Heat waves, droughts, and preferences for environmental policy

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Abstract

Using data from a new household survey on environmental attitudes, behaviors, and policy preferences, we find that current weather conditions affect preferences for environmental regulation. Individuals who have recently experienced extreme weather (heat waves or droughts) are more likely to support laws to protect the environment even if it means restricting individual freedoms. We find evidence that the channel through which weather conditions affect policy preference is via perceptions of the importance of the issue of global warming. Furthermore, individuals who may be more sophisticated consumers of news are less likely to have their attitudes towards global warming changed by current weather conditions.

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1 Introduction

Attitudes towards global warming and environmental policy have shifted recently, with several studies finding a decline in concern for environmental issues over the last three to four years. For example, a 2009 Pew Research Center report shows a decline since January 2007 across party lines among those who see solid evidence of global warming. A recent survey by Gallup also shows the percentage of Americans responding that the seriousness of global warming has generally been exaggerated has steadily increased from a low of 30 percent in 2006 to 48 percent in 2010. Although some of the recent skepticism may be in reaction to "Climategate," these studies show that the decline in concern for environmental issues began before the November 2009 release of communications between a few climate scientists that fueled the criticism of global warming skeptics.

Over this same time period, although some areas of the U.S. have experienced summer heat waves and droughts, temperatures in the summer of 2008 and 2009 have been relatively cool across the U.S., with average temperatures below a 20 year average in 37 of the 48 contiguous states in August 2008 and in 30 of the 48 contiguous states in August 2009. Media outlets have certainly made the connection of current weather conditions and climate change, especially when weather is hotter than average. An example is written by a *Seattle Times* business correspondent writing in response to the Pacific Northwest's record-breaking temperatures in August 2009:

> Seattle needs to pause from the "you can tell your grandkids about the great heatwave of '09," and take stock of potential climate-change effects here, including, for the sake of this blog's mission, the economic ones. For this may not be a twice-a-century event any longer. [1]

[1] Talton (2009).

While there are likely a variety of factors that have influenced public opinion in the U.S., this paper investigates the role of weather conditions in affecting individual's preferences for environmental regulation as well as their general attitudes towards the importance of the issue of global warming. Using data from a new household survey on environmental attitudes, behaviors, and policy preferences, we find that current weather conditions do affect preferences for environmental regulation. Our empirical results support the conclusion that individuals who have recently experienced extreme weather (summer heat waves or droughts) are more likely to support laws to protect the environment even if it means restricting individual freedoms. We find evidence that the channel through which weather conditions affect policy preferences is via perceptions of the importance of the issue of global warming. Furthermore, individuals who are more sophisticated consumers of news are less likely to have their attitudes towards global warming changed by current weather conditions.

Our work is related to the literature that examines support for environmental policy with a variety of methods. One way that some researchers have attempted to determine policy preferences is by examining outcomes on specific referendums. For example, Dubin, Kiewiet and Noussair (1992) use precinct-level voting data to show that individual demographic characteristics as well as political ideology influenced support for California ballot initiatives aimed at limiting economic development. In contrast, Kahn and Matsusaka (1997), although still focused on California initiatives, argue that income and price explains most of the variation in voting behavior and that political ideology does not play an important role in determining support for environmental goods.

Some recent work that analyzes voting on referendums in Switzerland corroborates the findings from the California referendums. For example, Halbheer, Niggli and Schmuzler (2006)

analyze the characteristics of referendums on environmental policy that have been passed by the Swiss electorate, showing that endorsement by business associations and favorable economic conditions are associated with a greater likelihood of passage. Bornstein and Thalmann (2008) confirm the importance of economic conditions, using data from a survey conducted a few weeks after a Swiss referendum vote in which individuals were asked to explain their recent vote. Similar to the conclusions of previous researchers, they find an important role for perceptions of current economic conditions in determining support for environmental referendums.

Although these studies have the benefit of examining actual voting behavior rather than stated preferences, because they are necessarily examining voting on specific initiatives, their conclusions may be limited to those specific issues or locations. Others have examined preferences for environmental policy via more broad-based surveys. Konisky, Milyo and Richardson (2008) examine responses to the 2007 Cooperative Congressional Election Study and find political ideology and partisan affiliation help to predict attitudes towards pollution and resource policies. Lee and Cameron (2008) find that individuals state that they are more willing to pay for climate change mitigation if they believe that the harm caused by climate change will be substantial, a finding that complements ours. Interestingly, Lee and Cameron (2008) use geographic characteristics that proxy for the vulnerability to climate change in their estimations (natural disasters, tornados recorded, hurricane zones, and temperatures). However, they use this data as a means of controlling for sample selection bias in a relatively low response rate mail survey and not as a direct determinant of policy preferences and attitudes as we do. Given the manner in which our sample was recruited and that its primary purpose was to elicit attitudes about the 2008 election and not environmental policy (explained more thoroughly below), we do not have the same concerns about sample selection as they do.

Of course, an important element of the decision to support environmental policy is the assessment of risk and the accuracy of the information that individuals possess. Owen, Videras and Wu (forthcoming) use similar survey data to that used in this paper and show that individuals do not have accurate information about the causes of climate change or the impact of their own individual behavior in reducing carbon emissions. Nonetheless, they show that individuals' behaviors are consistent with what they believe to be true.

