'Balance as Bias' Revisited: Harnessing the Power of Text-Mining to Understand Media Coverage of Climate Change

Constantine Boussalis*and Travis G. Coan

Harvard Law School

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Abstract

Although agreement among scientists on anthropogenic climate change is clear, national surveys show that the American public's perceptions on the science of climate change diverge significantly from the "consensus view". Some scholars point to the mass media as being largely responsible for this divergence. By providing disproportionate amounts of attention to climate change contrarians, many news outlets are, in effect, presenting a "biased" view of climate science. This paper applies automated text analytic techniques to compare levels of "information bias" in American television news coverage over the period January 2000-February 2013. While the research objectives outlined in this initial study are quite modest, our results highlight how even simple uses of recent advances in natural language processing provide insight into key questions in the literature on media coverage of the environment.

1 Introduction

Climate scientists resoundingly agree that the Earth is getting warmer and that the rise in average temperature is predominantly due to human activity. The Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC) states that, "warming of the climate system is unequivocal", and that "it is *extremely likely* that human activities have exerted a substantial

*Contact: 410 Areeda Hall, Harvard Law School, 1545 Massachusetts Avenue, Cambridge, MA 02138. cboussalis@law.harvard.edu

net warming influence on climate since 1750"(Solomon et al. 2007).[1] Similar statements have been made by major scientific organizations. For example, in the United States, the National Academy of Sciences concurs, stating that, "there is a strong, credible body of evidence, based on multiple lines of research, documenting that climate is changing and that these changes are in large part caused by human activities" (National Research Council 2010). In their survey of a representative sample of Earth scientists, Doran and Zimmerman (2009) find that 96.2% of respondents who are active climate researchers agree that mean global temperatures relative to pre-1800s levels have risen, and 97.4% of the same group agree that human activity is a significant contributor to the changing average global temperature. The authors conclude by stating that, "it seems that the debate on the authenticity of global warming and the roles played by human activity is largely nonexistent among those who understand the nuances and scientific basis of long-term climate processes" (Doran and Zimmerman 2009, p. 23).

While a strong consensus among climate scientists regarding human-induced rising global temperatures appears to be a reality, perceptions among the American public on climate change diverge significantly from the "consensus view". In 2012, 41% of Americans believed that increases in the Earth's temperature are determined by "effects of natural changes in the environment that are not due to human activities", while 32% believed that scientists are "unsure" about whether global warming is occurring, and 42% held the view that the seriousness of global warming is "generally exaggerated" in the news (up from 30% in 2006) (Gallup News Service 2012a). Americans also seem to be global leaders in opposing mainstream climate science. In 2010, a survey of 150 countries found that the United States had the largest share of respondents (47%) who primarily attribute rising global temperatures to natural causes (Ray and Pugliese 2011).

What explains this chasm in understanding of global warming between climate change experts and the general American public? This question has been explored extensively in the literature (e.g., . This paper provides an additional look at the potential for bias in the American mass media's coverage of climate change. Specifically, we re-examine several of the claims made in core empirical studies on media coverage of global warming. While our findings are preliminary and much more remains to be done, our contributions to the literature include the application of an alternative methodology to revisit and extend past findings in relationship to reporting on climate change.

2 Literature Review

Explanations of the divergence between beliefs on climate change held by scientists with those of large segments of the U.S. population abound. Perhaps the most common explanation is the role of the conservative movement in obfuscating the overwhelming agreement among climate scientists. McCright and

[1] "Extremely likely" corresponds to a greater than 95% probability.

Dunlap (2000; 2003) argue that a concerted effort on the part of an ideologically conservative countermovement to climate science is largely responsible for a growing presence of contrarian viewpoints in congressional hearings and within the American print media over the period 1990-1997. This effort has largely been effective in generating the "duelling scientists scenario" (McCright and Dunlap 2003, p. 366), whereby rigorous findings and speculation are mixed together to produce a "confusing impression that scientists share no consensus of the probable magnitude, timing, and potential seriousness of the environmental and societal consequences of the documented and well-understood buildup of various greenhouse-enhancing gases in the atmosphere" (Schneider 1993, p. 173).

