onwards. Throughout most of the century, the U.S. experienced approximately 500 county-level disaster events in each year. Since the early 1990s, there has been a clear acceleration in disaster counts, reaching around 1,500 county-level events per year by the 2000s. Natural disasters include drought, flood, hurricane, tornado, and severe rain and snowstorm, which account more than 95% of the all events in the dataset.[7] We then aggregate yearly disasters at the US census division level to match the GSS.[8]

An interesting aspect of the GSS dataset is that it contains information on census division in which the respondent was living when she was 16 years old. We use this information to match individuals with the environmental shock in the region where the person was living during her

[5]The original question reads "Generally speaking, do you usually think of yourself as a Republican, Democrat, Independent, or what?" The answer could take a value from 6 to 0: strong Democrat (6), not very strong Democrat (5), Independent, close to Democrat (4), Independent (3), Independent, close to Republican (2), not very Strong Republican (1), strong Republican (0). We code as 1 if respondent answers 4,5 or 6. We dropped from the analysis people who answered "Other party, refused to say" or "Don't know."

[6]The FEMA Disaster Declarations Summary lists all official FEMA Disaster Declarations, beginning with the first disaster declaration in 1953 and features disasters according to three declaration categories: major disaster, emergency, and fire management assistance.

[7]Our classification of natural disasters follows closely the definition by the International Disasters Database (EM-DAT) which we use in our cross-country analysis below. See section 3 for more information.

[8]The nine US census divisions are: *New England* (Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island), *Middle Atlantic* (New York, New Jersey and Pennsylvania), *East North Central* (Wisconsin, Illinois, Indiana, Michigan and Ohio), *West North Central* (Minnesota, Iowa, Missouri, North Dakota, Nebraska, Kansas), *South Atlantic* (Delaware, Maryland, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida, District of Columbia), *East South Central* (Kentucky, Tennessee, Alabama, Mississippi), *West South Central* (Arkansas, Oklahoma, Louisiana, Texas), *Mountain* (Montana, Idaho, Wyoming, Nevada, Utah, Colorado, Arizona, New Mexico) and *Pacific* (Washington, Oregon, California, Alaska, Hawaii).

youth. This information allows to examine the role of being exposed to a natural disaster in shaping individual attitudes towards the environment, especially during the critical years of adolescence and early adulthood in which the majority of beliefs under consideration are formed.

Appendix Table A.1 shows summary statistics for our sample. Approximately 60% of the individuals think that the government is spending too little in improving and protecting the environment or in developing alternative energy sources. Almost 36% of the sample have had an experience of natural disaster when between 18-25 years old, with middle Atlantic as the region with the low level (26%) while west south central with the highest percentage (43.5%). Appendix Figure A.1 in the Appendix shows the time trend of natural disasters by region. The environmental experiences of individuals living in different regions during their impressionable years varied greatly. Regarding demographics, more than 50% of the sample is married, with a mean age of 46; 55% are women and 13% are blacks. Around 3% of the individuals interviewed are unemployed and, overall, they have nearly 13 years of education.

Empirical Strategy. Our baseline specification models the response outcome Y_{irt} of one of the questions described above by individual i interviewed at time t in region r as the following function:

$$Y_{irt} = \alpha_0 + \alpha_1 ND_{r_{16},t_{imp.y}} + \alpha_2 X_{irt} + \theta_a + \omega_t + \delta_r + \gamma_{r_{16}} + \gamma_{r_{16}} * age + \lambda_{ci} + \varepsilon_{irt} \quad (1)$$

where $ND_{r_{16},t_{imp.y}}$ is the explanatory variable which captures an environmental shocks. More specifically, it is a dummy variable indicating whether the individual experienced a natural disaster during the impressionable years in her region of residence at 16 years, which we use as a reference region for the whole 18–25 range.[9] X_{irt} is a vector of individual characteristics such as gender, years of education completed, marital status (equal to 1 if married), labour market status (equal to 1 if unemployed), race (equal to 1 if back) and family income (in constant \$).[10] In some specifications, we also control for both the level of education of the father and family income at 16 years, the religion in which the person was raised, and the religion at time of interview.

All regressions include age (θ_a) and year dummies (ω_t) to control for age-specific trends at time t, as well as cohort effects[11] λ_{ci} and interactions of region-at-16 dummies with linear age trends

[9] In Table 2 we also look at different age samples to be able to validate the impressionable years theory.
[10] We obtain similar results controlling for family income deciles instead.
[11] In a single cross-section, age, year, and cohort dummies are perfectly collinear and cannot be included all together.