More broadly, several studies have demonstrated that individuals do not always accurately perceive risk. Viscusi (1993) asserts that individuals tend to systematically overestimate the probability of unlikely events and underestimate the probability of more common occurrences. In a complementary finding, Slovic (1987) argues that individuals overestimate the amount of risk they face relative to past risk. More recently, Viscusi (2009) analyzes survey data and concludes that people value preventing terrorism deaths about equally to valuing prevention of death from traffic accidents, which are actually much more likely to occur. Similar to our findings, Viscusi shows that education, political preferences, and beliefs about terrorism affect individual willingness to pay to protect against risk. Finally, one might interpret current extreme weather conditions as a "shock" that causes individuals to re-evaluate their current beliefs. This is similar to the behavior that characterizes the inattentive consumers and producers in Reis (2006a, 2006b).

We extend the findings of this previous literature by demonstrating that current weather conditions are related to individuals' evaluations of the importance of the issue of global warming and that this importance is related to policy preferences. Individuals who believe that global warming is an important issue are more willing to support regulation that might restrict individual freedom. We also corroborate the broad findings of the previous work on support for

environmental policy with a new nationally representative data source for the United States and, like previous authors, find support for the influence of political preference and ideology as well as income and education in determining attitudes towards environmental issues and policy.

These conclusions are discussed in the following three sections. Section 2 describes the survey and the data used in our analysis. Section 3 presents the estimation results and Section 4 provides some concluding thoughts.

2 Data

Household Survey

The main data set used to address these questions is from an August 2009 nationally representative survey of U.S. citizens. It was implemented as an off-wave of the American National Election Studies (ANES) panel. The NSF-funded ANES panel has monthly observations for approximately 2,500 respondents in the U.S. between 2008 and 2009. The surveys are administered by Knowledge Networks, who recruited the panel via random digit dialing. The surveys are approximately 30 minutes in length and are completed on-line. Respondents were offered $10 per month to complete the monthly surveys and individuals who did not have access to the Internet were offered a web appliance (MSN TV2 set-top box) and free access to the Internet during the survey period.

In several of the months, respondents are asked about attitudes relating to their political behavior and the 2008 election. In the remaining "off-wave" months, the ANES has made the panel available to other researchers for a fee. Therefore, in addition to having observations about environmental attitudes and behaviors, our data set can also be linked to an already rich data set from the ANES panel.

As we explain in more detail below, in our August 2009 survey we supplemented the ANES panel with 450 respondents who had also completed a nationally-representative survey of U.S. households conducted by Owen, Videras and Wu (forthcoming) in October 2007 using the Knowledge Networks web-enabled panel (also recruited via random digit dialing in a similar manner to the ANES panel). We repeated eleven questions from the October 2007 survey in the August 2009 survey, allowing us to form a small panel.

The survey instrument for the August 2009 survey elicits responses about topics that can be categorized as follows: 32 specific pro-environment behaviors; 12 attitudes towards the environment and policies aimed at improving the environment; 109 questions about the extent and nature of social networks, including characteristics of the members of the network and the nature of the interactions; 22 questions about changes in life circumstances; and 10 questions about the influence of religion and religious affiliations on environmental behaviors and attitudes.[2]

Overall, the data collected correspond to data in other large surveys. For example, results from the August 2009 survey indicate that only 14% of our sample recycles less often than several times a year and 17% contributed to an environmental organization in the last 12 months. In the third wave of the World Values Survey, 14% of the respondents from the U.S. indicate that they do not recycle and 25% say they have contributed to an environmental organization (time frame not specified).

Results from the small panel formed by combining the 2009 sample with the 450 October 2007 respondents also corroborate the findings of other studies mentioned in the introduction

[2] The survey instrument, descriptive statistics for the responses, and data are available for public viewing at the survey website:
https://my.hamilton.edu/levitt/Sustainability/Environmental_survey_2009.html

that attitudes have changed over this two year period. For example, in 2007, 39 percent of the respondents indicated that they did not consider themselves to be an environmentalist. In 2009, however, that percentage increased to 55 percent.[3] Responses to a second question also suggest concern about the environment has waned: In 2007, 23 percent of respondents believed that it was "very likely" that climate change will affect them personally. That percentage was down to 17 percent in 2009. It is possible that the nationwide deterioration of economic circumstances caused individuals to place a lower priority on the environment. In fact, 21 percent of the respondents strongly disagreed with the statement "We worry too much about the future of the environment and not enough about prices and jobs today," in 2007. In 2009, only 9 percent of these same individuals strongly disagreed. (We explore the possible impact of the severe economic downturn during this time period in our robustness checks.) Importantly, we also find that attitudes towards environmental policy have changed. In 2007, 57 percent of the respondents supported laws to protect the environment. In 2009, the fraction of the same people that continued to support environmental protection laws was reduced to 48 percent.

Two variables that will play a prominent role in the analysis are 1) the support for laws to protect the environment and 2) the importance of global warming as an issue to the respondent. Support for laws to protect the environment was asked in both August 2009 and October 2007, while the importance of global warming as an issue was only asked in the 2009 survey.

To construct the variable that represents support for laws to protect the environment, the following question was asked:

If you had to choose, which one of the following would be closest to your views?

a. *Government should let ordinary people decide for themselves how to protect the environment, even if it means they don't always do the right thing, or*

[3] We use sampling weights in these calculations and in all estimations we report in this paper.

b. *Government should pass laws to make ordinary people protect the environment, even if it interferes with people's right to make their own decisions.*

Responses in which individuals selected the second option were coded as a 1 and responses in which individuals selected the first option were coded as a 0.