Many have pointed to the mass media as the conduit by which this confusion has arisen among the general public. In their seminal study on the role of "balanced reporting" on climate change in the American "prestige" print press, Boykoff and Boykoff (2004) argue that journalistic norms such as objectivity, fairness, accuracy, and balance serve as a source of "informational bias" regarding coverage of global warming. Indeed, when it comes to science reporting, these journalistic norms act as "[surrogates] for validity checks" since "the typical journalist, even one trained as a science writer, has neither the time nor the expertise to check the validity of claims herself" (Dunwoody and Peters 1992, p. 210; Boykoff and Mansfield 2008). In effect, while providing a "balanced" view, many media outlets are really presenting a biased view of climate science by offering grossly disproportionate levels of attention to climate change contrarians. Boykoff and Boykoff (2004) estimate that for 1988-2002, about 53% of "prestige" newspaper coverage of global warming was "balanced"–that is, it provided "roughly equal" attention to the view that human activity is primarily responsible for global warming and also the opposing contrarian position that any warming is due to natural causes. The United States "prestige" print press also appears to be a global leader in climate change skepticism. Painter and Ashe (2012) content analyze articles from major newspapers from the United States, United Kingdom, Brazil, China, France, and India for early 2007 and November 2009 - February 2010. The authors find that, relative to these other countries, American newspaper coverage is much more likely to voice uncontested skeptical views on climate change.

2.1 Newspapers to Television: Shifting the Focus

The predominant source of information in studies on media coverage of the environment remains within the realm of print media. A recent meta-analysis of the media coverage of science literature, Schafer (2012) finds that 5.3% of published studies on coverage of science looked at television news, while over 78 percent studied newspaper coverage. While there have been a number of attempts to study television coverage of science, it remains a largely understudied topic. While newspapers are obviously important outlets of news and opinion; one can argue that, based on American news consumption statistics, television is an

equally influential institution.[2] A December 2008 survey estimated daily consumption of "prestige" newspapers (New York Times, the Wall Street Journal, and USA Today) at 9%. This is very low when compared to responses about daily consumption of other media such as cable news (40%), nightly network news (34%), and the internet (31%) (Gallup News Service 2012b).

Although understudied, important work has been done in the field on television coverage of environmental issues. In his content analysis of U.S. network television (ABC, CBS, NBC) evening news coverage of climate change from a sample over the period 1995-2004, Boykoff (2008) finds that "balanced" reporting accounted for over 69% of evening network news segments, while 28% of news segments portrayed human beings as largely responsible for global warming. Less than 3% of the segments argue that human activity is "negligible".

Not surprisingly, scholars who study television coverage of science and the environment have given special attention to the conservative Fox News Channel. Hart (2008) tests whether Fox News is more likely to convey information on climate change which is more similar to the views held by ideologically conservative groups that oppose mainstream climate science. The author finds that for prime-time, weekday CNN and Fox News shows over the period 1998-2004, Fox was more likely to have more skeptics than climate change advocates, more likely for its anchors to express skeptical opinions and also for them to highlight uncertainty in the science. Feldman et al. (2012) content analyze news transcripts for 2007-2008 from the major three American cable news channels and find that, relative to CNN and MSNBC, Fox News coverage had a more dismissive tone of climate change, stated less claims supporting the notion of a scientific consensus, and invited more skeptics onto its shows than believers.

There is empirical evidence which suggests that this type of "balanced" journalism is associated with public skepticism of climate science. Krosnick and MacInnis (2010) find that frequent Fox News viewers are more likely to reject mainstream climate science (e.g. the Earths temperature has been rising and that humans have caused the rise), to have less trust in scientists, and to believe that climate change mitigation policies would harm the U.S. economy. Feldman et al. (2012) find that not only are Fox News viewers less accepting of climate change, but also that Republican respondents' views on global warming are significantly moderated by Fox News viewership, with frequent Fox-viewing Republicans more likely to dismiss climate science relative to Republicans who rarely watch Fox News. Democrats' belief in climate change is not related to which cable news channel they watch more.