($\gamma_{r_{16}} * age$) to help rule out the possibility that results are driven by region-specific cohort effects. We also include regional dummies for both the region where the individual interviewed was living at the time of the survey (δ_r) and the region where the person was at 16 ($\gamma_{r_{16}}$) as a way to account for for regional ideology, both at birth and later on, and anything specific to a certain region of origin or residence that could be driving differences in beliefs. All models are estimated by OLS with standard errors corrected using the "wild bootstrap" procedure suggested by (Roodman et al., 2019).[12] In sum, our regressions closely follow the two most demanding specifications in Giuliano and Spilimbergo (2013).

Main estimates. We begin by showing out main estimates on the effect of natural shocks on environmental attitudes according to the 18-25 age sample. We coded the dependent variables so that a positive coefficient means a more pro-environment attitude.[13] Columns 1 and 2 of Table 1 report show a coefficient on the variable indicating whether the person experienced a natural disaster during her impressionable years that is both positive and significant at the 1%. To put the magnitude of this results into perspective, a natural disaster increases the likelihood of an individual having pro-environment attitude as much as roughly four extra years of education.

The coefficients on the other variables are consistent with the previous literature. In general, being married has a negative correlation with pro-environmental attitudes as the size of the household has been found to have negative association with pro-environmental behaviors (Clark et al., 2003; Longhi, 2013). Women exhibit higher pro environmental behavior than men (Lynn and Longhi, 2011; Hunter et al., 2004). This is in line with results on gender differences in moral values, as women exhibit altruistic behavior more often (Zelezny et al., 2000; Andreoni and Vesterlund, 2001). Schooling increases pro environmental attitudes as more educated people are likely more aware and more concerned with social welfare (Meyer, 2015; Torgler and Garcia-Valiñas, 2007). Finally, being unemployed has a positive coefficient which could be related to the fact that it represents a drop in individual income and an increase in free time (Meyer, 2016; Binder and Blankenberg, 2017).

In a repeated cross section, few cohorts could not be captured by the age and year dummies. In our specification, we add as many cohort dummies as possible up to the point that age, time, and cohort dummies are not perfectly collinear.

[12] This is due to the small number of clusters given by region at 16. We use the *boottest* stata command, with null imposed and alternative weights at 999 and 9999 number of replications.

[13] More formally, $Y_{irt} = 1$ if we are spending too little on improving and protecting the environment (or on developing alternative energy sources), and $Y_{irt} = 0$ if too much or about the right amount.

In columns 3 and 4, we report the results for spending on developing alternative energy sources. The coefficients are again positive and precisely estimated, with point estimates that are 50% higher but still equivalent to the magnitude of an increase of four years of education. As before, being married and education have negative and positive coefficients, respectively, while estimates associated with gender and race become smaller and largely insignificant.

Restricting the sample to non-movers. So far we have used the region of residence at 16 years to determine the region of residence for the whole "impressionable years" period. One problem with assuming that is that people could have moved during that period, potentially introducing measurement error that could bias our results towards zero. We address this problem by running our regressions on a subsample of *non-movers* - individuals who lived, at the time of interview, in the same region where they lived at 16 years. In Supplementary Table A.2 of the Appendix, we repeat the specifications of Table 1, restricting the sample to non-movers. The results for spending to protect the environment are very similar in terms of magnitude when compared to the results from the whole sample, but they are slightly less precisely estimated. Estimates for spending on alternative energy sources are still positive, but smaller and not significant.

The "impressionable years" versus other age ranges. So far we have focused our analysis on the role of the impressionable years in the formation of beliefs and attitudes towards the environment (Mannheim, 1952; Krosnick and Alwin, 1989). Here we change our perspective to test whether individuals constantly alter their attitudes in response to changing life circumstances by looking at the impact of environmental shocks during other age ranges.

In Table 2 we repeat our baseline specification (Table 1) focusing on other four different age intervals (2–9, 10-17, 26–33, 34–41 and 42–49). We report only coefficients associated with whether the individual experienced a natural disaster in that age sample. Overall, being exposed to a natural shock before the age of 17 years or after the age of 25 years has little or no impact on environmental attitudes. All but one coefficients are insignificant and small in magnitude. The formative period between the ages of 18 and 25 years is the age during which the majority of beliefs under consideration are formed.