The importance of the issue of global warming was elicited from a question that asked respondents to indicate how important the issue of global warming was to them personally. Higher values of this variable indicate that the individual believed that global warming was more important; "Extremely important" responses to the global warming issue were coded as a 5 and "not at all important" were coded as a 1, with intermediate levels of importance being assigned a 2, 3, or 4.

Control variables in the estimation included the respondent's self-identification as an environmentalist, education, political party identification, household income, marital status, gender, and four regional dummy variables. Individuals identified themselves as either "definitely" an environmentalist, "somewhat" of an environmentalist or not an environmentalist. Political party identification is measured on a 7 point scale with 1 indicating a person who identifies as a "Strong Republican" and a 7 indicating a person who identifies as a "Strong Democrat."

Although the procedures used to recruit the sample indicate that our sample is a representative sample, the descriptive statistics in Table 1 are calculated using sampling weights. These statistics indicate that approximately 48 percent of the sample supports laws that protect the environment, but on average, respondents rate the issue of global warming as being slightly more than "somewhat important." Only six percent of the sample consider themselves to

definitely be an environmentalist, but an additional 45 percent consider themselves to be "somewhat" of an environmentalist.

Comparing the mean estimates for several of the demographic characteristics to Census Bureau estimates suggest that the sample is slightly more educated and more likely to be married than the U.S. population as a whole. Thirty-nine percent of the respondents have a college degree compared to a 27 percent estimate by the Census Bureau while only 9 percent of our sample does not have a high school diploma (compared to 14 percent estimate by the Census Bureau). Nonetheless, the stated party affiliations of respondents match up with independent estimates.[4] These differences are likely due to the fact that the ANES sample contains only U.S. citizens and excludes U.S. residents who are unable to register to vote. Given our interest in understanding policy preferences, this slightly different sample should not alter the policy implications of our findings.

Additional Data

We supplement the survey data with data from the National Oceanic and Atmospheric Administration (NOAA) on average monthly temperatures by state and with data collected by the U.S. Postal Service on residential and business vacancies by census tract.

An important independent variable is related to the weather in the 48 contiguous states. These variables identify extreme weather in either August 2009 (the month the survey was completed) and in July 2009 (the previous month). To identify extreme weather, for each state, the average temperature for the month was divided by the 20 year average for that state for that month to form a relative temperature. A similar calculation was performed with the monthly precipitation. As mentioned earlier, the summer of 2009 was cool and dry in much of the U.S., however, some states experienced greater than typical average temperatures while others

[4] See, for example, Pew Research Center Publications (2008).

experienced significantly less rainfall. We identified states that had unusually hot weather as experiencing a "heat wave" in that month and states that were unusually dry as experiencing a "drought." Because the summer was cool on average, we categorized states as experiencing a "heat wave" if they were in the 90th percentile or higher in relative average temperatures. In August, this translated into average temperatures at least one percent higher than normal for that month.[5] To identify a drought in a particular month, we used the bottom quartile of states (80 percent or less of the normal precipitation in August). Given the potential for extreme weather to have cumulative psychological effects, we also created a second set of extreme weather variables that indicated that a state was in a drought in both July and August or was experiencing a heat wave in both July and August. Of course, there are fewer states that experienced extreme weather in both months.

Interestingly, because we used temperatures and precipitation relative to the average and not just absolute temperatures or precipitation, states that experienced extreme weather by this definition don't necessarily share other characteristics such as region or political affiliations of their residents. Specifically, the states that we identified as experiencing a heat wave in August are: Arkansas, Maine, New Jersey, Rhode Island, Texas, and Washington. The states that experienced a drought were: Arizona, California, Colorado, New Mexico, Nevada, Rhode Island, South Carolina, Texas, Utah, and Washington.

Finally, we also examined unusually cool states during the summer of 2009, identifying those with atypically low temperatures (in the bottom 10 percent, or less than 96 percent of the 20-year average.) States with unusually cool temperatures in August 2009 were slightly more

[5] Although one percentage point may not seem dramatic, recall that these are average temperatures over an entire month.

geographically concentrated: Illinois, Kansas, Montana, North Dakota, Nebraska, and South Dakota.

3 Analysis and Results

We are interested in the determinants of support for environmental policy. In particular, we estimate a probit model predicting support for environmental protection laws using individual characteristics and dummy variables indicating extreme weather in the respondent's state at the time of the survey. Specifically, we estimate

$$\text{Prob}(LAWS=1)=\Phi(\beta X + \gamma WEATHER+\theta REGION)$$

Where X is a vector of individual characteristics, *WEATHER* is a vector of dummy variables indicating extreme weather in the respondent's state, and *REGION* is a vector of dummy variables indicating region of the U.S. (North, South, Midwest and West). The individual characteristics that we include in X are indicator variables for an individual's stated level of environmentalism, indicator variables for education level, party identification index, an index for household income, age, age-squared, gender, marital status and region of the country. We expect that individual's with stronger identification as environmentalists and as Democrats will be more likely to support environmental protection laws. In addition, other researchers have shown that demographic characteristics may also predict support for environmental policy with more educated, higher income, younger, and female respondents being more likely to express pro-environment attitudes. Finally, we control for region of the country because the weather variables of interest are geographically determined and support for environmental protection may vary by region. As explained above, we develop a number of indicator variables that represent extreme heat, low precipitation, or cool temperatures during the survey period.