3 Research Objectives

Existing studies on climate change reporting rely exclusively upon the time-intensive and resource-dependent method of human coding of articles or tran-

[2] Trust in news outlets, however, has fallen over time. Gallup finds that "a great deal/quite a lot" of confidence in television news has declined from 46% in March 1993 to 21% in June 2012. Trust in newspapers has fallen as well, from 51% in April 1979 to 25% in June 2012.

scripts. For example, it took a whole summer for McCright and Dunlap (2000) to content analyze 224 conservative think tank publications on climate change. While the qualitative richness of these studies is undeniable, due to high costs, researchers tend to study samples with limited temporal coverage; which means that results may be representative but the full dynamics of media reporting trends cannot be captured. Drawing on recent advances in natural language processing, this study seeks to begin to alleviate some of the practical limitations in the literature by using automated text-analytic techniques to study media coverage of climate change. In the present analysis we seek to shed light on the following questions:

1. Among the three major American cable news channels, CNN, Fox News, and MSNBC, how many shows have mentioned the terms "climate change" or "global warming", and how has the frequency changed over time? Further, how many of these shows only briefly touch on climate change and how many attribute considerable attention?

2. Building on the work of McCright and Dunlap (2000), Hart (2008), and Feldman et al. (2012), do cable news channels differ in the number of featured guests who are affiliated with conservative think tanks?

3. To what extent are contrarian counterarguments showing up in cable news transcripts?

Although the goals of this initial study are quite modest, we demonstrate that automated text analysis provides a useful set of tools for researchers interested in understanding the influence between media and public opinion on the environment.

4 Climate Change Cable News Corpus

4.1 The Sample

We gathered all news transcripts from LexisNexis with any mention of "climate change" or "global warming" for CNN, Fox News, and MSNBC over all available years.[3]. This sample was then parsed as to allow for better comparability across cable channels. Instances of duplicate transcripts were dropped. Further, some transcripts (especially from Fox News) are not standalone shows but rather show segments. In these instances, we collapse the segments into a single show prior to the analysis. Lastly, all shows after the year 2000 and between 4:00 PM and 11:00 PM are retained for the analysis.[4] Our sample, therefore, consists of evening shows from the three major cable news providers over the period January 2000 - February 2013.

[3] Our search criteria reflect those employed by Boykoff and Boykoff (2004)

[4] MSNBC transcripts are available starting in December 1999 and for evening hours. Fox News transcripts are also from evening shows and begin in February 1998. Of the three cable news channels, CNN provides the most coverage with both morning and evening shows beginning in August 1993.

4.2 Text Normalization

As with any data analysis exercise, a good deal of "cleaning" is required before producing interpretable results. After using a series of regular expressions to parse the corpus of transcripts into a more readable form, we carried out the following common text normalization tasks:

1. We first tokenized the corpus using a simple Penn Treebank Tokenizer. Put simply, this process splits a string of text as "scientists believe climate change is a 'major' problem" into a vector of individual words (or tokens) easily processed by a computer, tokens = {scientists, believe, climate, change, is, a, 'major', problem}.

2. Next, we removed common characters (e.g., ".", "?", "!", etc.) and what are typically referred to as "stop words"—i.e., common words that add very little by way of information content to a sentence. Stop words include common words such as "and", "is", "the", etc. As such, our sample vector of tokens would now consist of {scientists, believe, climate, change, major, problem}.

3. Lastly, we employed a Porter Stemming Algorithm to reduce words to their core stems (i.e. "scientists" would be changed to "scientist").

5 Climate Change Coverage Density

Figure 1 displays the weekly number of shows that mention "climate change" or "global warming" from the parsed sample. CNN featured the most shows with a mention (n=2,802), with Fox News closely following (n=2,388), and MSNBC in a distant third (n=1,392). The descriptive dynamics of the shows is interesting. Prior to 2005, coverage of climate change was much more sparse as is evidenced by the gaps in weeks with no mentions as well as by the relatively low show counts. The prominent exception during this period was early and mid-2001 which coincided with the rejection of the Kyoto Protocol by the Bush Administration. Going into 2006, all three cable news channels began to ramp up coverage on climate change, with a peak during late 2009 and early 2010, which is around the time of the 2009 United Nations Climate Change Conference in Copenhagen and the leaked email issue, also known as "Climategate". Coverage dropped following this peak only to surge once again in late 2012/early 2013.