Table 1: GSS: baseline specification

Dep. var.	Environment		Energy	
	(1)	(2)	(3)	(4)
Natural disaster	0.037***	0.036***	0.056**	0.059***
	(0.011)	(0.011)	(0.020)	(0.017)
Married	-0.049***	-0.049***	-0.042**	-0.044*
	(0.007)	(0.008)	(0.015)	(0.022)
Black	0.060***	0.090***	-0.046**	-0.035
	(0.013)	(0.019)	(0.018)	(0.020)
Unemployment	0.015	0.025	-0.003	-0.007
	(0.012)	(0.014)	(0.016)	(0.019)
Years of education	0.010***	0.008***	0.019***	0.013***
	(0.001)	(0.001)	(0.002)	(0.002)
Female	0.016**	0.024**	-0.025*	-0.014
	(0.007)	(0.010)	(0.012)	(0.016)
Income	-0.002	-0.002	0.005	0.001
	(0.005)	(0.008)	(0.007)	(0.011)
Father's education		0.001		0.003
		(0.001)		(0.003)
Constant	0.404***	0.263	0.381**	0.555
	(0.118)	(0.144)	(0.140)	(0.856)
Wild cluster bootstrap p-values				
Rademacher (999)	0.0012	0.0010	0.0120	0.0120
Rademacher (9999)	0.0004	0.0059	0.0117	0.0118
Webb (999)	0.0030	0.0060	0.0070	0.0070
Wbbe (9999)	0.0033	0.0042	0.0089	0.0100
Age FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Region of interview FE	yes	yes	yes	yes
Region at 16 FE	yes	yes	yes	yes
(Region at 16)*age	yes	yes	yes	yes
Cohort FE	yes	yes	yes	yes
Religion FE	no	yes	no	yes
Religion at 16 FE	no	yes	no	yes
Income at 16 FE	no	yes	no	yes
R^2	0.078	0.092	0.047	0.059
Obs.	32080	18206	10199	5920

Notes: P-values obtained with wild cluster bootstrap (with null imposed and alternative weights and number of replications). The p-values are estimated using the STATA package *boottest* developed by Roodman et al. (2019). Robust standard errors in parenthesis, clustered at region at 16. * p<0.10, ** p<0.05, *** p<0.01.

How do estimates vary across time? Here we answer two separate questions regarding the role of environmental shocks in forming preferences. First, we split our sample across three separate

Table 2: GSS: other age samples

Dep. var.	Environment		Energy	
	(1)	(2)	(3)	(4)
Panel A: 2-9 age sample				
Natural disaster	0.037*	0.043	-0.022	0.004
	(0.014)	(0.026)	(0.016)	(0.045)
Panel B: 10-17 age sample				
Natural disaster	0.007	0.029	-0.010	-0.006
	(0.014)	(0.026)	(0.030)	(0.046)
Panel C: 26-33 age sample				
Natural disaster	0.007	-0.004	0.000	0.002
	(0.016)	(0.016)	(0.029)	(0.037)
Panel D: 34-41 age sample				
Natural disaster	0.007	0.012	-0.004	0.003
	(0.012)	(0.021)	(0.021)	(0.023)
Panel E: 42-49 age sample				
Natural disaster	-0.001	-0.017	0.014	0.003
	(0.018)	(0.011)	(0.021)	(0.024)
Age FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Region of interview FE	yes	yes	yes	yes
Region at 16 FE	yes	yes	yes	yes
(Region at 16)*age	yes	yes	yes	yes
Cohort FE	yes	yes	yes	yes
Religion FE	no	yes	no	yes
Religion at 16 FE	no	yes	no	yes
Income at 16 FE	no	yes	no	yes
Obs.	32080	18206	10199	5920

Notes: robust standard errors in parenthesis, clustered at region at 16. * p<0.10, ** p<0.05, *** p<0.01.

time periods: 1973-1989, 1990-2009, 2010-2021; and rerun our analysis with our two main dependent variables as reported in Table 3. The estimates in Panels A and B show that the impact of natural shocks on *Environment* is positive across all time periods, but significant only in 1973-1989 and 2010-2021, while data on *Energy* is only available from 2010 onwards.

Panels C and D addresses the concern of whether these questions on environment policy are an accurate measure of underlying preferences. If self-reported preferences for the environment reflect underlying preferences, then they should correspond to actual political behavior. We examine the validity of self-reported measures by looking at two different measures of political behavior corresponding to the following questions: *voting democrat* (whether the respondent voted for a Democratic presidential candidate in the most recent election) and democrat *party identification.*[14]

[14]We define *voting democrat* equal to 1 if the last president voted was democratic and equal to 0 if was republican.