Table 2 presents the main results of this estimation, with each column of Table 2 using different combinations of the extreme weather measures.[6] Looking across all the columns of Table 2, we can first draw some conclusions about the control variables. As to be expected, stronger levels of environmentalism are associated with more support for environmental protection laws but lower levels of education correspond to less support. Those with strong affiliations with the Democratic Party are also more likely to express support for laws to protect the environment. Although not reported in Table 2, the remaining demographic characteristics generally entered all estimations consistently and as expected. Women and individuals with higher household incomes were more likely to support environmental protection laws. Results for the regional indicators also are consistent with expectations—respondents living in the South or the Midwest are less likely to support environmental protection laws, even after controlling for political affiliation.

The bottom half of Table 2 presents the coefficients for the extreme weather dummies. The first six columns use various combinations of heat wave and drought variables and the last four columns introduce the cool weather variables. Focusing on the first 6 columns, we see that the summer heat wave indicator enters positively and significantly in predicting support for environmental protection as does the dummy variable for August drought. The remainder of the extreme weather dummies in the first six columns are all consistently positive, but not all statistically significant at the 10% level. Interestingly, the results in columns 7 through 10 suggest that cool weather during the survey period (either August or August and July) is associated with lower levels of support for laws that protect the environment. These results are

[6] Although we present some combinations of the extreme weather indicators in Table 2, we do not report an estimation in which they are all included simultaneously because several of the indicators are highly correlated. Nonetheless, if we do include all the extreme weather variables in one estimation, a Wald test rejects the hypothesis that all the coefficients on these extreme weather indicators are zero at the 1 percent level.

generally consistent with those experiencing greater heat in the summer being more supportive of environmental protection laws while those experiencing cooler temperatures being less supportive.

Although Table 2 presents the coefficients from the probit estimation, the magnitudes of the estimated marginal effects are also notable. For example, the marginal effects associated with the estimation in column 2 suggest that experiencing a heat wave in July and August increases the probability of supporting environmental protection laws by 11 percentage points. Similarly, experiencing a drought in August (column 4) raises the probability of support by 9 percentage points while a cool August (column 8) lowers the probability by 15 percentage points.

Of course, one potential issue with the interpretation of these results is the fact that the weather variables are measured at the state level. Although in the estimations in Table 2, we do control for region of the country and a number of individual characteristics that should control for the predisposition to support environmental protection laws, (including stated level of environmentalism), it is still possible that there are unobservable individual characteristics that correlate with a state-level effect that are really driving the results. Fortunately, we are able to assess the importance of this potential problem by taking advantage of the small panel data set that we are able to form that use some of the responses to our 2007 survey in which the question about support for environmental protection is repeated. The estimations in Table 3 replicate those in Table 2 using this small panel data set and add the respondent's support for environmental protection laws in October 2007 as an independent variable. As to be expected, support for environmental protection in 2007 is a strong and significant predictor of support in 2009. In fact, of the remaining individual characteristics in the estimation, only stated level of

environmentalism and party identification are significant in predicting support for environmental protection laws once the previous level of support is considered. Results for the weather dummies reported in Table 3 are broadly consistent with those in Table 2, however, in the reduced sample, they are not all significant at the 10 percent level. Nonetheless, once the initial attitudes towards environmental protection are accounted for, respondents who live in states that experienced extreme heat in August (column 2, 3, and 10), were more likely to express support for laws to protect the environment in 2009. While the small sample size used in these estimations allows us to only weakly corroborate the initial findings, they are suggestive that current weather may influence individual policy preferences.

Weather and attitudes towards global warming

Another way of examining the robustness of this initial finding is to find evidence for a channel through which weather might logically affect policy preferences. In this case, especially given the stronger results for extreme temperatures, it is reasonable to argue that the channel through which current weather influences policy preferences is by affecting an individual's assessment of the issue of global warming. As mentioned earlier, survey respondents rated the importance of the issue of global warming. We use the responses to this question and estimate an ordered probit model that examines the impact of weather on an individual's assessment of the importance of the issue of global warming, after controlling for the same individual characteristics as the earlier estimations. These results are reported in Table 4.

As to be expected, environmentalism and party identification are strong predictors of the importance of global warming to the respondent. The only other demographic control that was consistently statistically significant in these estimations (not reported Table 4) was that men were less likely to think that global warming was an important issue. The heat wave and drought

variables, however, continued to be statistically significant in ways that were broadly consistent with the earlier results. Individuals who lived in states that experienced a drought in August (column 1 of Table 4), a heat wave in August (column 2 of Table 4) or a heat wave in August and July (column 4 of Table 4) were all more likely to rate global warming as a more important issue. Interestingly, the coefficient on a cool July and August (column 6 of Table 4) is significant at the 10 percent level but has an unexpected sign—individuals in cool states were more likely to rate global warming as a more important issue, but our earlier results suggest that they were less likely to support environmental protection laws. It is possible that this set of results is due to respondents who experienced unusually cool summers recognizing that "global warming" may be associated with greater variability in weather and thus believe it is an important issue, but they are less willing to restrict their individual freedoms because they believe that the consequences for them personally will not be particularly bad. However, this puzzling result may also be due to the fact noted earlier that the states that experienced unusually cool weather in the summer of 2009 were geographically concentrated. Thus, the lack of support for environmental protection laws for individuals from these states may be attributed to some unobserved characteristic of the individual that is also related to the geographic region but is only imperfectly captured with the regional dummy variables. Because of the uncertainty surrounding the interpretation of this result, we do not explore it further in the remainder of the paper.