In an effort to further explore the nuances of television news coverage, we expand the list of keywords beyond the baseline ("global warming" and "climate change") by generating frequencies of mentions of alternative terms related to climate change. Specifically, we searched for matches of the most prevalent terms and bigrams from the *Summary for Policymakers* of the IPCC Fourth Assessment Report.[5] Figure 2 illustrates a closer approximation of "attention"

[5]These "IPCC keywords" include: "global warming", "climate change", "sea-level", "level rise", "carbon dioxide", "greenhouse", "emission", "mitigation", "mitigation potential", "long term", "pre-industrial", "best estimate", and "global average".

given to global warming by the cable news channels. For both CNN and Fox News, the number of climate change related keywords peaks during the second week of December which is when the Copenhagen Summit began. CNN devoted a significantly large amount of attention to the issue on 7 December 2009 with extensive live coverage of the opening of the Summit as well as a showing of the dedicated feature *Global Warming: Trick or Truth?* hosted by Campbell Brown. Fox News also focused on the Summit with significant keyword hits on 7 December 2009 attributed to *Fox Special Report with Brit Hume* and *Beck*.

6 Guest Affiliation

Using affiliation captions provided in the news transcripts, we test whether cable channels differ in their featuring of guests who are affiliated with conservative think tanks. We generate a ratio of conservative think tank (CTT) guests[6] as a share of total guests for shows with four or more (75th percentile) "IPCC keyword" matches.[7] This variable is plotted over time in Figure 3. Not surprisingly, over the sample period, Fox News invited the most CTT guests (n=156), with CNN close behind (n=144), and MSNBC registering a significantly lower number (n=22). While MSNBC clearly invites less CTT guests than the other two channels, it is somewhat more surprising that CNN is such a close second; though, a simple two-sample t-test finds that, compared to CNN, Fox News has a significantly higher share of CTT guests (p=0.0002) on relevant shows. Nevertheless, the strong contrarian presence on CNN is consistent with general "balance as bias" hypothesis espoused in Boykoff and Boykoff (2004). Moreover, the temporal pattern of appearances also seems to match the pattern of attention discussed in Section 5, with more CTT guests being featured after 2005 for CNN and Fox News.

7 Contrarian Counter Arguments

Section 6 demonstrated the presence of CTTs on cable news shows devoted to cable news shows over the sample period. It seems reasonable to assume

[6] Following the work of McCright and Dunlap (2000), we searched for guests with the following affiliations: National Center for Policy Analysis, Heartland Institute, National Center for Public Policy Research, Competitive Enterprise Institute, Hoover Institution, Marshall Institute, CATO Institute, Citizens for a Sound Economy Foundation, Heritage Foundation, American Enterprise Institute, Reason Public Policy Institute, Foundation for Research on Economics and the Environment, Pacific Research Institute, Claremont Institute, Hudson Institute, National Bureau of Economic Research, Institute for Foreign Policy Analysis, National Taxpayers Union and Foundation, Political Economy Research Center, Progress and Freedom Foundation, International Institute for Strategic Studies, Lehrman Institute, Center for the Study of Popular Culture, Madison Center for Educational Affairs, Manhattan Institute, Institute for Contemporary Studies, National Strategy Information Center, Center for Strategic and International Studies, Institute for Research on the Economics of Taxation, and the Free Congress Research and Education Foundation.

[7] News channel anchors and correspondents are not included in the denominator of this ratio.

that a primary motivation for agreeing to participate show is to argue for ones point and thus it is reasonable to assume that contrarian viewpoints are being represented (sometimes quit unequally) in cable news broadcasts. In this section, however, we take a slightly deeper look at the extent to which contrarian viewpoints are represented in American cable news.