Table 3: Main estimates split by decade

Period	1973-1989		1990-2009		2010-2021	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Environment						
Natural disaster	0.071**	0.074*	0.004	0.050	0.066**	0.078*
	(0.025)	(0.049)	(0.025)	(0.033)	(0.029)	(0.038)
R^2	0.102	0.070	0.077	0.107	0.119	0.126
Obs.	15620	5673	5185	10706	2579	3020
Panel B: Energy						
Natural disaster	-	-	-	-	0.056**	0.059***
					(0.020)	(0.017)
R^2	-	-	-	-	0.059	0.047
Obs.					5920	10199
Panel C: Voting democrat						
Natural disaster	0.059	0.035	-0.021	-0.062*	0.098**	0.073*
	(0.034)	(0.039)	(0.032)	(0.028)	(0.031)	(0.035)
R^2	0.153	0.185	0.142	0.182	0.189	0.240
Obs.	10532	9867	10875	6039	5363	4289
Panel D: Party identification						
Natural disaster	0.022	0.021	-0.027	-0.026	0.074***	0.047**
	(0.055)	(0.055)	(0.037)	(0.040)	(0.017)	(0.020)
R^2	0.108	0.154	0.110	0.168	0.149	0.203
Obs.	13687	12730	14482	7698	6340	5079
Age FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Region of interview FE	yes	yes	yes	yes	yes	yes
Region at 16 FE	yes	yes	yes	yes	yes	yes
(Region at 16)*age	yes	yes	yes	yes	yes	yes
Cohort FE	yes	yes	yes	yes	yes	yes
Religion FE	no	yes	no	yes	no	yes
Religion at 16 FE	no	yes	no	yes	no	yes
Income at 16 FE	no	yes	no	yes	no	yes

Notes: robust standard errors, clustered at region at 16. * p<0.10, ** p<0.05, *** p<0.01.

Our results show natural shocks is positively associated with our political dependent variables in 1973-1989 and 2010-2021, but negative in 1990-2009. The estimates are only significant in the most recent period, perhaps due to the observation that environmental issues have become more central in the agenda of the Democratic party in the recent years.

The variable democrat *party identification* is equal to 1 if the individual is strong democratic or not strong democratic or independent but near democratic and it's equal to 0 if strong republican or not strong republican or independent but near republican, avoiding independent and other party affiliation.

Falsification tests. In order to further stress test our results, we replicate our main analysis using dependent variables that in principle should not be directly affected by natural disasters. In particular, we use the same three questions explored in Giuliano and Spilimbergo (2014) that capture preferences for redistribution. Question 1 asks "Some people think that the government in Washington should do everything to improve the standard of living of all poor Americans (they are at point 5 on this card). Other people think it is not the government's responsibility, and that each person should take care of himself (they are at point 1). Where are you placing yourself in this scale?" This is referred to as "help poor." Question 2 asks "We are faced with many problems in this country, none of which can be solved easily or inexpensively. I am going to name some of these problems, and for each one I would like you to tell me whether you think we are spending too much money on it, too little money or about the right amount." A list of items follows, including "assistance to the poor." We coded the variable so that a higher number indicates too little assistance to the poor. This is named "assistance poor." Question 3 asks "Some people say that people get ahead by their own hard work; others say that lucky breaks or help from other people are more important. Which do you think is most important?" The answer can take a value from 1 to 3: hard work is most important (1), hard work and luck are equally important (2), luck is most important (3). This is referred to as "work-luck." Experiencing a natural disaster has no significant impact on our measures for preferences for redistribution and political views. By contrast, other individual variables have a strong, expected impact on these types of beliefs.

Heterogeneity analysis. So far we have considered that all individuals respond in the same way to natural disasters during their impressionable years, irrespective of their socioeconomic conditions during early adulthood. In Table A.3 we allow for the possibility of heterogeneous effects by re-estimating our baseline specification and splitting our sample between four dimensions, namely gender, education and income levels, and urban/rural.[15]

Overall, we find that the effect of experiencing a natural disaster when young is quite general and persistent. Across our sub-samples, all but one estimate remain positive even though they are unsurprisingly less precisely estimated. Individuals with above median family income (Huddart-

[15]Specifically we construct the variables such as: i) higher educational individuals are those with more than 11 years of education; ii) high income families are those with real income in the third and fourth quartile of the distribution; iii) urbans are individuals living in big cities up to 250000 hab. when 16 years old.

