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Declining public concern about climate change: Can we blame the great recession?☆

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ABSTRACT

Social surveys suggest that the American public's concern about climate change has declined dramatically since 2008. This has led to a search for explanations for this decline, and great deal of speculation that there has been a fundamental shift in public trust in climate science. We evaluate over thirty years of public opinion data about global warming and the environment, and suggest that the decline in belief about climate change is most likely driven by the economic insecurity caused by the Great Recession. Evidence from European nations further supports an economic explanation for changing public opinion. The pattern is consistent with more than forty years of public opinion about environmental policy. Popular alternative explanations for declining support – partisan politicization, biased media coverage, fluctuations in short-term weather conditions – are unable to explain the suddenness and timing of opinion trends. The implication of these findings is that the "crisis of confidence" in climate change will likely rebound after labor market conditions improve, but not until then.

1. Introduction

There is widespread evidence from national public opinion surveys that beliefs about the existence, immediacy, and seriousness of climate change have deteriorated during the last few years in the United States (Pew Center for People and the Press, 2008, 2009; Saad, 2009; Jowit, 2010; Kaufman, 2010; Satzman et al., 2010; McCright and Dunlap, 2011; Weber and Stern, 2011; Leiserowitz et al., in press). These changes have led to speculation about a "crisis of confidence" in climate science. Concern about public opinion is understandable as it is an important factor in policy change: while the earth's climate may not react to what people think about the climate, elected politicians often do.

Dominant explanations for the change in public opinion include: campaigns to promote "climate change" as a partisan political issue (e.g., McCright and Dunlap, 2011; Hoggan, 2009); allegations that scientists have suppressed evidence that the climate is not warming (Leiserowitz et al., in press); and cooler short-term global and seasonal temperatures in recent years, leading citizens to infer that long-term warming trends may have stopped or reversed (Woods Institute for the Environment, 2010).

While other factors – ideology, weather, variations in how the media cover climate – certainly play a role, our examination of the evidence suggests that poor economic conditions, specifically the recent economic downturn, can better account for the fluctuations, extent, and timing of the decline in popular concern about climate change over the last several years, particularly in the United States. We draw on three types of public opinion evidence to evaluate our claim: aggregate opinion trends in the United States since the 1990s; individual-level survey responses to seven polls administered between 2006 and 2010 in the United States; and aggregate public opinion trends about climate change in the 27 European Union countries between April 2008 and December 2009. Our analysis shows that declining concern about climate change in the face of economic turmoil is not unique to the United States or to the Great Recession. Moreover, labor market conditions appear to be more important in affecting concern than does news coverage of "anti-warming" claims, the "climategate" scandal, or changes in short-term weather conditions.

It may seem intuitive that there would be a negative relationship between opinion about climate change and economic conditions. However, a considerable amount of scholarship on post-materialist values during the last 30 years suggests otherwise (Inglehart, 1977, 2008). While Downs (1972) incorrectly suggested that early wave of environmentalism would fizzle in the face of economic hardship, he called attention to the possible negative impact of poor economic conditions on environmental concerns. Research on the issue has been surprisingly limited (Dunlap and Scarce, 1991; Dunlap and Mertig, 1992; Guber, 2003; Scruggs, 2003); and recent attempts to explain flagging opinion have paid little attention to the role of the economy (Walsh, 2009; Newport,

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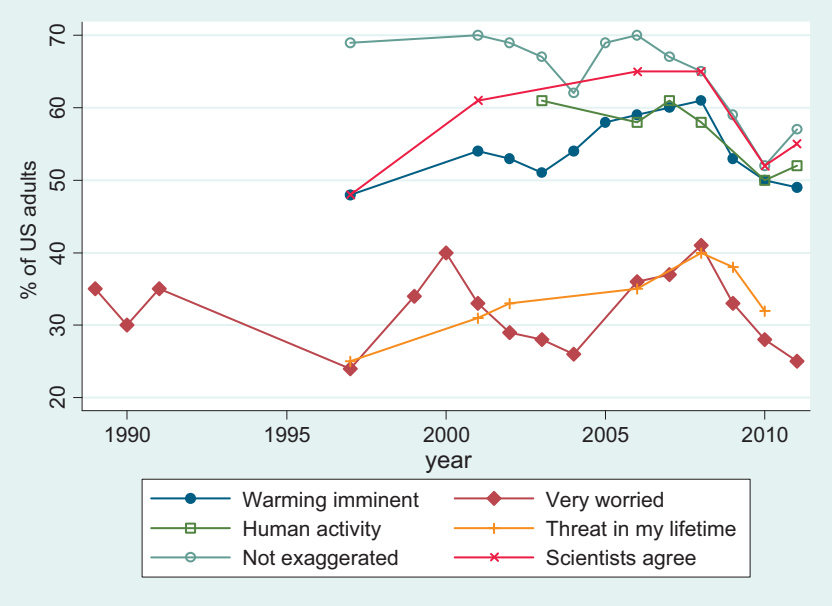

Fig. 1. Gallup poll trends on % of public support for questions about global warming.

2010; Satzman et al., 2010; Koch, 2010; McCright and Dunlap, 2011; Weber and Stern, 2011; Leiserowitz et al., in press).

2. Trends in public opinion about global warming: question wording does not seem to matter

Public opinion polling on climate change dates back to the mid-1980s in America (Nisbett and Myers 2007). The Gallup Organization has regularly asked several questions on the topic, some asked annually since the 1990s.[1] The most common question asks how much people *worry* about global warming. Since it was first asked in 1989, the percentage of people reporting that they worried about warming "a great deal" has peaked at the top of the economic cycle (i.e., in 2001 and in 2008). The percentage of adults saying that they worried a great deal about warming fell from 33% to 26% between 2001 and 2004. Worry then increased through March 2008, and then declined considerably: to 33% March 2009, to 28% in March 2010, and to 25% in March 2011.

