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Fox News and political knowledge ☆

Elizabeth Schroeder [a], Daniel F. Stone [b,*]

[a] Oregon State University, United States
[b] Bowdoin College, United States

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ABSTRACT

The effects of partisan media on political knowledge are theoretically ambiguous. Knowledge effects are important because of their close connection to welfare effects, but the existing empirical literature on knowledge is limited. We study the knowledge effects of the Fox News Channel. Following DellaVigna and Kaplan (2007), we exploit naturally random variation in Fox's availability to identify causal effects. We use knowledge survey data from 2000, 2004 and 2008; our final sample has nearly one million question-level observations. We first confirm and expand on previous findings of Fox effects on voting. We then present an array of results from our knowledge analysis. While average effects (across issues), over the full time-frame are near-zero and most precise, we find evidence of positive effects both for issues that were more favorable to Republicans and for issues that Fox covered more often, and negative effects for issues Fox neglected. We also present evidence of Fox being associated with a decline in newspaper readership.

1. Introduction

The economics literature on the causes and consequences of the behavior of political media firms has developed considerably in recent years. A key issue is partisan bias, or slant (these terms are often used interchangeably). The literature has shown that slant is real and quantified it, developed and tested theories of slant, and shown that slant has effects on voting.[1]

In this paper, we extend this literature by studying a new aspect of partisan media, its effects on political knowledge. This topic is of first-order importance because the welfare implications of partisan media effects depend on changes in knowledge (Gentzkow et al., 2014), and these knowledge effects are, in theory, ambiguous. It is unclear if and how entry of a partisan outlet causes voters to be more or less informed on different issues, and thus more or less likely to vote and monitor politicians optimally. We expect the media in general to provide information to voters. But while a partisan outlet could provide a distinct and useful perspective on the issues, it could also distort voters' beliefs and choices (or both). A partisan outlet could also affect voting and other political behavior via other mechanisms, for example, by influencing attitudes.

We analyze the knowledge effects of entry into new markets by a particular partisan outlet, the Fox News Channel cable station. We study Fox for three reasons. First, Fox is important—it has been the most highly rated cable news station in the US since 2002 (Collins, 2004; O'Connell, 2014). Second, Fox is well-known to have a (relatively rightist) slant (Groseclose and Milyo, 2005). Third, the gradual roll-out of Fox to cable systems across the US since Fox's inception in 1996 yields exogenous variation in access to Fox, conditional on controls. DellaVigna and Kaplan (2007) (DVK) were the first to use this research design, which we extend to additional years.

Our knowledge data are from the 2000, 2004 and 2008 National Annenberg Election Studies (NAES). Each of these surveys has over 50,000 respondents, and includes dozens of questions on political facts with right and wrong answers. Most of the questions refer to the platform positions of the US presidential candidates of that year. Questions were answered correctly around 50% of the time on average, and cover substantive and possibly politically-charged issues. For example, the 2008 survey included questions on which presidential candidate

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* Corresponding author at: Bowdoin College, Department of Economics, 9700 College Station, Brunswick, ME, USA 04011.
E-mail addresses: liz.schroeder@oregonstate.edu (E. Schroeder), dstone@bowdoin.edu (D.F. Stone).

[1] See Prat and Strömberg (2011) and Sobbrio (2014) for useful surveys.

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favored lifting the ban on coastal oil drilling, and which favored federal funding of stem cell research. Other field studies of media knowledge effects typically use more straightforward, less politically-charged questions (e.g., "Do you know the name of your Congressman?"). Our final sample has over 80,000 respondent-level observations, and nearly one million question-level observations.

In Section 2 we briefly review the relevant theory literature and present a stylized model tailored to our empirical setting, allowing Fox News to affect voting either by influencing NAES knowledge or via another mechanism. Key predictions are that Fox is relatively likely to increase knowledge for policy issues that are favorable to Republicans, more so when beliefs would otherwise be inaccurate, and relatively likely to decrease knowledge for issues favorable to Democrats. In Section 3 we describe the data, and in Section 4 we revisit the exogeneity of Fox News entry and voting effects. We find some evidence of entry being correlated with education in 00 and 04, but the effects are small, and wash out in the data pooled across all years. We also find that Fox News is associated with a two percentage point increase in Republican vote share in 00. We find no significant voting effects in 04, but in the 00–04–08 data there is a significant one point effect. We do not analyze the 08 data separately because there is very little variation in Fox News access in that year, but include 08 in the pooled data analysis because this yields variation in access to Fox across time. The pooled (00–04–08) data should be least subject to endogeneity concerns, since nearly all towns gained Fox access by the end of the sample time-frame.

In Section 5 we present the main results on knowledge effects. We regress the fraction of questions a respondent answered correctly on Fox access and a large set of individual political, demographic, survey, US Census and cable controls, and county fixed effects (FEs). We present three sets of results in this section. First, results for all knowledge questions grouped together. There is some suggestive evidence of Fox having positive effects in 2004, but no evidence of effects in 2000 or in the pooled data. Next, motivated by the model of Section 2, we separate questions into two groups, topics favorable or unfavorable to Republicans. We find significant evidence of positive effects for the favorable group in 2004, and marginally significant evidence for 00–04–08. The effects tend to be larger for subsamples that we expected, a priori, to experience larger effects. Third, we incorporate data from Fox News transcripts to directly measure the channel's informativeness across issues. Results from this analysis indicate that Fox News caused knowledge to increase for issues that Fox News was most informative about (as one would expect), to decrease for issues that Fox misled on (which happened rarely), and to also decrease for issues that Fox News simply neglected (which happened often). These results only indirectly imply that Fox News changed knowledge in a partisan way, since we do not know how exactly Fox News chose topic coverage. However, we do find a positive correlation (0.24) between our measures of transcript informativeness and issue favorability to the Republican party.