Table 4: GSS: falsification test

Dep. var.	Help poor		Assistance poor		Work-luck	
	(1)	(2)	(3)	(4)	(5)	(6)
Natural disaster	-0.075	-0.061	-0.053	-0.042	0.010	0.010
	(0.046)	(0.043)	(0.035)	(0.028)	(0.039)	(0.040)
Married	-0.034*	-0.048***	-0.040**	-0.056***	-0.043***	-0.044***
	(0.016)	(0.014)	(0.014)	(0.014)	(0.012)	(0.012)
Black	0.575***	0.583***	0.467***	0.476***	0.091***	0.102***
	(0.043)	(0.046)	(0.031)	(0.027)	(0.011)	(0.015)
Female	0.143***	0.150***	0.042***	0.046***	-0.067***	-0.064***
	(0.017)	(0.017)	(0.010)	(0.010)	(0.012)	(0.012)
Unemployment	0.157***	0.148***	0.190***	0.182***	0.105***	0.103***
	(0.044)	(0.042)	(0.040)	(0.039)	(0.024)	(0.024)
Years of education	-0.024**	-0.016*	0.005	0.003	0.009***	0.008**
	(0.008)	(0.008)	(0.004)	(0.004)	(0.003)	(0.003)
Income	-0.160***	-0.164***	-0.113***	-0.123***	-0.022***	-0.025***
	(0.011)	(0.010)	(0.007)	(0.007)	(0.006)	(0.005)
Father's education		-0.013***		0.003**		0.001
		(0.002)		(0.001)		(0.001)
Constant	5.354***	5.231***	3.095***	3.021***	1.526***	1.456***
	(0.276)	(0.251)	(0.346)	(0.346)	(0.276)	(0.285)
Age FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Region of interview FE	yes	yes	yes	yes	yes	yes
Region at 16 FE	yes	yes	yes	yes	yes	yes
(Region at 16)*age	yes	yes	yes	yes	yes	yes
Cohort FE	yes	yes	yes	yes	yes	yes
Religion FE	no	yes	no	yes	no	yes
Religion at 16 FE	no	yes	no	yes	no	yes
Income at 16 FE	no	yes	no	yes	no	yes
midrule R^2	0.103	0.113	0.119	0.127	0.025	0.030
Obs.	15140	15140	18564	18564	19157	19157

Notes: robust standard errors, clustered at region at 16. * p<0.10, ** p<0.05, *** p<0.01.

Kennedy et al., 2009; Gifford and Nilsson, 2014) and 12 or more years of schooling (Meyer, 2015; Torgler and Garcia-Valiñas, 2007) become significantly more pro-environment when they experience a natural disaster in their formative years. Attitudes of women (Lynn and Longhi, 2011; Zelezny et al., 2000; Andreoni and Vesterlund, 2001) and people in rural areas (Huddart-Kennedy et al., 2009; Gifford and Nilsson, 2014) react significantly when the dependent variable is related to spend more to protect the environment, but this effect may reverse if we focus on spending to develop alternative energy sources.

3 Empirical evidence from WVS

In this section we provide cross-country evidence regarding the role of natural disaster in explaining differences in pro environmental attitudes. The analysis relies on data from the WVS, a compilation of national, individual-level surveys on a wide variety of topics, including preferences for the environment, political behaviour, as well as standard demographic characteristics, such as gender, age, education, labour market status, and income. We use data from wave 3 to wave 7, ranging from years 1995–1997, 1999– 2004, 2005–2007, 2010-2014 and 2017-2021, which covers a total of 102 individual countries across all waves As a measure for preference for the environment, the WVS asks: "Here are two statements people sometimes make when discussing the environment and economic growth. Which of them comes closer to your own point of view? A) Protecting the environment should be given priority, even if it causes slower economic growth and some loss of jobs. B) Economic growth and creating jobs should be the top priority, even if the environment suffers to some extent." As our dependent variable, we define an indicator that equals 1 if the individual prioritizes the environment.

In the case of the cross-country analysis, data on natural disasters come from the International disaster database (EM-DAT) which contains essential core data on the occurrence and effects of over 22,000 mass disasters in the world from 1900 to the present day. This dataset is compiled from various sources - including UN agencies, non-governmental organisations, insurance companies, research institutes and press agencies - and has been extensively used in the public health and economics literatures (Kahn, 2005; Eisensee and Strömberg, 2007).[16] For each disaster, EM-DAT provides information on where the disaster occurred, the type of disaster, the beginning and ending dates, and severity (i.e. number of people killed, injured, and rendered homeless, and estimated damages). We use all natural disasters according to the EM-DAT classification system and aggregate them at the country-year level to match the WVS.[17]

In terms of individual controls, we follow closely the specification of the GSS and include in

[16]To be included, a natural disaster must fulfill at least one of the following criteria: i) 10 or more people reported killed, ii) 100 or more people reported affected or iii) declaration of a state of emergency and call for international assistance.

[17]The EM-DAT classification can be found at https://www.emdat.be/classification. Natural disasters include geophysical, meteorological, hydrological, climatological events. Non-natural (or technological) disasters include transportation and industrial accidents, among other miscellaneous.

our regressions gender, employment and marital status, education, income, and religious denomination.[18] We do not include controls for family background (such as family income when young or parental level of education) or race as the WVS does not contain any information on these.