Other Gallup survey questions on climate change show similar trends over time. The percentage of Americans agreeing that the seriousness of global warming is generally exaggerated by the media increased dramatically after 2008: from 35% to 41% in 2009, and then to 48% in 2010. Public agreement with the scientific consensus that the effects of warming are already being felt (National Research Council, 2010) shows a similar pattern. When first asked in 1997, only 48% agreed with this claim. Support rose to 53% in March 2001, dipped in 2002, and then rose steadily between 2004 and 2008 to 61%. In March 2009, however, only 53% agreed that effects of warming were already being felt. By March 2011, slightly less than a majority (49%) supported this view. Furthermore, in 2011, barely a majority of Americans (52%) said that human actions are mostly to blame for climate change, down significantly from 2008. Finally, the Gallup surveys show that the percentage of Americans who think that most scientists believe that the planet is warming fell by 13 points between March 2008 and March 2010 reaching the lowest level of support since the question was first asked in 1997 (Fig. 1).

National surveys conducted by other news and polling organizations corroborate the Gallup survey findings. For example, the Pew Center for People and the Press asked Americans several questions about global warming between 2006 and 2011. Like Gallup, the Pew surveys indicate that the public increasingly agreed with the scientific consensus before 2008. But then the trend reversed. Agreement that there is "solid evidence" of warming declined from 77% in 2007 to 71% in 2008, to 57% in October 2009, and stood at 58% in February 2011. Agreement that warming is a "very serious" or "somewhat serious" problem fell from 77% in 2006 and 2007 to 63% in 2010.

National surveys conducted at Stanford University and Ohio State University between October 1996 and June 2010 provide further evidence of this pattern. The percentage of American adults agreeing that the planet has been warming over the last century increased from 76% in 1996 to about 85% in 2007, but then declined to 80% in July 2008, to 75% in November 2009 and to 74% in June 2010 (GfK Roper, n.d.; Stanford 2010). Fox News and Cable News Network surveys asking similar questions are also consistent with these findings. In the Fox News survey, the percentage of Americans agreeing that "global warming exists" fell from 82% in January 2007 to 69% in May 2009 and then to 63% in December 2009.

Overall, public beliefs about climate change clearly reflect a more skeptical view in recent years. The size of the decline is considerable: around 10–20% over a short period of a year or two. The decline in support is consistent across survey questions, be they very subjective evaluations (e.g., personal worry), "facts" (e.g., warming has begun), or complex "evaluative" issues (e.g., most warming is human induced). While a majority of Americans still view global warming as real and problematic, the large, recent decline makes it understandable that scientists and policymakers would wring their hands over the public's apparently increasing ambivalence about climate change.

3. Explanations for changing public opinion about warming and climate science

3.1. Media, conservative counter-mobilization and public opinion

A common explanation for rising doubts about climate change among Americans is the existence of coordinated efforts to dissuade the public about climate science. McCright and Dunlap

[1] Survey question wordings are contained in the appendix.

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(2000, 2011) catalog efforts by conservative groups in America toward this end (also Hoggan, 2009). They argue that the conservative movement has been influential in raising the profile of climate skeptics and actively disseminate such claims among political elites and the public. Such information may be effective in shifting lay opinion against the scientific consensus, because non-specialists rely more on elites and the media when forming opinions about complex problems such as climate change (Wood and Vedlitz, 2007; Soroka, 2002).

Media coverage of issues like climate change can certainly affect public opinion (McCombs and Shaw, 1972; Krosnick and Kinder, 1990). Given the media's tendency to report conflicting views on issues, media outlets may be susceptible to misrepresenting the scientific consensus, or to presenting to the public an excessive emphasis on opposing views about the extent, causes, and consequences of climate change (McCright and Dunlap, 2000; Boykoff and Boykoff, 2004; Antilla, 2005; Krosnick et al., 2006).

When media pay more attention to scientific conflicts than to consensus, the public's view of the objectivity and competence of scientific experts will be more negative than informed scientific opinion (Weber and Stern, 2011). Public opinion research suggests, furthermore, that people with the least grounded opinions are the most susceptible to fluctuating media information (Zaller, 1992). Given their greater reliance on the media, it makes sense that media portrayals could move overall opinion about abstract and complex issues.

The media-coverage/partisanship explanation is logically consistent, but there is little evidence that it actually explains the magnitude of public opinion changes observed in recent years. McCright and Dunlap (2011), for example, explain *how* and *why* American conservatives have tried to affect the climate change debate; they do not systematically evaluate how much (if at all) these strategies have actually worked on public opinion. Partisanship is, of course, a strong predictor of differences in attitudes about climate change in numerous cross-sectional studies (Dunlap et al., 2001; O'Connor et al., 2002; Dunlap and McCright 2008; Zia and Todd, 2010; McCright and Dunlap, 2011). However, partisanship and ideological polarization fail to explain large declines in public opinion among non-partisans and those on the political left. There is little evidence that the average degree of partisanship has increased nearly enough to explain the large shifts in opinion (Fiorina 2009).

A second limitation of media and partisan "counter-information" explanations is the timing and character of public opinion trends. McCright and Dunlap (2011) locate a shift towards attacking climate science in the early to mid-1990s, and suggest that the politically bifurcated flow of climate change information has only grown since then. Yet the public increasingly embraced the scientific consensus from the late 1990s until 2007–8. Furthermore, the negative shift in opinion was dramatic and sudden. While the content of partisan messages no doubt plays a role in opinion formation, we think the rapid patterns of opinion change we have recently observed are more consistent with the effects of economic recession than with ideological polarization.

Claims that the so-called "climategate" scandal – a cause célèbre for the climate skeptic movement (Pearce, 2010) – can explain declining public opinion about climate change also fail to explain the timing of opinion change.[2] Public opinion fell precipitously *before* "climategate" occurred. In an October 2009 survey, one month before the computer hacking incident, a Pew Center found that 57% of the public believed that there was solid evidence of warming, down 14 points from the last time Pew asked the question in April 2008. The next time Pew asked the question, in October 2010, support warming was occurring was virtually identical to what it was the previous October. Evidence from Stanford, Gallup and Fox polls also suggests that the decline in the public's belief in planetary warming occurred before "climategate".