In Section 6, we consider the interpretation of our results in additional ways. We calculate approximate individual-level effects, some of which, frankly, seem questionably high. We also look at other dependent variables to better understand the mechanism underlying Fox News effects or the lack thereof. There is some evidence that Fox increased interest in online news in 2004, which may have contributed to the positive effects that year, and that Fox News decreased newspaper reading in other years, possibly contributing to negative effects for issues that were less covered. We also discuss our results' implications for the connection between voting and knowledge. In Section 7, we offer further remarks on interpretation and conclude.

1.1. Related literature

We first discuss the existing literature on Fox News effects, then turn to the literature on slanted media effects, and finally the more general literature on media information effects.

As referred to above, DVK were the first to use Fox's gradual roll-out to identify Fox's effects; DVK found Fox had a 0.4 to 0.7 percentage point increase on the Republican presidential vote share in 2000. Several other papers have used DVK's cable data and empirical approach. Hopkins and Ladd (2014) also merge the DVK cable data to NAES data, but use only the 2000 survey. They find significant effects on Republican voting in 2000 for the subsample of non-Democrats only. Their point estimates are similar to those that we find for that year. Clinton and Enamorado (2014) show that the presidential support score, for Democratic President Bill Clinton, declined for members of Congress in districts that obtained access to Fox News, indicating that Fox caused a shift in legislator behavior to the right. Arceneaux et al. (2013) conduct a similar analysis, finding that effects were stronger as elections approached.

Martin and Yurukoglu (2014) use Nielsen cable data and employ channel position as an instrument for watching Fox News; they find the marginal effect on voting Republican of an hour of Fox viewing per week is over 10 percentage points, about equal to DVK's viewer-level estimates. They compare their Nielsen data to the *Television and Cable Factbook* data used by DVK (and others), and find that from year to year, fewer than half of observations were updated in the Factbooks. We take these findings into account, but we are confident that the Factbook data still capture Fox News exposure reasonably accurately for several reasons. First, since we look at variation in Fox access every four years, the year-to-year non-updates should be less problematic. Second, the effects found by the several studies that use the Factbook data, including our own, support the validity of the data. Third, the non-updating would cause towns coded with Fox News access to on average have had access for longer periods of time than towns miscoded as not having access. This correlation of the measurement error with duration of Fox access should reduce the attenuation problem, since longer access was likely associated with stronger effects.[2]

Much of the other recent literature on partisan media uses lab experiments (see, e.g., Levendusky, 2013). While some lab work suggests substantial effects, there is reason to be skeptical. Prior (2005) argues, and provides evidence, that technological change yielding greater media choice has led to greater inequality of political knowledge, with people most interested in entertainment (and not politics) becoming more likely to avoid political news altogether. Arceneaux and Johnson (2013) discuss several experiments showing that when lab subjects are given the opportunity to choose entertainment options over news, this mitigates (apparent) partisan media effects substantially.[3]

We briefly discuss a few other relevant papers on media information effects. Gerber et al. (2009) report a field experiment, in which free subscriptions to Washington, D.C. newspapers with different slants were given to random households. They find that newspapers did not affect knowledge, regardless of slant; however, their knowledge questions were of a less partisan nature than ours (as we refer to in Section 1). Snyder and Strömberg (2010) find that, in areas where newspapers were, for exogenous reasons, more likely to cover local members of Congress, survey respondents were better able to answer questions about their Congressional representatives from 1982–2004, but local TV markets did not have the same effect. Gentzkow (2006) finds that the quasi-random entry of network TV reduced voter turnout between 1950 and 1970, and argues that this result was due to the crowding out of political information. He finds evidence that, during that time, individuals substituted their media consumption away from radio and newspapers.

[2] The non-updating would almost never cause towns to be mis-coded as having Fox News access, since once towns gained access they almost always kept it. Fox News effects were likely greater for towns that gained access earlier due to Fox having lower channel numbers in those towns, as discussed by Martin and Yurukoglu, or Fox's effects growing over time (due to increasing probability or duration of exposure to Fox for individual viewers).

[3] Arceneaux and Johnson (2013) also provide (in Chapter 3) a nice discussion of selection bias concerns for previous survey-based research on Fox News knowledge effects in particular.

He shows that having a TV reduced the likelihood that a respondent could name a local candidate for office in the 1952 National Election Study.

2. Theory

The media theory literature has identified numerous mechanisms by which the entry of a partisan outlet can affect voter information. Some of these mechanisms likely have positive effects and some effects are likely negative.[4] Given that, in reality, several of these factors are likely to be relevant for many consumer-voters, and that these effects may vary substantially across consumers (even within a particular media outlet), the sign of the overall effect of partisan media on voter knowledge is theoretically quite ambiguous.[5]

We are not aware of existing models that apply directly to our empirical context—knowledge about the presidential candidates' positions on various policy issues. In the online appendix we develop a model of this context to provide formal foundations for our empirical analysis. The model is very simple but captures a number of important features that the literature has emphasized.

In the model, biased reporting can be driven by either demand-side or supply-side factors (or both). On the demand side, voters have preferences for both belief-changing information and political preference affirmation, with the latter factor being more important. There is a vast literature supporting the idea that media consumers enjoy having their prior beliefs or preferences confirmed — that partisans enjoy both good news about their own party and bad news about the other, even if this news is not informative in the sense of changing the voter's beliefs about an uncertain political issue. On the supply side, the outlet's objective function includes both voting influence and direct profits. We make the fairly standard assumption that the outlet cannot misreport facts, but can strategically suppress information.

We assume the media outlet can either report factual news on a policy issue or make a cheap talk report on the valence of the candidates, to allow for the possibility that Fox News did not report on the issues that our knowledge data cover. We assume voters are mostly, but not entirely, strategically sophisticated; they are naive in that they do not update beliefs on the policy issue when policy news is not reported (although this should provide a subtle signal on the issue). We discuss the validity of the assumptions, and robustness of results, further in the appendix.