The baseline model is the following:

$$Y_{ict} = \alpha_0 + \alpha_1 ND_{t_{imp.y}} + \alpha_2 X_{ict} + \theta_a + \delta_c + \omega_t + \delta_c * age + \varepsilon_{ict} \tag{2}$$

where Y_{ict} equal to 1 if the individual i is pro-environment, at time t in country c. The variable $ND_{t_{imp.y}}$ is the explanatory variable which identifies whether the individual experienced a natural disaster during the impressionable years. X_{ict} is a vector of individual characteristics described above, θ_a, ω_t, δ_c are age, wave and country FE and $\delta_c * age$ capture country-specific age trends. We drop immigrants from the analysis. Standard errors clustered at the country level.

Results are reported in Table 5. In column (1) we consider all countries, while in column (2) and (3) we split the sample according to the 2000 World Bank country income classification with high and medium-high income countries in column (2) and medium-low and low income countries in column (3).[19] We find a positive and significant effect during the impressionable years only when considering high and middle high countries. For all other age ranges, all but one estimate are small in magnitude and insignificant. This is in line with other works who claim that people tend not to worry as much about future environmental issues when they have more immediate needs, like health care or jobs or scarcity of food, which are more salient in poor countries (Jacobsen, 2013). In fact, a number of studies have studied the relationship between economic development and environmental policy. Kahn and Kotchen (2010) uses data from California to show that a reduction in public support for policies related to climate change is associated with an increase in the unemployment rate. Also, this relates to the Environmental Kuznets Curve hypothesis that points out that developing countries or emerging economies are more likely to prioritize economic growth over environmental protection (Chandler, Secrest, Logan, Schaeffer, Szklo, Schuler, Dadi, Kejun, Yuezhong, Huaqing, Shukla, Tudela, Davidson, Mwakasonda, Spalding-Fecher, Winkler, Mukheibir, and Alpan-Atamer, Chandler et al.; Dasgupta et al., 2002; Shum, 2012) and this is partially based on the idea that developed countries call for more rigorous environmental regulations as they became

[18] Education is coded as low, medium, and upper. Dummies for religion include Roman Catholic, Protestant, Muslim, Orthodox, and Other. The excluded group is given by non-religious individuals. We also include in all our specifications 10 income dummies.

[19] Countries' list in the Appendix.

Table 5: WVS

	All countries	H-MH countries	ML-L countries
	(1)	(2)	(3)
Panel A: 18-25 age sample			
Natural disaster	0.004	0.011**	0.001
	(0.004)	(0.005)	(0.005)
R^2	0.066	0.057	0.078
Obs.	127171	56730	69677
Panel B: 2-9 age sample			
Natural disaster	-0.006	-0.012*	0.001
	(0.004)	(0.006)	(0.005)
R^2	0.066	0.057	0.078
Obs.	127182	56733	69685
Panel C: 10-17 age sample			
Natural disaster	-0.001	0.002	-0.000
	(0.004)	(0.007)	(0.004)
R^2	0.066	0.057	0.078
Obs.	127174	56732	69678
Panel C: 26-33 age sample			
Natural disaster	0.001	-0.006	0.006
	(0.003)	(0.005)	(0.004)
R^2	0.066	0.057	0.078
Obs.	127168	56727	69677
Panel D: 34-41 age sample			
Natural disaster	-0.001	-0.006	0.000
	(0.004)	(0.005)	(0.005)
R^2	0.066	0.057	0.078
Obs.	127171	56727	69680
Panel E: 42-49 age sample			
Natural disaster	0.002	-0.005	0.007
	(0.004)	(0.006)	(0.005)
R^2	0.066	0.057	0.078
Obs.	127179	56727	69688
Religion FE	yes	yes	yes
Income FE	yes	yes	yes
Country*age FE	yes	yes	yes
Country FE	yes	yes	yes
Year FE	yes	yes	yes
Age FE	yes	yes	yes
Cohort FE	yes	yes	yes

Notes: robust standard errors in parenthesis, clustered at country level. * refer to the following cases: * p<0.10, ** p<0.05, *** p<0.01. In column (2) high and middle high income countries while in column (3) middle low and low income countries. In the natural disaster variable we do not include: bacterial disease, chemical spill, famine, oil spill, other, parasitic disease, poisoning, radiation, road and viral disease.

richer (Grossman and Krueger, 1995).