3.2. Weather

A second explanation for lagging belief in climate change blames short-term weather patterns. Several recent studies suggest that people are more likely to say that they believe that global warming is occurring if they think that recent local temperatures are higher than normal (Li et al., 2011; Krosnick et al., 2006; Egan and Mullin, 2010). Li, Johnson and Zaval argue that this is due to "attribute substitution" whereby people use a simple familiar attribute (recent local weather) to substitute for more an unfamiliar, complex attribute (climate change) when forming an opinion. This explanation makes sense with respect to opinion about climate change: confusion between "changes in the weather" and "changes in climate" is not intuitive, and this kind of misattribution may be adaptive (Weber and Stern, 2011).

Researchers have even suggested that cooler weather might explain the public's declining concern about climate change in recent years (Woods Institute for the Environment, 2010; Science Daily, 2011). But the literature has really only confirmed that local temperature anomalies are correlated with "pro-warming" opinions. Since local weather conditions fluctuate above and below their local means at any given time, whether these extreme *local* anomalies add up to the observed changes in *national* opinion has not been definitively demonstrated.

3.3. Economic conditions

A third explanation for fluctuating attitudes about climate change is that the public has adjusted their beliefs about climate in light of the economic crisis. Surveys of the public's willingness to sacrifice economic development for more environmental protection (like mitigating climate change) suggest that environmental concern is inversely related to the health of the economy. For example, as unemployment increases, people prioritize environmental protection less (Guber, 2003). This suggests that environmentalism is something of a "fair weather friend".

Fig. 2 shows the proportion of American respondents in regular national surveys who say they would prioritize environmental protection even at the expense of some economic growth plotted against the national unemployment rate. This "environment versus growth" survey question has been repeated annually since the mid-1970s by two different survey organizations. There is a clear negative correlation ($\rho = -.43$, $p < .01$, $n = 48$). There is a similarly strong negative correlation between the unemployment rate and the percentage of respondents to the General Social Survey, over the years 1973–2008, who suggest that the country should devote more resources to environmental protection ($\rho = -.62$, $p < .001$, $n = 26$) (Smith et al., 2011). Of course, unemployment does not produce an absolute disregard for the environment, but it does suggest changed *priorities* for many people.

That the public would re-prioritize climate change during economic recession seems just as plausible as their apparent tendency to do so with respect to the environment more generally. There is, in fact, direct evidence over the last two decades that changes in the economy affect the priority given to climate change. Using Gallup survey trends dating from 1989, the correlation

[2] Leiserowitz et al. (in press) compare responses in a survey conducted before large increases in unemployment (October 2008) and one conducted soon after the climategate scandal (late December 2009). They attribute the decline in belief that the warming is occurring (71–57%) to the climategate revelations. Their design does not control for the effects of recession on changes in opinion.

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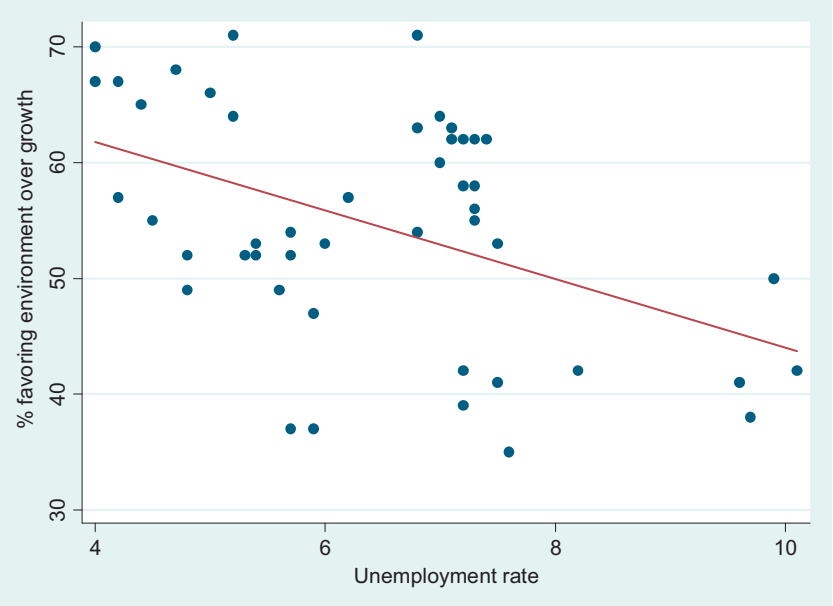

Fig. 2. Americans support of environmental protection as the expense of some economic growth, 1974–2010. *Note*: Information is from two different survey series, one by Gallup and one by Cambridge Research associates, with similarly worded questions. (Exact question wording is provided in the supplementary appendix) A Chow test confirms that the two series can be pooled.

between the unemployment rate and the percentage of American adults agreeing that the media "exaggerate the seriousness of global warming" is very high ($\rho = .92$, $p < .001$, $n = 12$).

What is more puzzling is not that people's *priorities* shift with the economic conditions, but that their *beliefs* about basic climate facts and their trust in climate science also appear to change. The condition of the economy should not alter perception of basic facts or the state of scientific opinion. And yet public opinion trends suggest that people are more likely to "deny" various facts today than they were a few years ago.

A major factor influencing this pattern is likely to be dissonance reduction (Festinger, 1957; Thogersen, 2004). Cognitive dissonance arises when individuals have conflicting beliefs or behaviors; people alter beliefs to be consistent with their behavior. We suggest that economic recessions lead people to demand behaviors by governments, other individuals, and themselves to increase current economic activity and consumption which conflict with their beliefs about what is needed to ameliorate climate change: limiting economic activity. When the desire for "anti-mitigation" behavior is strong ("we must stimulate the economy"), dissonance with its environmental cost is reduced by changing expressed beliefs ("oh, global warming is just a theory"). Of course, dissonance could also be ameliorated by changing beliefs about the need to expand production ("we have to live with fewer jobs") or by adjusting beliefs about the compatibility of short-run economic stimulus and long-run solutions to climate change ("we can have economic growth and reduce greenhouse gas emissions"). Neither of these resolutions is readily available in people's minds. The former is widely viewed as politically unacceptable, while the latter may not be politically credible.