The model yields the following key implications. First, a pro-Republican outlet is relatively likely to cause knowledge to increase (decrease) on issues for which the outlet's viewers are more (less) likely to prefer the true Republican position. Second, the negative effects would likely be smaller due to the lower availability of material to support that reporting. Third, the model implies that the magnitude of effects would be greatest for non-Democrats, as an outlet with a pro-Republican slant will tend to attract non-Democrats as viewers. Democrats obtain the greatest loss in utility from watching news that conflicts with their priors, and so are most likely to avoid the channel.[6]

Thus, as is the case for this literature in general, the sign of the knowledge effects in our context is, in general, ambiguous. But the signs (and to a lesser extent, magnitudes) of knowledge effects in specific situations are more clear. We discuss operationalizing the testing of these hypotheses in Section 5, after discussing the data and the preliminary analysis.

3. Data

3.1. The National Annenberg Election Studies (NAES)

The NAES has been conducted each presidential election year since 2000. In 2000, there were 58,373 (National Rolling Cross-Section) interviews; in 2004, there were 81,422, and in 2008, 57,967.[7] The interviews are conducted by phone and last around 30 minutes, and are first conducted in the final months of the previous year (1999, 2003 and 2007) and continue throughout the election year, with the frequency (number of interviews per day) increasing in the months just prior to the general election.

In each year, there are many survey questions on factual issues. These questions focus on the candidates' platforms and backgrounds, but include (17 out of 101) questions on current events and general political knowledge.[8] Table 1 presents a sample of the questions, and the complete list is provided in the online appendix. Almost all of the correct answers are provided by the NAES. The NAES also provides detailed demographic data on respondents, and geographic data including county and zip code.

3.2. Cable channels

We start with the extensive cable data collected by DVK, graciously made available on DellaVigna's website. DVK's data include Fox News availability, cable system and number of cable channels for 21,194 towns across 33 states for the year 2000; Fox News and cable system data for 19,672 towns for the year 2003; and Fox News and channel data for 7022 towns for 1998. Their cable data set was collected manually from the Factbooks referred to above. As DVK note, cable markets are usually natural monopolies due to the fixed cost of cables; the vast majority of towns are served by just one company. The final sample DVK use for their analysis has fewer than 10,000 towns because they are only able to match cable and voting data for these towns; we use the larger sample of 21,194 towns with cable data in 2000 for most of our analysis.

We augment this data set by collecting data on Fox access and number of channels by cable system from the Factbooks for additional years. We followed DVK's method for data collection as closely as possible, making a few additional assumptions to expedite the quite extensive task. See the appendix for a complete description of our cable data collection and cable-NAES data matching methodologies.

3.3. Transcripts

We use transcripts from Fox News programs to directly examine to what extent Fox News provided information (or misinformation) on particular issues. We use two highly rated shows, *The O'Reilly Factor* and *Special Report with Brit Hume*, as they are in different genres (opinion and hard news) and time slots (8:00–9:00 p.m. and 6:00–7:00 p.m.) and thus likely to span a large fraction of Fox News viewership. We use one randomly chosen transcript for each show from February, April,

[4] For example, Chan and Suen (2008) show how consumers with partisan preferences may rationally prefer a news source that filters news in a like-minded way, and so slanted news entry can increase their knowledge. Stone (2011) shows that if partisan consumers are biased information processers, these consumers may be either less or more informed when partisan news is available (less due to switching from a more informative neutral outlet, more due to switching from no news at all to partisan news). Anderson and McLaren (2012) show how an outlet with a biased agenda can skew the beliefs of even rational consumers.

[5] Gentzkow et al. (2014) provide a recent survey. An interesting new paper is Alaoui and Germano (2014), in which media outlets rank stories in a potentially biased way, which can lead time-constrained consumers to be less informed about relevant topics. Consumers may prefer biased outlets that more prominently feature stories they want access to, resulting in different information across viewers.

[6] It is also worth noting that the model is consistent with the magnitudes of all knowledge effects being of any size, since either viewer utility or voting effects could be more influenced by reporting on other topics.

[7] There were fewer interviews in 2008 as compared to 2004 because an additional online survey was introduced in 2008. Although the online survey was a companion to the phone survey in 2008, we cannot use the online survey as it did not include the same knowledge questions as the phone survey.

[8] Almost all of the questions in 2000 and the large majority in the other years are on the general election; we exclude questions on the primaries and candidates who failed to win their party's nomination.

Table 1
Selected NAES knowledge questions (correct answers provided by NAES).

2000		
No.	Question	Correct answer
1	Who favors the biggest tax cut, George W. Bush or Al Gore?	Bush
5	Who favors the biggest increase in spending for Social Security, George W. Bush or Al Gore?	Gore
16	Who favors using government funds to make sure that every child in the US is covered by health insurance? George W. Bush, Al Gore, both or neither?	Gore
27	Who favors the death penalty for some crimes? George W. Bush, Al Gore, both or neither?	Both
42	How many Americans do not have health insurance? About one American in 50, one in 20, one in 10 or more than one in 10?	>1 in 10
2004		
No.	Question	Correct answer
48	Who favors making the recent tax cuts permanent — George W. Bush, John Kerry, both or neither?	Bush
51	Who favors eliminating tax breaks for overseas profits of American corporations and using the money to cut corporate income taxes — George W. Bush, John Kerry, both or neither?	Kerry
57	Who favors changing the recently passed Medicare prescription drug law to allow re-importing drugs from Canada — George W. Bush, John Kerry, both or neither?	Kerry
69	Which candidate proposes moving 60,000 to 70,000 troops stationed in Europe and South Korea to other locations, including the United States, in the next decade — George W. Bush, John Kerry, both, or neither?	Bush
76	How much of a majority is required for the U.S. Senate and house to override a presidential veto?	Two-thirds
2008		
No.	Question	Correct Answer
79	Which candidate(s) would eliminate the Bush tax cuts for people above a certain income level: John McCain, Barack Obama, both, or neither?	Obama
88	Which candidate(s) opposed the war in Iraq: John McCain, Barack Obama, both, or neither?	Obama
93	Which candidate(s) supports federal funding for embryonic stem cell research: John McCain, Barack Obama, both, or neither?	Both
97	Which candidate or candidates favors reducing pollution through a process called cap and trade: John McCain, Barack Obama, both, or neither?	Both
99	How much of a majority is required for the US Senate and House to override a presidential veto?	Two-thirds

June, August and October of each election year, and use keywords to identify potentially relevant content. We then use a combination of workers from the online service Mechanical Turk, a research assistant and our own judgment to code the content as informative, irrelevant, or misleading. The coded data are used to create an index of transcript informativeness for each question; 61 of the 101 knowledge questions were never covered (in a relevant way), and the index has a mean of 0.47 informative mentions per 10 transcripts, a maximum of 4, and a minimum of −1 (an average of one misleading mention per 10 transcripts). Only five of the questions have an index less than zero.[9] The index has a correlation of 0.24 with the percentage of non-Democrat NAES respondents who prefer the true Republican position on the issue, indicating that Fox News was more informative on these issues. We refer to the index variable as *TInfo* (transcript informativeness); see the appendix for more detail on how it was constructed.