7.1 Measuring Climate Change Denial

What does it mean to be a contrarian? This question was taken up in detail by McCright and Dunlap (2000; 2003). For instance, based on an extensive content coding of U.S. print media, McCright and Dunlap (2000) demonstrate that the key elements of contrarian counter movement centers on three claims: 1) the evidence for global warming is weak or wrong, 2) global warming would be beneficial if it does occur, and 3) environmental policies, such as emission cuts, would do more harm (i.e., to the economy, national security, etc.) than good. In order to capture these dimensions, our first step in measuring climate denial was to mine the text outlined in McCright and Dunlap (2000). Specifically, we extracted the cited text in the article and produced a vector of all two-word (bigrams) and three-word (trigrams) combinations of words. This process lead to a number of tokens that represent major themes in the conservative counter movement, at least prior to the year 2000.

Next, in order to collect more recent information on contrarian arguments, we extracted all relevant counter movement information from Wikipedia, again producing all bi- and trigrams. The decision to use Wikipedia was practical: Wikipedia provides considerable text on a wide-range of topics in a format that is easy to extract using a computer. Given that one of our primary objectives is to produce fully automated systems for analyzing environmental media, these practical benefits took precedence.

7.2 Isolating the Counter Argument

The results of mining both McCright and Dunlap (2000) and Wikipedia provided a number of plausible tokens that were consistent with common conceptions of climate denial and thus provided a certain level of face validity. However, this exercise also produced a number of tokens that are not particularly helpful for *isolating* the contrarian viewpoint, per se. For instance, the token "global warming" shows up quite frequently in the contrarian literature, but is clearly not a strictly "contrarian" term. As such, it is necessary to remove tokens that provide little information unique to the contrarian viewpoint.

To achieve this objective, we carried out the following two step procedure. First, we produced a complete set of bi- and trigrams from the *Summary for Policymakers* of the IPCC Fourth Assessment Report. Next, we collected information—again, from Wikipedia—on two "placebo" public policy debates, one on healthcare and the other related to fiscal policy. In effect, the goal of collecting this information was to remove the "science" and "public policy" terms

from the contrarian tokens. More precisely, to actually remove the tokens, we calculated inverse document frequency (idf) weight using the following formula:

$$idf = log \frac{|D|}{|\{d \in D : t \in d\}|} \tag{1}$$

Where $|D|$ equals the number of documents in the corpus and $|\{d \in D : t \in d\}|$ represents the number of documents where the term, t, appears at least once. The idf weight simply measures how common a term—or, in our case, bigram and trigram—is across documents in a corpus. For the present analysis, we use the idf to filter out common phrases across the contrarian tokens, the Fourth Assessment Report, and the "placebo" policy articles. In the end, this leaves us with a set of tokens that represents unique tokens commonly found in documents describing the contrarian position.

7.3 Contrarian Viewpoints Across Networks

Figure 4 plots the number of keyword hits for the unique tokens described in the previous section, across the three networks. What is striking about Figure 4 is its similarity to Figure 2. While far from conclusive, the evidence at least suggests that the extent to which the contrarian viewpoint makes its way into American cable news rises and falls with the intensity with which climate change is covered. This finding is once again consistent with the core assertion of the "balance as bias" literature: in an effort to remain balanced, the contrarian viewpoint is intimately tied to discussion of global warming more generally.

8 Conclusion

As debate on the issue of climate change continues, the need for real-time information on the policy positions of key actors in the political system will become increasingly important. While the goal of the present study was quite modest, we see considerable potential in the future of text analytic studies to serve this objective. Even in the very simple set of analysis outlined in this paper, evidence of the persistence of balance in American media—and thus the level of bias—is clearly observed. This is, however, only an initial step towards "harnessing" the full power of text mining to better understand media coverage of global warming. While much needs to be done, we are confident that text analysis will become an important tool for researchers interested in environmental public opinion.