Given that weather is arguably an exogenous shock to individual attitudes towards global warming, it can be used as an instrument for these attitudes. However, Wald tests for exogeneity do not allow us to reject the null hypothesis of no endogeneity in the estimation of support for environmental regulation at the 10% significance level. Therefore, the instrumental variables

approach is unwarranted. Nonetheless, in results available from the authors upon request, we show that attitudes towards global warming are strong predictors of support for environmental regulation when the extreme weather dummy variables are used as instruments.

Thus far, we have presented evidence that extreme weather affects policy preferences and that this effect likely works through the weather's effects on attitudes towards global warming. To complete this argument, we need to demonstrate that once we control for attitudes towards global warming in our initial estimation predicting support for pro-environment laws, the effect of weather is no longer significant. Table 5 presents these results, showing that none of the original significant coefficients in Table 2 remain once we control for these attitudes.

Interactions of weather and media exposure

Taken together, these results suggest that current weather conditions affect attitudes towards global warming. Ironically, however, even the most pessimistic scientific analysis considers global warming to be a long-run phenomenon. Given that the current month's weather should not rationally affect a well-informed individual, we might expect that it might not affect all individuals in the same way. Especially if the weather serves as a shock that causes individuals to seek out more information and possibly update their beliefs, individuals who are less well informed may be more likely to be affected by current weather conditions. In this section of the paper, we explore some interactions with individual media exposure to evaluate the evidence that the weather has a differential impact based on the nature of the information that an individual might have about global warming.

As mentioned in the introduction, several media reports on the unusual weather patterns in the summer of 2009 made connections between these weather patterns and the probability that global climate change would occur. We construct two variables that measure an individual's

exposure to the news media from a question asked of about half of our ANES respondents in the first wave of the ANES conducted in January 2008. Individuals were asked how many days per week they received news from four sources: print, television, radio or the Internet. For each source, individuals responded from 0 to 7. We used these responses to create a variable called "Days News" which is the sum of the responses to the four questions. The minimum is 0 and the maximum is 28. We also created four different variables which is the response to each of the four questions, each one ranging from 0 to 7. In Table 6, we report results for the interaction between days news and heat waves and also the interaction between the number of days of Internet news per week and heat waves. (The other news sources and their interaction with extreme weather were not statistically significant.)

Interestingly, the results in columns 1 and 2 of Table 6 indicate that there is not a significant interaction between total news exposure and attitudes towards global warming, either with or without an interaction with the weather. However, the results in columns 3 and 4 suggest that individuals who more frequently consult the Internet for their news are less affected by the weather than those that do not. One possible explanation for this result is that those who frequently use the Internet to get their news may be more sophisticated in obtaining information than those who do not. In particular, the nature of the Internet encourages and facilitates news gathering from multiple sources as readers of Internet stories can easily follow links to other sources or easily search multiple sites for news of interest. In contrast, those who primarily consult print, TV or radio may be less likely to seek out multiple sources and rely more on one newspaper, television station or radio program. In fact, a recent Pew Research Center report finds that 65% of people who get news from the Internet use a news portal that gathers news from multiple sources and that 57% consult two to five sources for news information (Purcell, et

al., 2010). This increased variety of sources is also borne out in our data in which 61% of the respondents that use the Internet as a news source reporting that they regularly consult radio, print, and television news sources as well. Thus, the fact that more sophisticated news gatherers are less affected by current weather conditions gives credibility to the finding that weather may be affecting the assessments of others.

Robustness check: economic conditions

Earlier we noted that one possible reason for the significance of state-level weather variables is that there is some unobserved state-level characteristic that is coincidentally correlated with extreme weather in the summer of 2009. Given the exogenous nature of weather and the fact that, at least for the heat wave states, there are no obvious similarities, it is difficult to identify such a characteristic. However, one potential candidate is economic conditions in the state which may relegate longer term environmental concerns to lower prominence. In fact, during the summer of 2009, the U.S. economy was in the midst of one of the worst economic downturns since the Great Depression. Furthermore, because this downturn was linked to a crash in the real estate market and a crisis in the mortgage markets, some areas of the country were hit harder than others. Therefore, it would be useful to determine if the results reported so far are affected by including a measure of the severity of the recession. Of course, we cannot use state level economic variables simultaneously with state-level weather variables, but we do have access to census tracts for the individuals who were in our August 2007 survey and who form our small panel. Fortunately for us, there is a measure of how severely an area as small as a census tract was hit by the economic and financial crisis: the U.S. postal service tracks total addresses and vacancies (residential and business) and records them by census tract, enabling us to calculate a vacancy rate for each census tract. Because we are now focused on economic conditions and the

possibility that the severity of the recession varies geographically, we also add a variable that indicates if a person is currently working. Unfortunately, we do not have access to census tracts of the ANES respondents but can re-estimate the equations in Table 3 for those weather variables that were statistically significant (or border-line significant).

Table 7 contains those results. Column 1 of Table 7 first presents the results for the slightly changed specification that includes whether or not a person is working and the census tract vacancy rate. While employment status is not significant once we control for the original individual characteristics, vacancy rates do predict support for environmental regulation, with individuals from areas that have higher vacancy rates being more likely to support laws to protect the environment, even controlling for their 2007 stance. Importantly, the inclusion of this variable proxying for economic conditions does not remove the significance of the August heat wave variable (column 2) and in column 3 of Table 7, the significance level of the August drought variable, though still not at 10%, actually increases from that reported in Table 3. Finally, in the last column of Table 7, we take advantage of another variable in our survey that measures whether or not individuals have fallen behind on their credit card payments in the last two years. Consistent with the positive sign on the vacancy rate, this variable also enters the estimation positively and significantly, yet does not affect the magnitude or significance of the effect of the heat wave variable. Therefore, we conclude that economic conditions are not an omitted state level characteristic that is driving our results.