3.4. Other data and summary statistics

DVK's data set includes town-level voting outcomes and US Census demographic data. The voting data are available for around half the cable sample for the 1996, 2000 and 2004 elections, and for less than one quarter of the sample for 1992 and 1988. The Census data are available for nearly the entire sample for 1990 and 2000. We added zip code tabulation area (ZCTA)-level 2000 and 2010 Census data for the same variables DVK used.[10] ZCTAs are very similar to, but not exactly the same as, zip codes for the same year. We matched ZCTAs to the zip codes for each survey year by latitude and longitude (minimum absolute deviation from centroid to centroid).

Summary statistics are presented for key variables in each year in Table 2. The fraction of our sample with Fox News in 2000, 24%, is somewhat less than that of DVK in part because, as discussed in the appendix, we drop respondents with Fox News in 2000 but without Fox in 1999 who were surveyed in the first half of 2000. Approximately 77% of our sample had Fox News access in 2004, and 96% in 2008. The mean fraction of questions answered correctly varied (across years) from 46% to 56%, and mean number of knowledge questions per respondent from 9.2 to 13.4. Table 2 also shows the sample size limitations for the town-level voting variables, and how survey demographic data changed over time (the mean age increased from 45.5 to 53.0 and fraction employed full-time declined from 58.6% to 49.1%) and are not necessarily representative in any given year. In particular, the sample seems skewed toward females. The composition of the sample should be kept in mind when interpreting subsequent results.[11]

4. Preliminary analysis: entry, voting intentions and viewership

4.1. Fox News entry

Fox News entry across space and time was certainly not completely random. DVK addressed this issue by showing that both 1996 Republican presidential vote share and the 1992–96 change in this share were uncorrelated with 2000 Fox News entry, conditional on appropriate controls, and argued this implied that entry was uncorrelated with pre-existing political characteristics. We use a similar strategy, but with more of a focus on education variables since they are more highly

[9] These are questions: 5, 27, 51, 57, and 69. The question with the maximum index value of 4 is question 74 (who was George W. Bush's vice president).

[10] These are: population, population age 18+, percent (age 25+) high school grad, percent (age 25+) with some college, percent (age 25+) college grad, percent male, percent African-American, percent Hispanic, percent employed, unemployment rate, percent married, median income, percent living in urban area.

[11] The NAES provides sampling weights but advises that they not be used unless applied to the entire sample. Since we are only using the subsample we match with cable data, the simplest and most transparent approach is to report summary statistics so that the composition of our sample can be understood and analysis interpreted accordingly. Roughly speaking, since Fox News viewers tend to be older males and our sample is somewhat skewed toward older females, the effects may approximately cancel with respect to Fox News impacts (older respondents being more likely to watch Fox, and females less likely).

Table 2
Selected summary statistics.

	2000		2004		2008	
	Mean	SD	Mean	SD	Mean	SD
Panel A: NAES knowledge questions						
# questions per respondent	13.438	7.696	10.047	6.075	9.154	6.193
Difficulty						
Fraction answered correct	0.462	0.291	0.561	0.300	0.562	0.281
# questions with fraction correct < 0.4	5.049	2.817	2.277	1.501	1.251	1.623
# questions with fraction correct ∈ [0.4, 0.6]	6.622	3.697	3.832	3.257	3.160	2.225
# questions with fraction correct > 0.6	1.767	1.741	3.938	2.202	4.743	2.771
Frac. correct, respondent educ. ≤ HS	0.380	0.281	0.451	0.296	0.424	0.276
Frac. correct, respondent educ. ≥ college degree	0.553	0.279	0.666	0.271	0.674	0.245
Partisanship						
# "pro-Republican" questions	1.428	1.007	1.960	1.838	2.003	2.178
# "anti-Republican" questions	9.299	5.858	2.853	2.433	0.490	0.500
Frac. correct, "pro-Rep" q's, respondent Dem.	0.609	0.423	0.530	0.368	0.538	0.346
Frac. correct, "pro-Rep" q's, respondent Repub.	0.745	0.378	0.596	0.362	0.544	0.315
Frac. correct, "anti-Rep" q's, respondent Dem.	0.487	0.267	0.602	0.296	0.807	0.395
Frac. correct, "anti-Rep" q's, respondent Repub.	0.465	0.253	0.509	0.293	0.831	0.375
Panel B: Demographics/other vars						
Fox News Available (Fox_i)	0.238	0.426	0.772	0.420	0.957	0.203
NAES politics/demographics						
Vote Republican for President	0.493	0.500	0.491	0.500	0.457	0.498
Male	0.446	0.497	0.445	0.497	0.428	0.495
Age	45.464	17.109	48.027	17.342	53.020	16.595
Employed full-time	0.587	0.492	0.539	0.499	0.491	0.500
Census demographics						
% high school grad	0.297	0.097	0.303	0.100	0.295	0.108
% some college	0.208	0.049	0.206	0.051	0.206	0.063
% college grad	0.316	0.155	0.338	0.157	0.375	0.169

Notes: N = 31,717; 24,281; and 27,708, for main variables for 2000, 2004 and 2008, respectively. "# questions with fraction correct < 0.4" refers to questions that were answered correctly less than 40% of time (across respondents). "Pro-Republican questions" are those for which the correct Republican position is the preferred policy of over 50% of non-Democrat respondents (# pro-Repub and # anti-Repub sum to less than total # questions because we do not have data on respondent preferences for all questions). Other terms analogous. "Vote Republican" is two-party vote share (Democrat/Republican), planned vote for those respondents surveyed before the election.