McCright and Dunlap (2011) suggest climate denial among conservatives is similarly based on a form of cognitive dissonance whereby uncomfortable facts about warming are actively rejected in order to maintain what they term a "simple modernist" worldview. Their evidence links party and ideology to these positions. However, they attribute dissonance almost exclusively to political conservatives. By allowing for a more "non-partisan" dissonance pattern, we can reconcile *both* ideological polarization on climate change and the aggregate drop in concern about and belief in basic climate science. Conservatives may be *more likely* than political liberals to resolve dissonance problems in times of economic hardship "against climate science", because they see *more* conflict between economic development and government economic regulation. Thus, an economic crisis may precipitate a shift in beliefs that is *uniformly* "anti-warming" and "anti-science", in the population, but *more pronounced* for conservatives. This effect may be similar to the mediating effects of education and ideology on beliefs about climate change (Malka et al., 2009; Krosnick et al., 2006; Egan and Mullin, 2010; McCright and Dunlap, 2011).

4. Data

In this section, we describe the data that we use to evaluate the three different explanations for declining public concerns about climate change identified in the last section. As the wording of specific survey questions affects responses, when trying to understand changes in opinion over time, it is best to compare similarly or identically worded questions. Unfortunately, there are only a few climate change survey questions that have been repeated over a substantial length of time; and, as the information in Section 2 suggests, even these have been asked quite infrequently.

We utilize three sets of data on climate attitudes. The first draws on aggregate public opinion poll results from the Gallup, Pew and Stanford/Ohio State surveys about basic belief about climate warming. The Gallup question has been asked on twelve different occasions all in March (1997, 2001–2011) and codes the percentage of adults saying that "the effects of global warming" have "already begun to happen". The Pew Center data contains the percentage of American adults in each survey (June, July and August 2006, January 2007, April 2008, October 2009, October 2010, and February 2011) agreeing that "there is solid evidence that the earth is warming". Finally, the Ohio State/Stanford poll is asked on seven different occasions dating back to the late 1990s (1997, 1998, 2006–2010), and gives the percentage of American adults that agree that "the world's temperature may have been going up over the last 100 years". While these three survey questions differ in wording and are asked by different survey organizations, all ask about the basic belief that warming is

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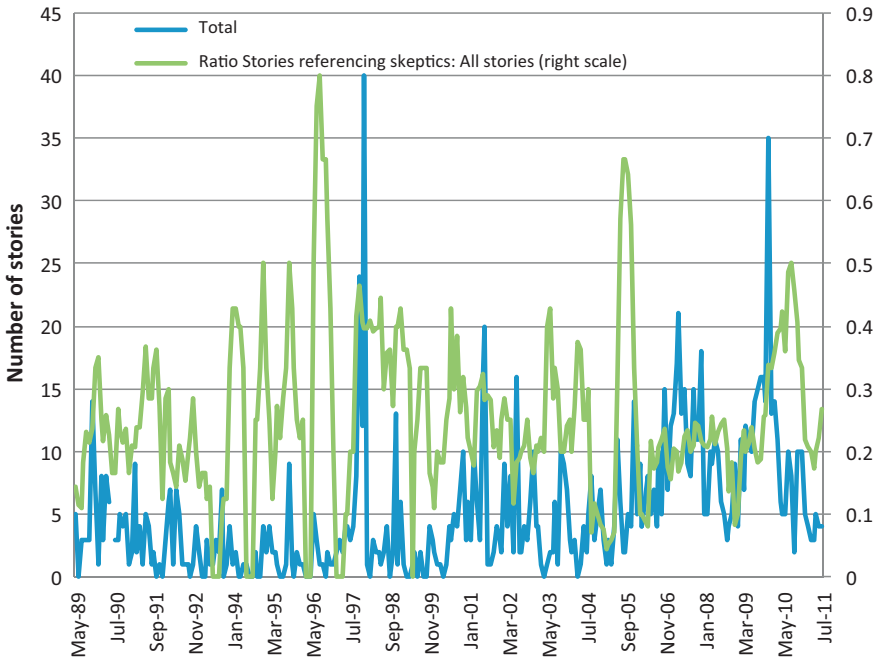

Fig. 3. Counts of New York Times Stories on warming, and ratio of "critical" mentions.

occurring. While we would not expect each question to elicit the exact same level of support, we would expect that the responses to these questions are affected in very similar ways to changes in the amount of skeptical media coverage, recent weather pattern, and economic conditions.[3]

The second data set used to evaluate these three explanations is comprised of individual respondents in the Pew Center surveys for years 2006–2010. We used the Pew surveys because the information allowed us to match zip code information to respondents; this in turn enabled us to match individual respondents with local temperature and economic information. We focus on responses to the question "Is there solid evidence that the earth is warming?"

The third dataset uses a battery of questions asked three times in 27 European countries in April 2008, January 2009, and September 2009 (European Commission, 2008, 2009, 2010). Each survey was administered to a representative national sample drawn from each member state of the European Union in each time period. National sample sizes are at least 1000 in most countries, though Malta, Cyprus and Luxembourg use sample sizes of approximately 500. While the overall interval of time evaluated here is limited (less than 2 years), the timing of the surveys is before, during and at the end of the Great Recession (notwithstanding additional economic turmoil in the EU in 2011). The impact of the recession on different European countries varies, so we have a type of natural experiment. We observe what happens to opinion before and after economic conditions deteriorate, with variation across countries in the extent of economic recession. For ease of exposition, this data and analysis are reported together in Section 7.

[3] Sample size for the surveys varies somewhat from survey to survey. Gallup and Stanford/Ohio State polls each have approximately 1000 respondents; the Pew survey samples are all at least 1500. Percentages used include sampling weights to make responses representative of the natural adult population in the USA. The pattern of responses to questions about science, trust in scientists, priorities generally follow the same pattern as the basic belief questions in these surveys, as illustrated in the Gallup results in Fig. 1. However, most of these other questions are asked less frequently than the basic "is the earth warming" question.

4.1. Measuring "Skeptical" media coverage

People with low information, expertise, and ideological predisposition are most susceptible to public viewpoints presented by elites and in public debate (Zaller, 1992). We expect that when media is portraying a more skeptical view of the scientific debate about warming, public opinion will tend move in a more skeptical direction (see Malka et al., 2009; Krosnick et al., 2006). To evaluate this hypothesis, we use information about the content of news coverage on climate change. We measure the ratio of critical stories to all stories on climate change, coding articles in the *New York Times* between March 1989 and July 2011. Various types of content coding are widespread in media studies of climate change reporting (e.g., Brossard et al., 2004; Boykoff and Boykoff, 2007; Antilla, 2005). Unfortunately, these and other longitudinal studies end prior to the Great Recession.