The question remains, however, why is economic misfortune positively related to support for laws to protect the environment? In order to understand this positive coefficient, it is important to recognize that the question underlying the dependent variable elicits support for the environment, but it also elicits support for laws that might restrict individual freedom. It is

possible that those who have witnessed the worst consequences of the financial crisis would be more likely to favor greater regulation. Of course, this is a speculative conclusion; further study on this issue is warranted and is the subject of future research.

The survey also asked respondents to rate the importance of the issue of education to them personally. As a final check on our results, we use responses to this question to perform a falsification test. In other words, weather should not be related to the respondents' beliefs about the importance of education. When we attempt to estimate the importance of education using the same independent variables used in the estimations in Table 4, we do not find significant results for the weather dummy variables. While it is the case that if we add the importance of education to the list of control variables in the global warming estimation it enters positively and significantly, it does not affect our original conclusions about the effect of weather on global warming attitudes. This positive correlation between the importance of education and global warming could be because both are important issues to similar people or this result could be caused by an unobserved individual characteristic that causes some respondents to assign similar levels of importance to many social issues.

4 Conclusion

Using data from a new household survey on environmental attitudes, behaviors, and policy preferences, we find that current weather conditions affect preferences for environmental regulation. Our empirical results support the conclusion that individuals who have recently experienced extreme weather (heat waves or droughts) are more likely to support laws to protect the environment even if it means restricting individual freedoms. We find evidence that the channel through which weather conditions affect policy preference is via perceptions of the importance of the issue of global warming.

These findings have important policy implications. Pessimistically, our results can be interpreted to imply that some individuals will not support environmental protection until they begin to experience the effects of climate change, when arguably, small changes in policy will not be effective. More optimistically, however, we see that the effects of extreme weather conditions on attitudes towards policy are strongest among those who may be less aware of global warming and are perhaps less sophisticated in their use of news media. This suggests that more education about climate change may mitigate the need for individuals to actually experience extreme weather before supporting environmental protection. Furthermore, these results suggest that support for environmental policy may depend on the timing of its introduction. Policy makers may want to opportunistically introduce policy when current events (e.g., heat waves, droughts, hurricanes) make the public more receptive to it.

Of course, there are limitations to our findings. Importantly, our results are based on individual responses to a survey, not on actual votes. It might be the case that stated preferences for policy that are influenced by current weather conditions don't follow individuals into the voting booth. However, these initial results do suggest further research on how individual, perhaps idiosyncratic, experience affects support and votes for environmental policy.

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Table 1: Descriptive Statistics

Variable	Mean	Minimum	Maximum
Policy variables			
Support for laws	0.48	0	1
Importance of global warming	3.24	1	5
Definitely environmentalist	0.06	0	1
Somewhat environmentalist	0.45	0	1
Individual Characteristics			
Age	48.15	18	98
No HS diploma	0.09	0	1
HS diploma	0.3	0	1
Some College	0.23	0	1
College degree	0.39	0	1
Male	0.48	0	1
Married	0.66	0	1
Household income index	12.01	1	19
Party ID	4.21	1	7
Republican	0.32	0	1
Democrat	0.4	0	1
Region identifier			
Northeast	0.19	0	1
Midwest	0.25	0	1
South	0.35	0	1
Weather variables (state level)			
August heat wave	0.13	0	1
August and July heat wave	0.09	0	1
August drought	0.27	0	1
August and July drought	0.15	0	1
Cool August	0.09	0	1
Cool Summer	0.09	0	1
Media exposure			
Days News	14.63	0	28
Days Internet News	3.04	0	7

Means calculated using sampling weights. For all variables except *Days News* and *Days Internet News*, 2,473 observations used. For Days News and Days Internet News, 1,180 observations used.

Table 2: Support for laws to protect the environment (Probit Coefficients)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Definitely environmentalist	1.1310**	1.1498**	1.1505**	1.1480**	1.1431**	1.1502**	1.1303**	1.1297**	1.1516**	1.1445**
	(7.50)	(7.67)	(7.64)	(7.68)	(7.63)	(7.69)	(7.53)	(7.53)	(7.68)	(7.63)
Somewhat environmentalist	0.4229**	0.4235**	0.4235**	0.4259**	0.4237**	0.4255**	0.4215**	0.4210**	0.4220**	0.4218**
	(5.57)	(5.59)	(5.60)	(5.62)	(5.58)	(5.62)	(5.56)	(5.55)	(5.59)	(5.57)
No HS diploma	-0.2971*	-0.2932*	-0.2890*	-0.2919*	-0.2994*	-0.2927*	-0.3226*	-0.3230*	-0.3127*	-0.3192*
	(1.70)	(1.67)	(1.65)	(1.67)	(1.69)	(1.66)	(1.87)	(1.87)	(1.81)	(1.83)
HS diploma	-0.1332	-0.1379	-0.1385	-0.1361	-0.1308	-0.1346	-0.1313	-0.1315	-0.1372	-0.1303
	(1.38)	(1.43)	(1.44)	(1.42)	(1.36)	(1.40)	(1.37)	(1.37)	(1.43)	(1.36)
Some college	-0.1141	-0.1221	-0.1185	-0.1204	-0.1181	-0.1198	-0.1246	-0.1241	-0.1281	-0.1236
	(1.38)	(1.48)	(1.44)	(1.46)	(1.44)	(1.46)	(1.51)	(1.50)	(1.55)	(1.50)
Party ID	0.1921**	0.1945**	0.1941**	0.1932**	0.1941**	0.1938**	0.1950**	0.1949**	0.1970**	0.1965**
	(11.61)	(11.84)	(11.83)	(11.71)	(11.80)	(11.79)	(11.77)	(11.77)	(12.00)	(11.96)
Drought in July and August	0.1969		0.1505							
	(1.29)		(0.98)							
Heat wave in July and August		0.2813**	0.2652*						0.2815**	
		(2.02)	(1.89)						(2.02)	
August drought				0.2322*		0.1791				
				(1.89)		(1.20)				
Cool august								-0.4131**		-0.4135**
								(3.02)		(3.02)
August heat wave					0.1759	0.0816				0.1763
					(1.45)	(0.56)				(1.46)
Cool July and August							-0.4054**		-0.4057**	
							(2.93)		(2.93)	
Observations	2487	2487	2487	2487	2487	2487	2487	2487	2487	2487