correlated with political knowledge. Specifically, we estimate variants of the following model:

$$Fox_i = \delta^v VoteRepub96_i + \delta^E Education_i + \beta X_i + \epsilon_i. \quad (1)$$

The (binary) dependent variable is Fox News availability for respondent i, Fox_i. The right-hand side variables are town-level Republican vote share in 1996 ($VoteRepub96_i$), the vector $Education_i$, which includes the three ZCTA-level education variables (percent high school graduate, percent with some college, and percent college graduate), and a number of controls (X_i). We use only *VoteRepub*96 because voting in 2000 and after could be affected by Fox access.[12]

We use county FEs in all of our analysis, the most "aggressive" geographic FEs used in previous literature. Results are similar, but somewhat stronger, when we use state FEs. We use individual demographic NAES variables similar to those used by Hopkins and Ladd, and control for partisanship and ideology at a finer level, with a seven category measure of partisanship, five category measure of ideology, an interaction of these two variables and an interaction of ideology with a categorical income variable.[13] This should substantially reduce the chances of estimated Fox News effects picking up omitted political or economic associations correlated with Fox News entry.[14] We also use Census demographic variables, using the town-level differences from 1990 to 2000 from DVK and current year ZCTA-level variables from the Census.[15] Finally, we control for the time of year the survey was taken with monthly dummies for each month from July to November, and dummies for pre-July of election year, pre-election year, and post-election day.

We follow DVK and estimate (1) as a linear probability model and cluster standard errors by cable system for the regressions using data from 2000 or 2004 only. For the 00–04–08 data, since cable systems change over time, we cluster by Nielsen media market. We include year FEs in the 00–04–08 analysis. We report results with $VoteRepub96_i$ both included and excluded to increase sample size. Throughout the paper we separately analyze samples of 00, 04, and 00–04–08 data.[16]

Table 3 reports results. In the 00–04–08 data, all coefficients are both small and insignificant. F-tests of joint significance of the education variables also fail to reject the null. For the 2000 data, $VoteRepub96_i$ is insignificant, and when it is excluded only percent with college degree is significant. The coefficient is positive but the magnitude is small (when the percent with college degree increases by one point, the chance of entry increases by 0.19 percentage points). For 2004, no education variables are significant when $VoteRepub96_i$ is dropped. We also

[12] DVK also include voting data for earlier years, which could be useful for looking at voting trends. But these variables are only available for around one-third of their sample. When we include them in our analysis, the loss in precision from sample loss is too great to make their inclusion worthwhile.

[13] We include the individual-level education variables in these regressions for consistency. It would be reasonable to exclude them as they could be highly correlated with the ZCTA-level variables, but this does not appear to be an issue—estimated coefficients for the ZCTA variables are similar whether the individual variables are included or not. We do not report estimates for the individual variables as they are almost entirely insignificant.

[14] Hopkins and Ladd include the partisanship variable but not ideology or interactions of partisanship or ideology. DVK do not include any contemporaneous political variables as controls. From the NAES, we also use controls for sex, age (cubic), number of children, religious, employed full-time, union member, military service (own or family), urban, and categorical variables for race, education, income.

[15] For 2004 and 2008 we use linear interpolations of the 2000 and 2010 ZCTA values.

[16] As discussed in Section 1, we do not analyze the 08 data separately since there is little *Fox* variation in that year, but we do combine the 08 data with 00 and 04 data to obtain additional *Fox* variation over time.

Table 3
Fox News entry.

	2000		2004		00–04–08	
	(1)	(2)	(3)	(4)	(5)	(6)
Repub. vote share	−0.018		−0.072		0.017	
	(0.085)		(0.074)		(0.060)	
% high school grad	−0.177	0.148	0.290*	−0.011	0.058	0.006
	(0.190)	(0.142)	(0.166)	(0.107)	(0.112)	(0.093)
% some college	−0.350**	−0.128	−0.260*	−0.158	−0.162	−0.079
	(0.154)	(0.119)	(0.148)	(0.100)	(0.119)	(0.093)
% college grad	−0.027	0.190**	0.146	0.011	0.043	0.023
	(0.122)	(0.096)	(0.114)	(0.074)	(0.086)	(0.075)
F test: Educ. vars = 0	2.90**	2.69**	2.15*	1.00	1.30	0.42
Adjusted R-sq	0.766	0.761	0.768	0.764	0.731	0.717
N	18,080	29,912	14,369	22,929	49,077	79,285
Y-mean	0.227	0.240	0.764	0.774	0.635	0.635

Notes: All estimates from OLS. Dependent (LHS) variable is Fox News availability (Fox_i) for all models. Standard errors in parentheses, clustered by cable system (2000, 2004) or media market. NAES political, demographic controls, Census controls, cable system controls and year effects included in all models, as described in body text.
* Denotes 10% significance.
** Denotes 5% significance.
*** Denotes 1% significance.

examine (but do not report) the estimates for the town level changes in education variables from 1990 to 2000, and individual-level education variables, all of which are generally insignificant. Overall, these results fully support the validity of causal interpretations of Fox News effects for the pooled data analysis, and imply that we can safely drop $VoteRepub96_i$ in the knowledge analysis to increase sample size. There is mild evidence that Fox News entry was positively correlated with education in 2000.

4.2. Voting and viewership

In this section, we investigate effects of Fox access on voting intentions and on Fox News viewership variables in the NAES, for two reasons. First, this will shed light on the integrity and statistical power of our sample — the precision of our measure of Fox News access and merging of data sets, and the potential to reject the hypothesis of no Fox effects. Besides measurement error, other issues that could limit power are limited effects of Fox cable access on Fox exposure (due to alternative means of access, e.g. satellite and Internet, and limited viewership of those with access), inclusion of respondent-level ideological controls in the regressions, and limited coverage by Fox of the NAES knowledge questions. The second reason we analyze voting is to better understand the connections between knowledge and voting. However, to be clear, we do not have direct evidence on these connections, and so our analysis of them, discussed further in Section 6.3, is largely speculative.