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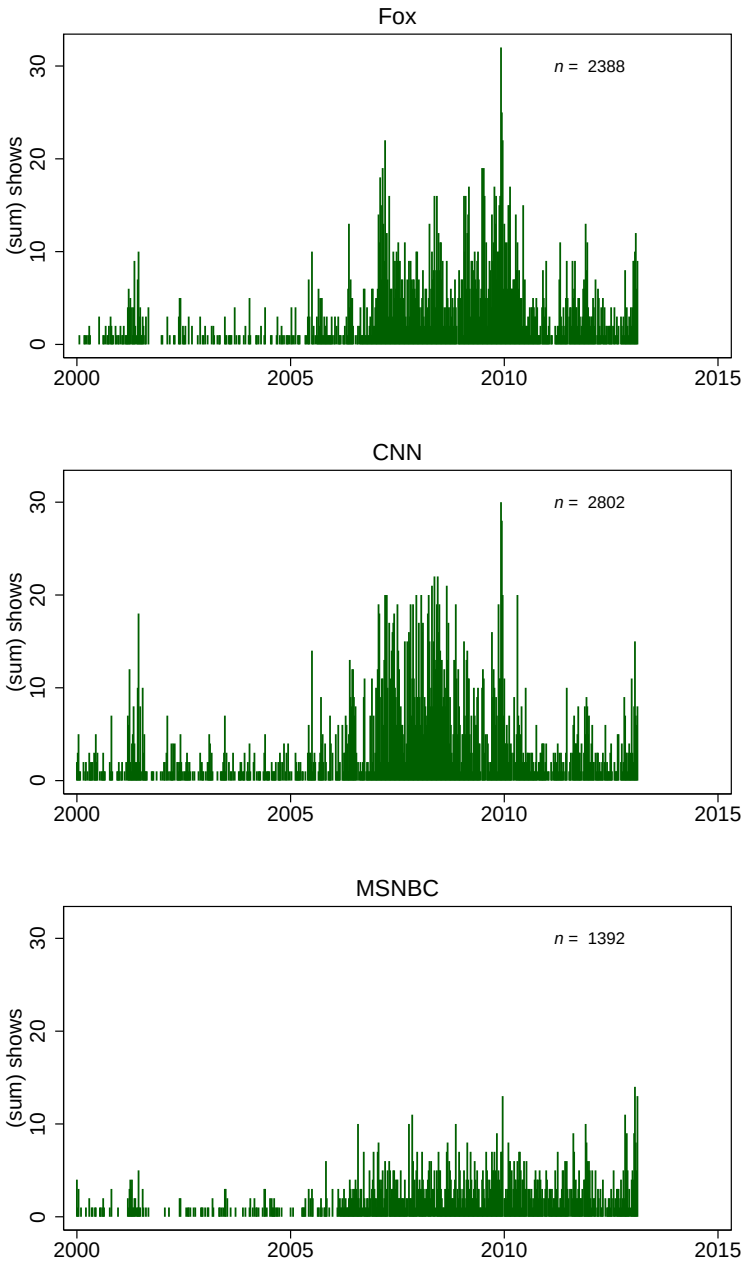

Figure 1: Number of shows that mention either "climate change" or "global warming", by cable news channel, for 2000-2013