4 Conclusions

In this paper, we study the permanent effect of environmental shocks on the formation of beliefs towards the environment. Using information from the General Social Survey and World Values Survey, we exploit yearly natural disasters variation both within the US and across countries to identify these effects. We find that individuals who experience a natural shock in the period of early adulthood (between 18 and 25) develop more pro-environmental attitudes. People tend not to change beliefs in response to natural disasters experienced in other age ranges.

We contribute to the literature on the determinants of beliefs in three ways. First, we study the importance of natural events in the formation of environmental attitudes. Second, we focus explicitly on the importance of the "impressionable years" in shaping these beliefs. Third, we use time-varying natural disasters to identify the impact of environmental shocks on preferences.

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Online Appendix (not for publication)

Figure A.1: Number of natural disasters per year and by regions

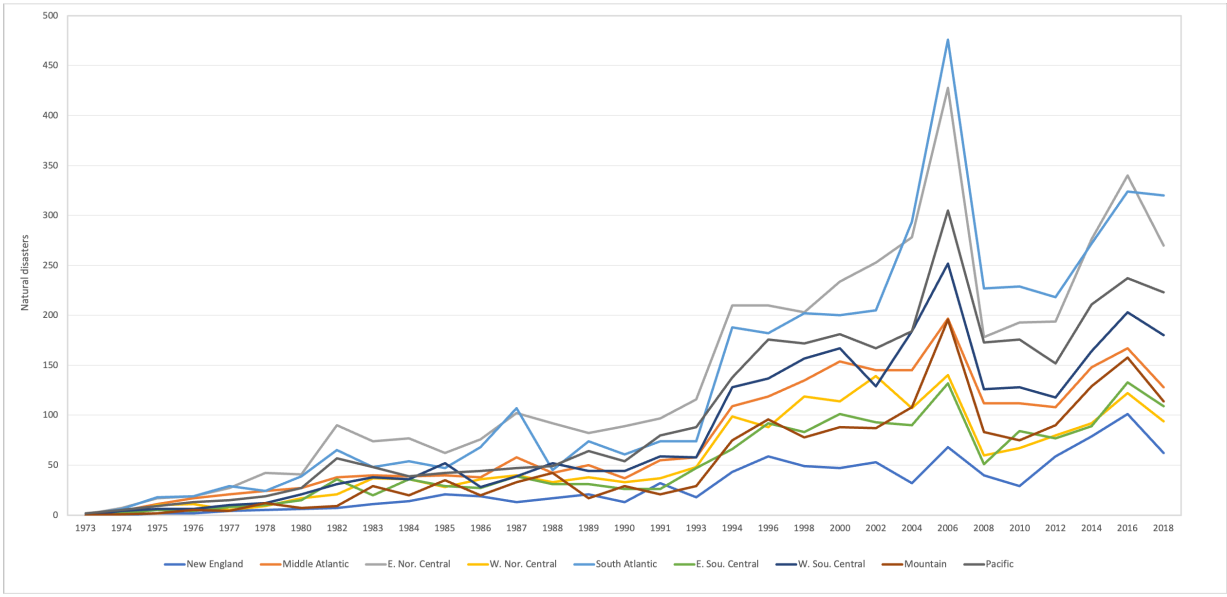

Table A.1: GSS summary statistics

Variable	Mean	SD	Min.	Max.
Environment	61%	0.48	0	1
Energy	58%	0.49	0	1
Natural disaster	31%	0.46	0	1
Married	54%	0.49	0	1
Black	13%	0.34	0	1
Female	55%	0.49	0	1
Unemployed	3%	0.18	0	1
Years of education	12.81	3.13	0	20
Father's education	10.59	4.33	0	20
Age	45.36	17.37	18	89

Table A.2: GSS: non movers

Dep. var.	Environment		Energy	
	(1)	(2)	(3)	(4)
Natural disaster	0.018	0.037**	0.008	0.026
	(0.019)	(0.013)	(0.037)	(0.032)
Married	-0.043***	-0.042***	-0.046***	-0.041
	(0.010)	(0.008)	(0.011)	(0.030)
Black	0.046**	0.091***	-0.074***	-0.051*
	(0.019)	(0.017)	(0.016)	(0.027)
Unemployment	0.016	0.015	0.001	-0.006
	(0.014)	(0.021)	(0.014)	(0.031)
Years of education	0.009***	0.006**	0.019***	0.011***
	(0.002)	(0.002)	(0.003)	(0.003)
Female	0.014*	0.025**	-0.029*	-0.027
	(0.006)	(0.011)	(0.013)	(0.023)
Income	-0.004	-0.006	0.002	-0.000
	(0.005)	(0.007)	(0.008)	(0.014)
Father's education		0.003*		0.004
		(0.001)		(0.003)
Constant	-0.881*	4.747***	0.474**	1.113***
	(0.406)	(0.553)	(0.145)	(0.140)
Income FE	yes	yes	yes	yes
Age FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Region of interview FE	yes	yes	yes	yes
Region at 16 FE	yes	yes	yes	yes
(Region at 16)*age	yes	yes	yes	yes
Cohort FE	yes	yes	yes	yes
Religion FE	no	yes	no	yes
Religion at 16 FE	no	yes	no	yes
Income at 16 FE	no	yes	no	yes
R^2	0.087	0.103	0.053	0.079
Obs.	21107	12173	6483	3715