Like DVK, we look at two-party voting outcomes, using the dependent variable $VoteRepub_i$, equal to one if respondent i plans to (or did, for a small minority of cases) vote Republican and zero if Democratic. NAES data on Fox News viewership are only available in 2004 and 2008. In 2004, the NAES asked a question on which cable news network the respondent watched most, and in 2008 the NAES asked about which specific cable news shows respondents watched most. We create an indicator variable, $WatchFox_i$, in 2004 equal to one if respondent i said she watched Fox News as much or more than other cable news channels (and watched cable news at least once in past week), and in 2008 equal to one if i said a Fox News show was the program from which she got most of her information about the 2008 presidential campaign.[17]

We estimate the following models using the same methods as for (1):

$$VoteRepub_i = \delta Fox_i + \beta X_i + \epsilon_i; \tag{2}$$

$$WatchFox_i = \delta Fox_i + \beta X_i + \epsilon_i. \tag{3}$$

The vector X now includes the education Census variables and $VoteRepub96$ (in some specifications) along with all other controls referred to above. We estimate the voting models on samples restricted to non-Democrats because our model implies larger Fox News effects for this population, and Hopkins and Ladd found this to be the case. We examine Fox News access in 04 as a placebo (for analysis of the 00 data), and Fox News access in 00 (and 04) in 04 (00–04–08 data) models to examine dynamic effects.

Results are in Table 4. We find substantial significant voting effects for 2000 and the pooled data, but not for 2004.[18] The estimates for 2000 are similar to those of Hopkins and Ladd, and larger than DVK's. Hopkins and Ladd discuss why estimates could be larger using individual-level data than those obtained with town-level data.[19] There is no evidence of positive effects in 2004. There are significant effects, just above one percentage point, in the pooled data, supporting the existence of positive effects in 08 in addition to 00. The placebo and lagged Fox terms are all insignificant.

Estimated effects on *WatchFox* are also typically significant. The estimates are 2.2 and 1.8 percentage points for 04 and 04–08, respectively, when lagged terms are excluded, and slightly smaller with the lagged terms (whose coefficients are positive but insignificant, consistent with a more powerful effect for those exposed earlier).

To summarize our results from this section, we find no evidence that Fox entry was correlated with zip-code level education over the 00–04–08 period (on average), but some positive correlation in 2000 only. We also find evidence of voting effects in 2000 and over the 00–04–08 period, but not in 04, and of viewership effects for both years for which data are available (04 and 08). These results in general support: 1) the

[17] The Fox News program options were: Fox News (unspecified), Fox News Report with Shepard Smith, Glenn Beck, Hannity and Colmes, The O'Reilly Factor, On the Record with Greta Van Susteren, Special Report with Brit Hume and Your World with Neil Cavuto.

[18] DVK do not study Fox News effects on 2004 voting in general, but do find that Fox access in 2000 has effects that are persistent—they do not decline in the 2004 election.

[19] Particular differences between our work and Hopkins and Ladd's worth noting are that they use state (not county) FEs, include the lagged voting variables in all models, so they do not analyze the larger sample obtained when these variables are excluded; they did not use two-party vote share; and they did not drop respondents surveyed early in 2000 who gained Fox News access in the year 2000 (i.e. did not have Fox News in 1999, but did in 2000).

Table 4
Voting and Viewership.

	LHS: $VoteRepub_i$			LHS: $WatchFox_i$	
	(1)	(2)	(3)	(4)	(5)
2000					
Fox_i	0.021	0.021**	0.022**		
	(0.013)	(0.010)	(0.011)		
1996 Repub. vote share	0.082**				
	(0.040)				
2004 Fox_i			−0.006		
			(0.010)		
Adjusted R-sq	0.549	0.548	0.544		
N	15,473	25,621	21,001		
Y-mean	0.482	0.494	0.493		
2004					
Fox_i	−0.004	−0.010	−0.010	0.022*	0.018
	(0.014)	(0.011)	(0.012)	(0.013)	(0.013)
1996 Repub. vote share	0.121***				
	(0.047)				
Lag Fox_i			0.001		0.015
			(0.008)		(0.011)
Adjusted R-sq	0.614	0.616	0.616	0.105	0.105
N	12,550	20,015	20,015	22,929	22,929
Y-mean	0.476	0.493	0.493	0.247	0.247
00–04–08					
Fox_i	0.012**	0.012***	0.008	0.018**	0.017*
	(0.005)	(0.005)	(0.009)	(0.009)	(0.009)
1996 Repub. vote share	0.111***				
	(0.022)				
Lag Fox_i			−0.007		0.005
			(0.006)		(0.006)
Adjusted R-sq	0.577	0.579	0.607	0.145	0.144
N	38,014	61,545	34,765	49,061	47,230
Y-mean	0.469	0.484	0.479	0.196	0.198

Notes: All estimates from OLS. Standard errors in parentheses, clustered by cable system (2000, 2004) or media market. NAES political, demographic and question controls, Census controls, cable system controls and year effects included in all models, as described in body text. $VoteRepub_i$ equals one if respondent said planned to (or had) voted Republican for president, zero if Democrat. $WatchFox_i$ equals one if respondent said Fox News was most watched (or tied) cable news station in 2004, and equal one if the TV program watched most was a Fox News program in 2008; there was no analogous question asked in the 2000 survey. Lag Fox_i is Fox_i in 2000, 2004 for observations in 2004, 2008, respectively.
* Denotes 10% significance.
** Denotes 5% significance.
*** Denotes 1% significance.

consistency of our results with those from previous research, where comparable; 2) the power of our sample, with respect to rejecting the null of no Fox effects; 3) the validity of interpreting Fox knowledge effects as causal, especially for 00–04–08. The estimation of these effects is the subject of the next section.