With more critical mentions in their stories, we expect opinion to be more skeptical that climate change is occurring. To assemble our skeptic ratio, we collected all headlines in the *New York Times* mentioning "climate", "greenhouse", or "warming" from March 1989 to July 2011 from Lexis/Nexus. After purging stories clearly not about climate change, or which were published in the obituaries, Metro or other Regional sections of the paper (because these sections are not distributed nationally), the remaining 1277 items were then coded for location in the paper: Front page, front (A) section, and editorial. Counts for the respective codes were: 612, 96, and 337. Next, we performed a similar breakdown on the subset of all of the above items that mentioned the word fragments "critic", "skeptic", or "doubt", in the text or in the headline. There were 285 such articles with 163 in the A section, 42 front page stories, and 40 in editorials. We did not count editorials in this analysis, as most of these were short letters to the editor. Counts were aggregated on a monthly basis and the skeptic ratio was computed as the monthly ratio of stories with skeptical mentions to those without.

Fig. 3 plots total stories on the left *Y*-axis and the skeptic ratio on the right *Y*-axis against time. It suggests that there has not been a secular increase over time in the overall ratio of articles skeptical

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stories.[4] Spikes in total stories correspond to major international climate conferences – e.g., Kyoto (late 1997), Genoa (2001), Copenhagen (late 2009) – and the publication of the 2007 IPCC 4th Assessment Report. Skeptic arguments seem to be most pervasive during the late 1990s, but have fluctuated considerably over the measured interval. Since we want to use the skeptic index as proxy for the amount of skeptical arguments in the media more widely, we are not necessarily concerned with whether the content of the *Times* coverage mentions skeptic arguments to refute them, only that they reflect general prevalence of those positions in the media. We use the average skeptic ratio during the two months prior to the date of the surveys analyzed in the statistical analysis.[5]

4.2. Data for short-term weather anomalies

In trying to determine an appropriate model for the effect of recent weather on attitudes about climate change, we have to consider the individual experience of weather, both in time and space. One approach would be to look at trends in global temperatures, since these may be widely reported and viewed in the public as evidence that average temperatures are rising or falling. Another approach would be to consider a more limited scale and scope of coverage, focusing on more recent anomalies in national or even local weather. For example, survey respondents in America might be much more sensitive to seasonal anomalies in the US – whether last winter was unusually warm or cool – and not with the world as a whole. We explored both possible empirical connections. To measure *global temperature anomalies*, we use data from NASA's Goddard Institute land-ocean temperature index (NASA, 2011). These data are lagged one year, since the calendar year anomaly is not known and reported until the subsequent year. To measure *national seasonal anomalies*, we use the National Climate Data Center information on the average temperature anomaly in the contiguous United States for the season preceding the survey date (NOAA, 2011). For example, the Gallup survey is typically conducted in March of each year, so we would use the anomaly for the winter season, December–February in the statistical analysis. For both global and regional temperature measures, we expect higher anomalies (warmer weather) to produce more support for the existence of climate warming.

For the analysis of individual-level responses, we test for the impact of short-term local temperature anomalies on opinions. Since people are much more familiar with their immediate, local weather conditions, we expect that people will react more intensely to local conditions (Weber, 2010). To measure short-term temperature anomalies on individual climate attitudes, we merged information on local temperature history for individual survey respondents. 98% of the respondents to Pew surveys (a total of 11,721) conducted in 2007–2010 provided five digit zip codes. These were matched to Zip Code Tabulation Areas (ZCTAs). The 10,562 respondents with ZCTAs were then linked to temperature data from the nearest weather station in their ZCTA or the adjacent ZCTA. The National Climatic Data Center (NCDC) calculates departures from normal temperatures (DPNT) for each day over the period 1971–2000: the average DPNT for the week (seven days) prior to the survey data was averaged and merged with each individual survey. Since we can only test the effect of local variations on individual-level responses, results for this measure are reported in only Section 6.

4.3. Data for economic context

To evaluate the impact of the economy on changing beliefs about climate change, we use conventional measures of economic conditions that are widely reported. We expect that labor market conditions – proxied by the monthly unemployment rate published from the Current Population Survey by the Bureau of Labor Statistics (US Department of Labor, 2011) – will be influential on public opinion.[6] Unemployment is a more appropriate measure of economic conditions than other commonly reported measures like economic growth for several reasons. First, unemployment is vital to material well-being and happiness for the overwhelming majority of households, while overall income growth in the last several decades has gone disproportionately to a very small segment of the population (Saez, 2009).[7] Second, the unemployment rate is estimated directly via very large population surveys, while a common macro-economic indicator like the economic growth rate is volatile and subject to large revisions (Mankiw and Shapiro, 1986).

In the analysis of aggregate US and European data (Sections 5 and 7), we use the national rate of unemployment in the month before the climate change survey was conducted. For tests of individual responses from Pew surveys analyzed in Section 6, we measure the unemployment rate in the state of the respondent in the month prior to the survey asking about climate change opinions. We expect to see a decline in belief in global warming as unemployment increases in the respondent's state.

As a test of the robustness of our results in Section 5, we include the Consumer Confidence Index as an alternative measure of economic conditions. The Consumer Confidence Index is based on a monthly national survey of individuals' assessments of business, employment, and personal income conditions at present and over the subsequent six-months (Conference Board, 2011). It is also a commonly cited indicator in the press of consumer sentiment, though it is more volatile, and almost certainly less widely known than the unemployment rate. This measure is not available at the state level.