Notes: robust standard errors in parenthesis, clustered at region at 16. * refer to the following cases: * p<0.10, ** p<0.05, *** p<0.01.

Table A.3: GSS: Heterogeneity effects

Dep. var.	Environment				Energy			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Female		Male		Female		Male	
Natural disaster	0.022*	0.046***	0.059**	0.023	0.051*	0.030	0.060	0.090
	(0.012)	(0.014)	(0.021)	(0.029)	(0.023)	(0.026)	(0.035)	(0.051)
R^2	0.087	0.103	0.088	0.112	0.071	0.097	0.063	0.096
Obs.	17521	9967	14559	8239	5481	3247	4718	2673
	Low education		High education		Low education		High education	
Natural disaster	0.073*	0.030	0.030**	0.043***	0.004	0.098	0.069***	0.056***
	(0.033)	(0.049)	(0.013)	(0.008)	(0.092)	(0.075)	(0.016)	(0.015)
R^2	0.097	0.135	0.072	0.092	0.157	0.384	0.036	0.057
Obs.	7198	3401	24929	14821	1384	628	8820	5294
	Low income		High income		Low income		High income	
Natural disaster	0.024	0.016	0.050**	0.050*	-0.037	-0.020	0.145***	0.123***
	(0.016)	(0.030)	(0.020)	(0.025)	(0.046)	(0.065)	(0.020)	(0.027)
R^2	0.100	0.121	0.076	0.094	0.082	0.113	0.054	0.082
Obs.	15817	7954	16263	10252	5142	2667	5057	3253
	Rural		Urban		Rural		Urban	
Natural disaster	0.034	0.038*	0.047	0.048	0.056**	0.041*	0.070**	0.106**
	(0.021)	(0.017)	(0.030)	(0.051)	(0.025)	(0.022)	(0.030)	(0.038)
R^2	0.084	0.097	0.079	0.123	0.057	0.072	0.073	0.126
Obs.	23573	13650	8470	4542	7123	4225	3069	1692
Age FE	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Region of interview FE	yes	yes	yes	yes	yes	yes	yes	yes
Region at 16 FE	yes	yes	yes	yes	yes	yes	yes	yes
(Region at 16)*age	yes	yes	yes	yes	yes	yes	yes	yes
Cohort FE	yes	yes	yes	yes	yes	yes	yes	yes
Religion FE	no	yes	no	yes	no	yes	no	yes
Religion at 16 FE	no	yes	no	yes	no	yes	no	yes
Income at 16 FE	no	yes	no	yes	no	yes	no	yes

Notes: robust standard errors, clustered at region at 16. * refer to the following cases: * p<0.10, ** p<0.05, *** p<0.01.

Table A.4: WVS: falsification test

Dep. var.	Trust			Happiness		
	All countries (1)	H-MH countries (2)	ML-L countries (3)	All countries (4)	H-MH countries (5)	ML-L countries (6)
Natural disaster	0.003*	0.005	0.002	0.000	0.007	-0.007
	(0.002)	(0.004)	(0.002)	(0.004)	(0.005)	(0.006)
Constant	0.397	0.972*	0.024	2.653	3.113	3.768***
	(0.451)	(0.540)	(0.049)	(29.101)	(.)	(0.204)
Religion FE	yes	yes	yes	yes	yes	yes
Income FE	yes	yes	yes	yes	yes	yes
Country*age FE	yes	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Age FE	yes	yes	yes	yes	yes	yes
Cohort FE	yes	yes	yes	yes	yes	yes
R^2	0.154	0.154	0.132	0.152	0.135	0.169
Obs.	135690	61080	73745	137175	61808	74500

Notes: robust standard errors in parenthesis, clustered at country level. * refer to the following cases: * p<0.10, ** p<0.05, *** p<0.01. In column (2) high and middle high income countries while in column (3) middle low and low income countries. In the natural disaster variable we do not include: bacterial disease, chemical spill, famine, oil spill, other, parasitic disease, poisoning, radiation, road and viral disease.