5. Empirical knowledge analysis

The basic model that we use to estimate knowledge effects is:

$$\bar{y}_i = \delta Fox_i + X_i\beta + \frac{1}{n_i}\sum_j d_{ij}\alpha_j + \epsilon_i. \quad (4)$$

$\bar{y}_i$ is the fraction of questions answered correctly by respondent *i*. It might be ideal to analyze each question separately, but we combine questions (in various ways) both to simplify the presentation of results and to improve estimation precision. The coefficient on Fox_i, δ, is thus a weighted average of the effects of Fox News on the various questions. These weights are uncorrelated with respondent characteristics given random sampling, so δ can be interpreted as Fox's average knowledge effect.

If we knew the direction of this effect, it might be preferable to model it as a constant proportion of the fraction of respondents who *could* be affected by Fox News—those who would have gotten the questions wrong, if Fox News's effect was positive, and those who would have been correct if Fox News's effect was negative. We model Fox News's effect this way—as a type of persuasion rate, as discussed in DVK—for subsets of questions for which the sign of Fox News's effect is less ambiguous, which we discuss further below.

The other terms in the model are X_i, a vector of respondent-specific controls, α_j, a fixed effect for question *j*, and d_{ij}, a dummy for whether *i* was asked *j*. We divide the sum of fixed effects for respondent *i* ($\sum_{j=1} d_{ij}\alpha_j$) by the number of questions *i* was asked, n_i, to scale each question's effect appropriately.[20]

We estimate (4) with OLS, weighted by n_i, separately for the 00, 04, and 00–04–08 samples, clustering standard errors and using the same controls (X_i) as in the analysis of Section 4. We exclude *VoteRepub*96 due to its limited availability, and lack of economic or statistical significance when included. We obtain similar results when we use Poisson regressions with a dependent variable of number of questions answered correctly and exposure of number of questions asked. We also obtain

[20] We derive this from a question-level model in an earlier version of the paper. Note that alternatively we could multiply through by n_i, and the dependent variable would be the number of questions answered correctly by *i*, and the *Fox* term would be replaced by $Fox \times n_i$. In addition, this method of accounting for question variation and difficulty is conceptually equivalent to estimating a one-parameter item response model, using a linear probability model instead of logit or probit, and then regressing the estimated individual (respondent) effect onto Fox_i. Instead, we estimate all parameters simultaneously in one step.

very similar results when we stack the data by question and use respondent random effects (fixed effects are collinear with Fox_i).[21]

We first conduct the analysis on all knowledge questions grouped together. We estimate (4) separately for subsamples of non-Democrats (for reasons discussed above) and respondents in towns with fewer than the median number of channels (which DVK found to experience larger effects). We also estimate (4) for a subsample of people who claim to follow political news "some" or "most" of the time in response to an NAES question on the topic. Although this variable is potentially endogenous (as is non-Democrat), this subsample seems worth examining separately since it is plausible that Fox News effects would be strongest for those who are at least somewhat interested in news. We again examine models with lagged and placebo Fox News access terms.

We next conduct an analysis based on the model predictions that knowledge effects are more likely to be positive and larger in magnitude for issues more favorable to Republicans, and more likely smaller or negative for less favorable issues. First, we categorize questions as favorable to either Republicans or Democrats by exploiting survey questions on the respondents' own preferences for the policy issues. For example, the questions about whether Bush or Gore favored handgun licenses in 2000 are accompanied by the question, "Do you personally favor or oppose requiring a license for a person to buy a handgun?" These respondent-preference questions are only available for around half of the knowledge questions. We divide questions into two groups: those for which over half of non-Democratic respondents (these are relatively likely to be Fox News viewers) with a preference prefer the Republican position or are opposed to the Democratic position ("pro-Republican questions"), and those for which over half prefer the Democratic position or are opposed to the Republican one ("anti-Republican"). Questions asking about both of the candidates' positions are excluded when the candidates agree. Since the model predicts positive effects of Fox News for the former group, and negative effects for the latter group, we can now estimate persuasion rates. To do this, we need to first estimate the fraction of questions for which a respondent is "persuadable," or treatable. For pro-Republican questions, we refer to this as $\widehat{treatable}_i$, defined as the fraction of non-Democrat respondents with $Fox_i = 0$ who incorrectly answered the questions received by respondent i. This gives an estimate of the probability that respondent i held wrong beliefs about questions that she was asked that could be corrected by Fox News. For anti-Republican questions, $\widehat{treatable}_i$ is defined analogously except as the fraction of questions answered correctly, an estimate of the probability that i held correct beliefs in the absence of Fox, and thus could have been misled by Fox. We replace the *Fox* variable with the interaction $Fox \times \widehat{treatable}_i$ to allow the impact of Fox News to be proportional to this fraction of people who could be impacted by Fox News. Note that $\widehat{treatable}_i$ is measured as a decimal, not in percentage points.[22]

Last, we use *TInfo* (transcript informativeness) to directly test whether Fox News indeed had heterogeneous effects across issues based on the information it conveyed. We cannot directly observe which of the issues Fox News may have believed served partisan interests best, but we can infer this indirectly. We interact *TInfo* with *Fox*; the natural hypothesis is the interaction has a positive coefficient. The stand-alone *Fox* term's coefficient in these regressions is also of interest. While there is no reason to expect it to be positive, if negative, this would indicate Fox News access decreased knowledge on issues that Fox neglected.[23]

Table 5
All knowledge questions.