5. Results for aggregate public opinion trends

In this section we report test results for aggregate opinion trends from the Pew, Gallup and Stanford/Ohio State polls. We report OLS estimates of the multivariate relationship between the percentage of the population saying that there has been global warming and measures of each of the theoretical explanations discussed in Section 3: weather, media bias, and the economy. The statistical estimates "pool" observations for the three alternative "warming now" questions, one item each from the Pew, Gallup, or Stanford/Ohio State surveys. The estimation model includes a "fixed effect" for each for different survey question wording. The fixed effect controls for the possibility that the three different survey questions being pooled have a different average positive response rates due to things other than the variables explicitly in the model (Wooldridge, 2009). The general form of the multivariate equation is:

$$\begin{aligned}\%\ \text{saying warming is occurring} &= D(\text{Gallup survey}) + D(\text{Pew survey}) \\ &\quad + D(\text{Stanford survey}) + \text{Skeptic index} \\ &\quad + \text{Weather anomaly} + \text{Economic conditions} + e.\end{aligned}$$

Table 1 provides regression estimates. The table reports standardized coefficients and *t*-scores in parentheses. Since there are two alternative measures for weather and economic

[4] This measure has limitations since it does not content code each story. For example, it may misattribute stories that refute erroneous skeptical claims as being critical stories.

[5] We experimented with a six-month moving average with no substantive effect on our results.

[6] Analysis using a broader definition of unemployment which includes discouraged workers and the underemployed produces very similar to results to what we find for the traditional unemployment rate used here.

[7] The same problem applies to measures like the movement of the stock market.

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Table 1
Public opinion that warming is underway: regression results.

	1	2	3	4
Media				
Skeptic ratio	−.06	−.02	−.10	−.03
	(.80)	(.29)	(1.23)	(.43)
Weather				
Seasonal temp anomaly	.11		.20	
	(1.63)		(2.51)**	
Global temp anomaly		.18		.24
		(4.34)***		(3.30)***
Economy				
Unemployment rate	−.31	−.38		
	(4.25)***	(5.70)***		
Consumer confidence index			.10	.28
			(1.40)	(2.91)***
R-squared	.91	.93	.85	.86
n	27	27	27	27

Standardized coefficients; *t*-scores in parentheses.
** $p < .05$.
*** $p < .10$.

conditions, we provide estimates for all combinations of measures evaluated previously. The estimates for the fixed effect terms are not shown in the table.

These estimates are based on a relatively limited number of observations (27), an inherent limitation of the available survey data. Nonetheless, the results suggest some support for the economic explanation, particularly for the impact of unemployment. The unemployment rate is consistently estimated to be an important correlate of change in beliefs about climate. A standard deviation increase in unemployment (∼2.1 points) is associated with sizable decline in support for climate change (about .33 standard deviations, ∼4 points). The consumer confidence index is estimated to be a somewhat weaker indicator of opinion.

There is more modest support for *weather* as an explanation for differences in public attitudes about the existence of climate change. A standard deviation increase the observed seasonal statistical anomaly (∼.85) is expected to increase opinion by between .1 and .2 standard deviations. The global anomaly appears to be a much better correlate of opinion. A standard deviation in the observed anomaly is associated with a .18–.24 standard deviation increase in belief that warming is underway.

Together, economics and weather explain much of the observed variations in opinion between 2008 and 2009:2009 was both a relatively cool year and a year with high unemployment. However, only the economic indicators are consistent with continued low public concern about warming in 2010 and 2011. Unemployment was high during those years, while temperatures returned to their long-term upward trajectory. Based on the relative size of the coefficients and *t*-scores in Columns 1 and 2, unemployment effects on opinion are two to three times greater than the effects of weather or the skeptic index. Recall that Section 3c suggests that there is corroborating evidence of the effect of unemployment and the economy "environmental concern" historically.

Finally, the skeptic index receives minimal support in the regression: while the estimates have the expected (negative) sign, they are not statistically different from zero in any of the models.

6. Evidence from individual—level survey responses

In this section we test for effects of changing weather and unemployment at the sub-national level, using individual-level responses from the Pew surveys, local weather data and state unemployment rates. The Pew surveys are the same Pew polls used in the previous analysis. Here, however, we estimate the likelihood that an individual responds positively to the question about planetary warming. The total number of respondents included (across the seven surveys for which we have individual data, 2006–2010) is 9572.

Since we are modeling an individual's agreement with the claim that there is evidence that warming in underway, the dependent variable is binary: "yes" or "no". A few volunteered "don't know" responses were recoded to "no". OLS regression is inappropriate with a binary dependent variable, so we estimate the model using logistic regression.

Recall that we measure the effect of economic conditions by the unemployment rate in the respondent's *state* in the month prior to the survey (US Department of Labor, 2011); and we measure the effect of local weather as the *deviation from normal temperature* in the week prior to the survey at the weather station nearest to the respondents reported zip code; and we measure. We do not have a measure of the skeptic index that varies within a particular survey sample, so this is not considered. The results in the previous section seem to justify excluding it here in any case.

In addition to contextual weather and unemployment data, we include controls for various demographic factors that might affect responses to the climate change questions. Drawing on previous work on predictors of beliefs about climate change, we control for the following factors: gender, age, race, frequency of religious attendance, ideology, party, education, and income (Egan and Mullin, 2010; Malka et al., 2009; Krosnick et al., 2006; Zia and Todd, 2010). Finally, in estimating the model, we include different intercepts for each state. Including these fixed effects allows us to control for unspecified factors unique to states that might otherwise be captured by the unemployment rate or local weather information. There is no fixed effect for survey year, because individuals and state unemployment rates are not fixed, and we actually want to capture over time variations in mean state unemployment as an unemployment effect. The state fixed effect estimates are not reported in the table.

The estimates reported in Table 2 are odds ratios for the main independent variables and demographic controls. Both unemployment and temperature variations have a statistically significant effect on opinion about warming, and are in the expected direction. The coefficient of .873 for state unemployment rate implies that, conditional on the other variables in the model, a one point increase in the unemployment rate in the respondent's state makes that person only 87.3% as likely to agree that warming is occurring. Thus, if state unemployment went from 5% to 8% (all else equal), we predict that the probably of an individual agreeing that the planet is warming under the higher rate to be only about 66% (.873*.873*.873) of what it is under the lower rate. This estimate is statistically significant and corroborates other indirect evidence about the impact of unemployment on opinion (Kahn and Kotchen, 2010).