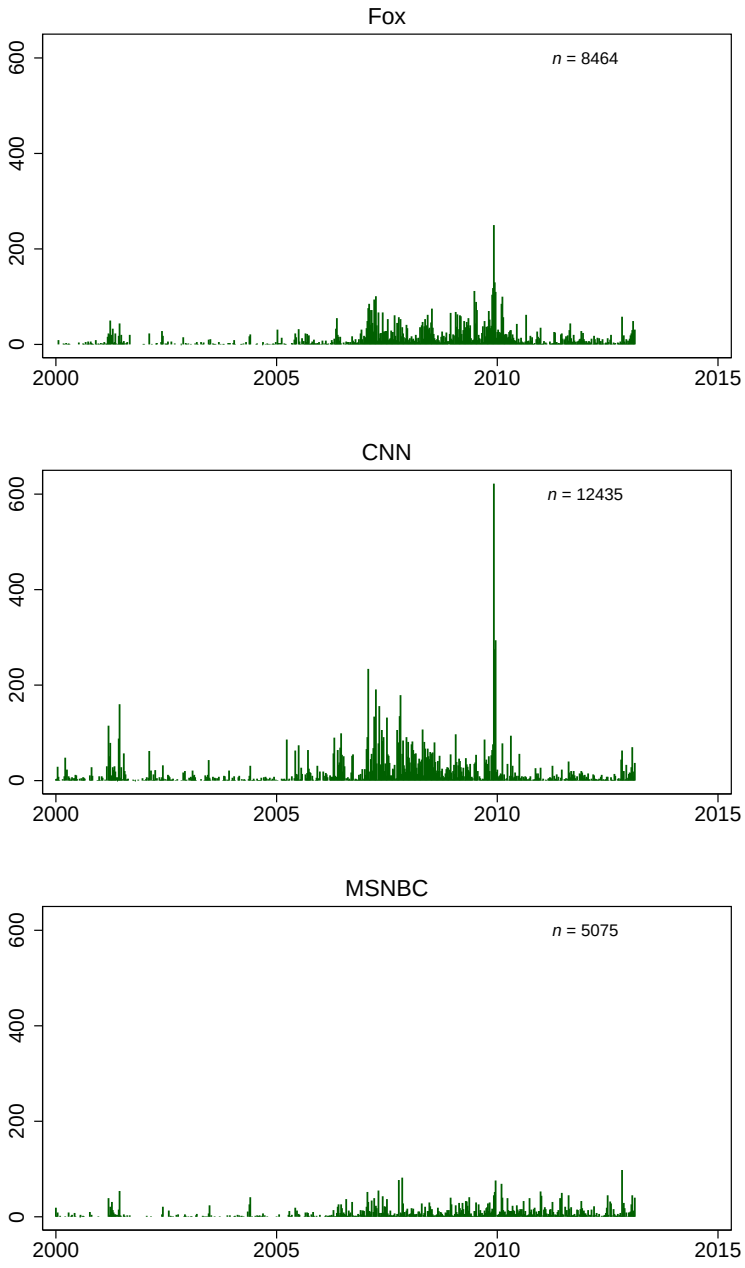

Figure 2: Sum of weekly "IPCC keyword" matches, by cable news channel, for 2000-2013