Robust z statistics in parentheses. All estimations use sampling weights and include controls for household income, age, age squared and dummy variables for sample, region, gender, and marital status. * significant at 10%; ** significant at 5%

Table 3: Support for laws to protect environment, controlling for prior support (Probit Coefficients)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Support in 2007	0.9353**	0.9553**	0.9565**	0.9041**	0.9482**	0.9436**	0.9326**	0.9325**	0.9743**	0.9809**
	(5.26)	(5.31)	(5.31)	(5.07)	(5.32)	(5.28)	(5.29)	(5.29)	(5.56)	(5.54)
Definitely environmentalist	1.1437**	1.1928**	1.1925**	1.1156**	1.1469**	1.1407**	1.1093**	1.1096**	1.1377**	1.1835**
	(3.48)	(3.55)	(3.56)	(3.36)	(3.45)	(3.44)	(3.34)	(3.34)	(3.41)	(3.51)
Somewhat environmentalist	0.4534**	0.4630**	0.4620**	0.4646**	0.4465**	0.4548**	0.4274**	0.4261**	0.4123**	0.4306**
	(2.52)	(2.56)	(2.56)	(2.53)	(2.48)	(2.51)	(2.30)	(2.29)	(2.25)	(2.34)
No HS diploma	0.1523	0.2374	0.2331	0.1681	0.1769	0.1856	0.1458	0.145	0.1574	0.2187
	(0.43)	(0.66)	(0.65)	(0.47)	(0.49)	(0.51)	(0.40)	(0.40)	(0.43)	(0.60)
HS diploma	-0.2501	-0.2143	-0.2209	-0.1882	-0.2238	-0.2148	-0.193	-0.193	-0.2222	-0.2121
	(0.98)	(0.83)	(0.86)	(0.73)	(0.88)	(0.84)	(0.75)	(0.75)	(0.87)	(0.83)
Some college	-0.0876	-0.0482	-0.0523	-0.0527	-0.0645	-0.0541	-0.0766	-0.0776	-0.0839	-0.0666
	(0.36)	(0.20)	(0.21)	(0.22)	(0.27)	(0.22)	(0.32)	(0.32)	(0.34)	(0.27)
Party ID	0.1410**	0.1431**	0.1434**	0.1367**	0.1387**	0.1392**	0.1407**	0.1406**	0.1433**	0.1479**
	(3.23)	(3.28)	(3.30)	(3.09)	(3.17)	(3.18)	(3.18)	(3.18)	(3.28)	(3.40)
August drought	0.4499		0.0589							
	(1.50)		(0.17)							
August heat wave		0.6566**	0.6302*							0.6661**
		(2.28)	(1.91)							(2.32)
Drought in July and August				-0.1916		-0.3031				
				(0.59)		(0.88)				
Cool August							-0.5444			-0.5673
							(1.35)			(1.39)
Cool July and August								-0.5552	-0.5772	
								(1.36)	(1.41)	
Heat wave in July and August					0.4661	0.5118			0.4837	
					(1.36)	(1.48)			(1.41)	
Observations	405	405	405	405	405	405	405	405	405	405

Robust z statistics in parentheses. All estimations use sampling weights and include controls for household income, age, age squared and dummy variables for region, gender, and marital status. * significant at 10%; ** significant at 5%

Table 4: Importance of Global Warming Issue (Order Probit Coefficients)

	(1)	(2)	(3)	(4)	(5)	(6)
Definitely environmentalist	0.6120**	0.6095**	0.5980**	0.6082**	0.5986**	0.5982**
	(4.22)	(4.20)	(4.14)	(4.20)	(4.12)	(4.12)
Somewhat environmentalist	0.3308**	0.3273**	0.3282**	0.3277**	0.3305**	0.3304**
	(5.62)	(5.57)	(5.58)	(5.58)	(5.62)	(5.61)
No HS diploma	-0.1111	-0.1173	-0.1142	-0.1151	-0.1131	-0.1127
	(0.83)	(0.87)	(0.86)	(0.86)	(0.84)	(0.84)
HS diploma	0.0826	0.086	0.0843	0.0822	0.0847	0.0846
	(1.08)	(1.13)	(1.10)	(1.08)	(1.11)	(1.11)
Some College	-0.0721	-0.0708	-0.0668	-0.0724	-0.0673	-0.0668
	(1.06)	(1.04)	(0.98)	(1.06)	(0.99)	(0.98)
Party ID	0.1269**	0.1276**	0.1260**	0.1274**	0.1257**	0.1256**
	(9.73)	(9.78)	(9.71)	(9.72)	(9.65)	(9.64)
August drought	0.2059**					
	(2.19)					
August heat wave		0.1741**				
		(2.01)				
Cool July and August						0.1784*
						(1.69)
Cool August					0.1655	
					(1.59)	
Heat wave in August and July				0.1824*		
				(1.92)		
Drought in August and July			0.1417			
			(0.98)			
Observations	2514	2514	2514	2514	2514	2514