The corresponding odds ratio for the effect of local weather conditions is 1.011. Thus, all else equal, if the local temperature 5 degrees above normal in the week before the survey, people are a bit more than 5% more likely (1.011^5 = 1.056) to agree that there is solid evidence of warming. This modest result is consistent with findings elsewhere (Egan and Mullin, 2010).

The results for demographic controls are largely consistent with previous research and corroborate the demographic results found by Egan and Mullin (2010) and McCright and Dunlap (2011). Males are less likely than women to agree with the consensus of scientific evidence that the earth is warming. The "churched" (those who attend church at least a few times a year) are significantly less likely than those who never go to church to agree that the planet is warming. Evidence for clear partisan divisions on climate change is clear, and reflects findings in other studies (O'Connor et al., 2002; Zia and Todd, 2010; Malka et al., 2009). Republicans are about 75% as likely as Independents to believe that climate change is occurring, and "very conservatives" are about 50% (or half) as

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Table 2
Logistic regression estimates.

Is there solid evidence that the Earth is warming?	Odds-ratio
Dev. from norm. temp. (°F)	1.011***
State UE rate (%)	0.874***
Male	0.823***
Race	
Black	1.004
Hispanic	1.022
Other non-white	1.521***
Age	
18–24	1.108*
25–34	1.003
35–44	1.132***
55–64	1.157***
65+	0.977
Education	
High school	1.116***
College grad	1.008
Post grad	1.140**
Party affiliation	
Republican	0.736***
Lean republican	0.839***
Lean democrat	2.289***
Democrat	2.521***
Ideology	
V. conservative	0.469***
Conservative	0.681***
Liberal	1.430***
V. Liberal	2.293***
Church attendance	
Attend often	0.783***
Monthly	0.882**
A few times a year	0.747***
Income ($)	
Income under 20 K	1.299***
50–75 K	0.827***
75–100 K	0.991
100–150 K	0.840**
150+ K	0.924
Constant	6.599***

Notes: Reference categories for each variable are: Gender: Female; Race: White; Age: 45–54; Education: Some college; Party affiliation: Independent; Ideology: Moderate; Religious attendance: Never. Family income: $20,000–49,999.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

likely as "neutrals" to believe. Democrats are about 2.5 times more likely than Independents to believe the climate is warming, and "very liberals" are 2.25 times more likely than "neutrals" to believe.

Our results do not suggest that Republicans or conservatives are uniquely partisan when it comes to climate change opinions. Republicans move from about 60% believers in 2006 to about 38% believers in 2010. Support by self-identifying Independents decreased by almost the exact same amount: 79–58%. Even among Democrats, the decline in belief that the planet is warming – 90% to 80% – is substantively and statistically significant. These changes in opinion among Independents and Democrats are inconsistent with the notion that Republican partisans are exceptional. In fact, our explanation is compatible with Democrats (or liberals) as a group being less likely to change opinions—they have fewer conflicting beliefs about government and positive economic activity, so can more easily reconcile stimulating economic activity and acting to stop climate change.

7. Evidence from Europe

As a third test of the hypothesis that recent public opinion about climate change can be attributed to the Great Recession comes from Europe. The public and elites in Europe are widely regarded as having a much higher level of concern about climate change and basic acceptance of climate science than Americans do (Leiserowitz, 2007). Europe has been on the forefront of efforts to establish international institutions to reduce major greenhouse gas emissions (Schreurs and Tiberghien, 2007; Keleman and Vogel, 2010; Stoddard, 2010). Citing EU officials, Schreurs and Tiberghien (2007:30) conclude that "climate change is an issue that has reached such a level of social and political acceptability across the EU that it enables (indeed, forces) the EU Commission and national leaders to produce all sorts of measures, including taxes". Support for this view can also be seen in news reports over the last several years. Headlines like "In Europe, a Call for Tighter Caps on Greenhouse Gas Emissions", "Europeans Say U.S. Lacks Will On Climate", "Europe Sets Ambitious Limits on Greenhouse Gases" attest to this characterization (Kanter, 2010; Broder and Kanter, 2009; Bilefsky, 2007).

Because Europeans seem to be more supportive of climate change, the effect of the economy on opinion provides a test for our economic explanation of climate change opinion. Comparing European opinions over the economic cycle requires opinion trends over the cycle. The EU's Eurobarometer Survey asked several climate change questions at several critical periods surrounding the Great Recession: "pre-recession" (April 2008), mid-recession" (January 2009) and "late recession" (September 2009).[8] Since these surveys contain representative national samples, it is possible to correlate changes in national opinion about climate change with the severity of the recession by country.

Three different climate questions in the Eurobarometer correspond to the types of questions asked in US surveys. The first question asks "How serious a problem do you think climate change is at this moment?" on a scale of 1–10? We coded responses of 8, 9, or 10 as indicating that the respondent thinks it is a "very serious" problem. We find that the magnitude of the decline in opinion in the EU (considered as a whole) during the recession period is very similar to what we observed in the United States. Concern there declined from 61% in 2008, to 53% in 2009, and then to 45% in late 2009. In every EU countries, the perceived seriousness of warming declined between April 2008 and December 2009.

Trends for the other two climate change questions in the Eurobarometer show a now familiar pattern. The questions are:

"For the following statements, please tell me whether you totally agree, tend to agree, tend to disagree or totally disagree:

The seriousness of climate change has been exaggerated

Emissions of CO_2 have only a marginal impact on climate change"

Overall, very few – 20–30% in most countries – say that "climate change has been exaggerated", or that CO_2 "has a marginal impact" on warming. However, as the Great Recession unfolded, doubts among European citizens increased substantially. There was a significant increase in the proportion of adults saying that climate change is exaggerated in 16 EU countries in the period: Denmark, Spain, Italy, the Netherlands, Sweden, Czech Republic, Hungary, Estonia, Latvia, Lithuania, Malta, Poland, and Slovakia. The largest changes again came in Eastern Europe: Latvia, the Czech Republic, Estonia, Lithuania, and Poland. Between April 2008 and January 2009, the portion of people agreeing that CO_2 did not matter much for warming increased considerably, but only the Eastern European

[8] EU countries were not technically in recession until the second quarter of 2008. In September 2009 most EU countries were emerging from the recession, although as in America, labor market improvements lagged the upturn in production.