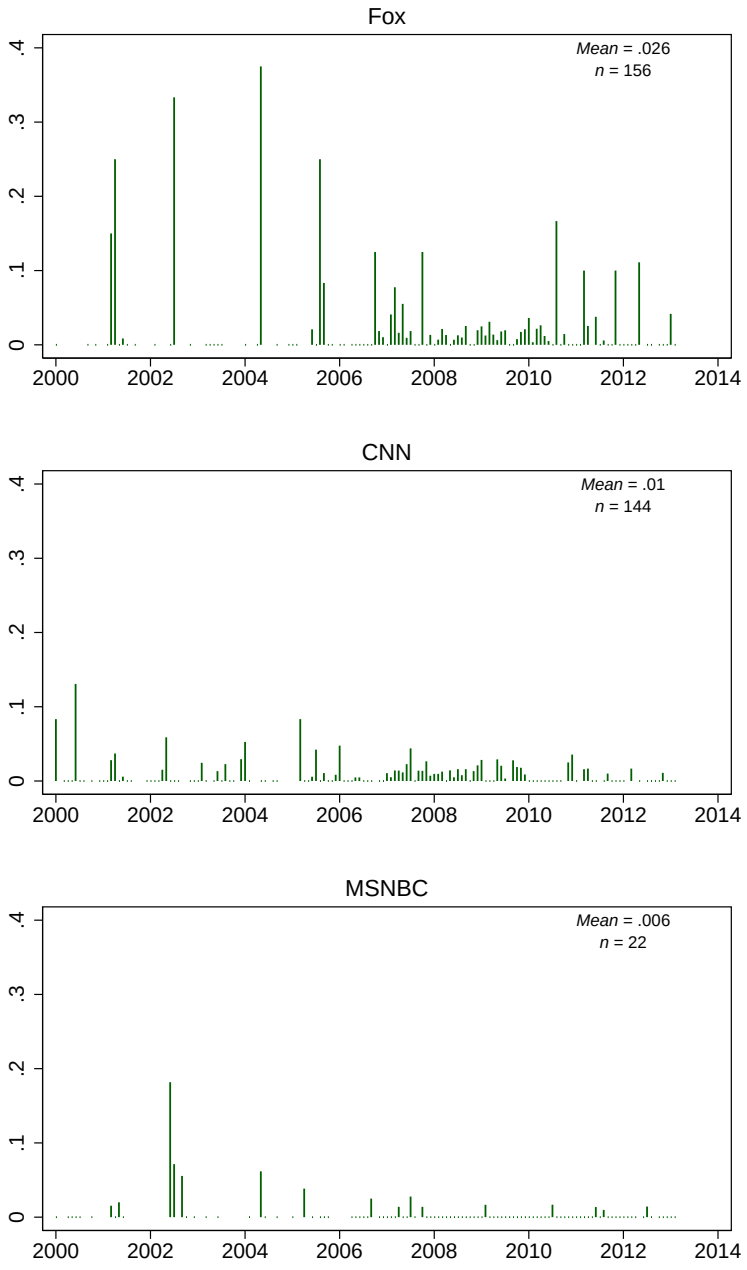

Figure 3: Average monthly share of guests affiliated with conservative think tanks featured in shows with more than four "IPCC keyword" matches, by cable news channel over the period 2000-2013.

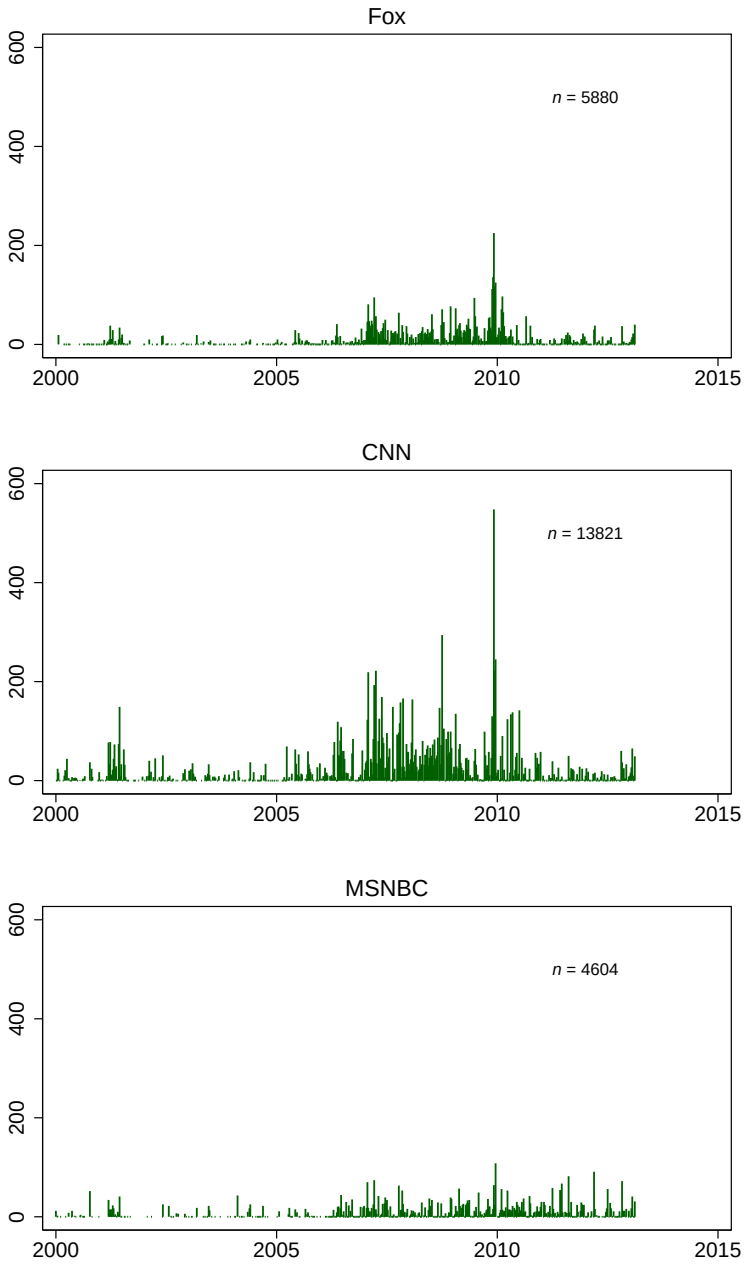

Figure 4: Sum of weekly contrarian keyword matches, by cable news channel over the period 2000-2013.