Robust z statistics in parentheses. All estimations use sampling weights and include controls for household income, age, age squared and dummy variables for sample, region, gender, and marital status. * significant at 10%; ** significant at 5%

Table 5: Support for laws to protect the environment, including attitudes towards global warming issue (Probit Coefficients)

	(1)	(2)	(3)	(4)	(5)	(6)
Global warming extremely important	1.3986**	1.4015**	1.3965**	1.4084**	1.3991**	1.3951**
	(8.01)	(8.03)	(8.00)	(8.06)	(8.03)	(8.00)
Global warming very important	1.4682**	1.4707**	1.4672**	1.4735**	1.4666**	1.4640**
	(9.09)	(9.11)	(9.08)	(9.11)	(9.10)	(9.07)
Global warming somewhat important	0.9798**	0.9782**	0.9780**	0.9821**	0.9762**	0.9742**
	(6.40)	(6.39)	(6.38)	(6.40)	(6.39)	(6.36)
Global warming not too important	0.5901**	0.5922**	0.5889**	0.5928**	0.5916**	0.5863**
	(3.45)	(3.47)	(3.44)	(3.46)	(3.46)	(3.43)
August drought	0.1628		0.1358			
	(1.28)		(0.89)			
August heat wave		0.1129	0.0413			
		(0.95)	(0.29)			
August and July drought				0.1713		0.139
				(1.10)		(0.88)
Cool August and July						
Cool August						
August and July heat wave					0.2003	0.1861
					(1.45)	(1.33)
Observations	2473	2473	2473	2473	2473	2473

Robust z statistics in parentheses. All estimations use sampling weights and include controls for household income, age, age squared, political party identification and dummy variables for sample, region, gender, education, level of environmentalism, and marital status.
* significant at 10%; ** significant at 5%

Table 6: Importance of Global Warming: Interactions with Media Exposure and Heat waves

	(1)	(2)	(3)	(4)
No HS diploma	-0.1657	-0.1809	-0.1732	-0.1915
	(0.76)	(0.84)	(0.80)	(0.89)
HS diploma	0.0293	0.0275	0.0236	0.0193
	(0.25)	(0.23)	(0.20)	(0.16)
Some college	-0.0454	-0.0525	-0.0561	-0.054
	(0.50)	(0.57)	(0.62)	(0.60)
Party ID	0.2036**	0.2014**	0.2036**	0.2019**
	(10.48)	(10.30)	(10.50)	(10.32)
August heat wave	0.8446**		0.6748**	
	(2.67)		(3.15)	
August and July Heat wave		0.7341**		0.7020**
		(2.18)		(3.08)
Days News	0.0062	0.0042		
	(0.81)	(0.56)		
Days News*August heat wave	-0.0301			
	(1.64)			
August and July Heat wave* Days News		-0.0253		
		(1.27)		
Days Internet News*August heat wave			-0.0822**	
			(1.99)	
Days Internet News			0.0037	0.0029
			(0.22)	(0.18)
August and July Heat wave*Days Internet News				-0.1074**
				(2.36)
Observations	1121	1121	1121	1121

Robust z statistics in parentheses. All estimations use sampling weights and include controls for household income, age, age squared, and dummy variables for sample, region, gender, level of environmentalism, and marital status. * significant at 10%; ** significant at 5%

Table 7: Support for laws to protect environment, controlling for prior support and economic conditions (Probit Coefficients)

	(1)	(2)	(3)	(4)
Support in 2007	0.8980**	1.0174**	0.9981**	0.9778**
	(5.02)	(5.56)	(5.53)	(5.37)
Definitely environmentalist	1.0991**	1.2228**	1.1706**	1.4008**
	(3.42)	(3.66)	(3.59)	(3.82)
Somewhat environmentalist	0.4667**	0.5096**	0.5007**	0.5260**
	(2.61)	(2.83)	(2.79)	(2.94)
No HS diploma	0.1172	0.2702	0.1865	0.3126
	(0.34)	(0.75)	(0.53)	(0.87)
HS diploma	-0.2544	-0.2001	-0.2363	-0.2066
	(1.02)	(0.78)	(0.94)	(0.81)
Some college	-0.0899	-0.1044	-0.1449	-0.1447
	(0.38)	(0.42)	(0.58)	(0.57)
Party ID	0.1303**	0.1350**	0.1331**	0.1319**
	(3.02)	(3.08)	(3.05)	(2.98)
Currently working	0.1943	0.131	0.117	0.0815
	(0.95)	(0.61)	(0.56)	(0.38)
Vacancy Rate	4.3394**	5.0421**	5.0575**	5.1616**
	(2.03)	(2.39)	(2.34)	(2.45)
August heat wave		0.6690**		0.6425**
		(2.42)		(2.33)
August drought			0.4711	
			(1.61)	
Fell behind in payments				0.5338*
				(1.92)
Observations	415	405	405	404

Robust z statistics in parentheses. All estimations use sampling weights and include controls for household income, age, age squared, and dummy variables for region, gender, and marital status.
* significant at 10%; ** significant at 5%