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Table 3
Unemployment and support for climate change in European Union countries.

	Serious problem	Exaggerated	CO_2 not relevant	Negative to all questions
Unemployment				
b	−2.45	0.91	0.55	0.80
robust s.e.	.24***	0.25***	0.39	.13***
	87	87	87	87
R-squared (within)	0.36	0.34	0.09	0.42

All models use a fixed effects estimator for country;
*$p < .10$
**$p < .05$.
*** $p < .01$.

countries saw significant increases in skepticism from the first to the third survey in the series.

While these results partially corroborate the effects of economic conditions on public support for climate change policy in the United States, we can explore whether there is a correlation between the extent of the economic downturn in EU countries and the change in public opinion in that country.[9] To do this, we estimate four regression models using aggregate national responses from the three climate survey questions just discussed. There is a model for each of the three survey questions about climate change. We also created a fourth measure which is the percentage of the population in each country who responded "negatively" to all three individual questions; that is, the portion of the population who do not perceive climate change to be a serious problem, consider the problem exaggerated, and say that CO_2 plays a negligible role in climate change. There are 87 data points, one for each survey in 29 EU 'countries': 27 EU member states, plus Germany is split into Eastern and Western regions, and the United Kingdom split between Great Britain and Northern Ireland.

The main independent variable in all three models is the national unemployment rate for the quarter preceding the survey (Eurostat, 2010). The main hypothesis is that higher increases in unemployment lead to a greater degree of climate skepticism. Table 3 reports results for OLS estimates for with country fixed-effects (Wooldridge, 2009, 481). The logic for choosing fixed effects for countries was explained in Section 5: the units do not vary over time, and there may be unaccounted for variance within countries (besides unemployment) that affects the level of public opinion.

The results reported in Table 3 show that among European countries there is a very strong association between increases in unemployment rates and increases in skeptical opinion. A one point increase in national unemployment is associated with a 2.5 point decline in the percentage saying that warming is a serious issue, and almost a one point increase in the percentage of the country saying that warming is exaggerated or saying that it is simultaneously not serious, exaggerated, and not due to CO_2 emissions. We do not find a strong association with unemployment and the percentage of people who say that carbon dioxide has a marginal impact on climate change, though the estimated effect is in the expected direction.

These regression results suggest that a shift in the national unemployment rate from 5 to 9% in Europe (approximately the increase in unemployment in the United States during the time period) reduces the percentage of people reporting that global warming is a very serious problem by about 10 points. This is very close to actual change for the equivalent question during the equivalent period United States (i.e., to the Pew poll question, "How serious a problem is global warming?" in April 2008 and October 2009): 8 points. Keeping in mind that direct comparison of effects should be treated with caution and that the wording of the questions asked in the US and EU is different, the changes in American opinion seem in line with how public opinion in Europe has responded to the effects of the recession.

In summary, the effects of the Great Recession on public opinion about climate change were very similar in European countries and the United States. All European countries experienced declining public opinion about warming as the Great Recession has developed, and those that fared the worst economically tended to see the largest declines in opinion.

8. Conclusion

Past and recent public opinion in the US and Europe indicates that beliefs and concerns about climate change are affected in very important ways by short-term economic and weather conditions. These changes are consistent with over-weighting of recent events, and of shifting beliefs to reduce cognitive dissonance about short term needs and long term problems. The historical, inverse relationship between public environmental concern and economic conditions in the United States and Europe also suggests that the public views climate change, for better or worse, somewhat like they view environmental problems generally. It also suggests that the public opinion "problem" may wane with improving economic conditions. Public anti-warming campaigns and partisan divides about climate change are real, but the evidence over the last decade and more does not suggest that they have gotten worse. For this reason, it is not clear why this time is different.

Perhaps the fundamental reason that we observe this negative association between the health of the economy and environmental opinion is related to a prosaic public goods dilemma: people's immediate economic concerns – not just for themselves, but also for their friends, neighbors, countrymen, and even fellow man – lead many to adjust their expressed concern about long-term worries when they seem to directly compete. This has recently been shown to be especially the case in bad economic times (Singer, 2010). Those concerns do not change facts, of course, but they do create a situation in which people are more likely to change their (stated) beliefs about what the facts are.

Our point here is not to suggest that non-economic issues related to climate change can simply be ignored, or that they are irrelevant. Partisanship, public information campaigns, and the media affect public perceptions (including how the public reacts to the economy or the weather). But such concerns should not obscure the profound impact that an economic crisis – doubling the unemployment rate or flirting with a depression – has on public beliefs and actions on long-term problems like climate change. We would suggest that it is misreading public opinion to dismiss the impact of the current economic crisis and to blame the problem mainly on a disinformation or the weather. The European experience suggests that the economy profoundly affects beliefs

[9] There are no *representative* samples of state level opinion to test this thesis this way in the United States. The United States might also have a weaker association from state to state, because it has a more integrated economic and media system, and a common language.

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about climate change, even in a political culture in which climate science is very widely accepted.

Given what we know about recent and historic patterns, it seems probable that climate change opinion will rebound as the economy, and more specifically the job situation, improves. Both would obviously improve more quickly if planetary stewardship can become a catalyst for economic recovery and transformation, and not instinctively seen as a barrier to that goal. But it would be incorrect to conclude that policy waits for opinion. Historically, major environmental policy improvements have occurred in "bad" economic times. The Endangered Species Act (December 1973), Resource Conservation and Recovery Act (1976), Solid Waste Disposal Act (1976), Clean Air Act Amendments (1977), Clean Water Act Amendments (1977), and CERCLA (Superfund) (1980) were all passed in tough economic climate. On the other hand, the early 1980s, when the economic situation perhaps most closely resembled the present one, was a period with little major environmental policy legislation. While this may point to a few more years of inaction on climate change, it is worth recalling that in the recession of the early 1980s, efforts by the Reagan administration to severely curtail environmental policy were rejected by the public (Gilroy and Shapiro 1986). The administration of the day may have misinterpreted low public support for progressive environmental policy as a permanent change rather than a temporary response to economic conditions.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.gloenvcha.2012.01.002.

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