	(1)	(2)	(3)	(4)	(5)
2000					
Fox_i	−0.123	−0.476	0.951	0.311	0.422
	(0.547)	(0.742)	(2.122)	(0.671)	(0.566)
2004 Fox_i					−0.022
					(0.581)
Adjusted R^2	0.261	0.258	0.259	0.248	0.260
N	29,912	20,659	14,759	20,831	24,543
Y-mean	47.297	46.420	46.570	51.940	46.981
2004					
Fox_i	0.893	1.149	1.803*	0.365	0.853
	(0.759)	(0.888)	(0.979)	(0.862)	(0.778)
Lag Fox_i					0.143
					(0.554)
Adjusted R^2	0.363	0.367	0.365	0.354	0.363
N	22,929	15,656	11,584	15,506	22,929
Y-mean	53.099	52.473	51.997	57.750	53.099
00–04–08					
Fox_i	−0.166	0.113	0.446	−0.157	0.406
	(0.310)	(0.363)	(0.508)	(0.317)	(0.500)
Lag Fox_i					−0.195
					(0.348)
Adjusted R^2	0.305	0.303	0.305	0.285	0.339
N	79,285	53,512	38,318	58,847	47,517
Y-mean	50.742	50.127	49.936	55.033	53.595
Non-Democrat		✓			
Low Channels			✓		
Follow News				✓	

Notes: LHS is respondent-level percentage of all knowledge questions answered correctly. All estimates from OLS. Standard errors in parentheses, clustered by cable system (2000, 2004) or media market. NAES political, demographic and question controls, Census controls, cable system controls and year effects included in all models, as described in body text. "Non-Democrat" models restricted to respondents who did not identify as Democrats; "low channels" restricted to observations with fewer than median number of channels (in that year); "follow news" restricted to respondents who said they followed the news most or some of the time. Lag Fox_i is Fox_i in 2000, 2004 for observations in 2004, 2008, respectively.
* Denotes 10% significance.
** Denotes 5% significance.
*** Denotes 1% significance.

5.1. All knowledge questions

Basic results (all knowledge questions, excluding *TInfo*) are presented in Table 5. The estimated coefficients on Fox_i for 2000 are all insignificant, and none of the point estimates are greater than a percentage point. Since, as reported in Section 4.1, the population that had Fox access in 00 may have been relatively highly educated (and hence more knowledgeable), these null results are, if anything, indicative of negative effects.

There is a bit more action in the 2004 results. The point estimate for the full sample is somewhat large, 0.89, but insignificant. The estimated coefficients are even larger for subsamples expected to experience stronger effects, non-Democrats and low number of channels, and the latter estimate is significant at 10%. In additional regressions unreported, we obtain similar results when the lagged town voting variables are included,

[21] A benefit of our data and approach is that we naturally pick up local spillover effects: if Fox News makes viewers more or less knowledgeable, who then pass on this knowledge (or lack thereof) to neighbors, these effects would be captured by our estimates. Another plausible specification would be to instrument for Fox News viewership with cable access, using the 04 and 08 viewership variables referred to above. This specification, however, would only capture direct viewership effects and not the spillover effects (and yields extremely imprecise estimates, with standard errors over 0.1). On the other hand, if there are non-local spillover effects – if knowledge is transmitted to others (by the Internet, phone etc.) who live in areas with different Fox News access – then our estimated local Fox News effects would be less than the actual larger-scale effects.

[22] Results are qualitatively similar when we estimate Fox's effects for these sub-samples of questions using the original specification, and not as a persuasion rate.

[23] In a previous version of the paper we reported results for other subsets of questions: hardest vs. easiest; most frequently mentioned keyword vs least frequently mentioned; and most often answered correctly by Republicans vs Democrats. Most results were noisy and few patterns emerged; the most significant results were positive, for questions answered more correctly by Democrats in 2004. A referee pointed out that this result was hard to interpret, however, and suggested the specifications we use in this version of the paper, which we agree are superior.

and find that replacing Fox_i with $WatchFox_i$ yields effects of 2.5–2.7 percentage points, significant at 1%, restricting the sample to those who say they follow politics most closely (results are even stronger with the full sample). While these results do not have a causal interpretation, they still provide support for the possibility of positive (causal) effects of Fox_i.

The results for the 00–04–08 data are substantially more precise. The point estimates are consistently small: for the full sample the estimate is −0.17 percentage points, with a standard error of 0.31, and for the subsamples the point estimates are all less than 0.5 percentage points. Not a single estimate is larger than its standard error. Considering these results together with the results from Table 3 indicating that Fox entry was uncorrelated with observables of interest for the pooled sample, the overall evidence that Fox's knowledge effects were small, *on average* (across issues and time), is strong.

5.2. Variation across questions: respondent policy preferences

Table 6 presents the persuasion rate estimation results, for samples of so-called pro- and anti-Republican questions. For anti-Republican questions, the estimates are almost entirely insignificant, with the exception of the low-channels subsample in 04, whose coefficient is 6.623 and significant at 5%.

The persuasion rate estimates are larger and more often significant for the pro-Republican questions. For the 04 data, the coefficient is significant across all specifications. For the full sample, the coefficient of 7.208 indicates that increasing the fraction of questions a viewer answered incorrectly by 0.1 increases the expected effect of Fox News on knowledge by 0.72 percentage points. The estimates are larger for each of the subsamples considered: non-Democrat, low-channels, and news followers. This supports the estimates' validity, since these subsamples were predicted to experience larger effects.

For the 00–04–08 data, the coefficients for the pro-Republican questions become smaller, but are significant at 10% for each of the subsamples. Including a lagged term increases the significance to a 5% level and the coefficient to 3.237. In unreported analysis we replace Fox_i with $WatchFox_i$ and find supportive qualitatively similar results (substantially larger persuasion rates for pro-Republican questions).

Overall, these results continue to suggest that the strongest positive effects of Fox News occurred in 04, and tell us more about what was driving those results. The Table 6 results also suggest that, when the questions are disaggregated properly, there may have been Fox News effects over the full time-frame. The result that Fox News effects were stronger in magnitude for pro-Republican questions is consistent with the model's corresponding comparative static prediction (driven by the assumption that it is easier for the outlet to find information supporting a claim when the claim is true). To test another comparative static, that effects would be stronger when priors were further from the outlet's desired position, we estimated models with quadratic terms; results were very noisy and thus not reported, but the signs were typically consistent with this prediction as well.

Table 6
"Persuasion rates" for pro and anti-Republican questions.

	Pro-Republican questions $\left(\widehat{treatable}_i = \left(1-\bar{y}_j^i\right)\right)$					Anti-Republican questions $\left(\widehat{treatable}_i = \bar{y}_j^i\right)$				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2000										
$Fox_i \times \widehat{treatable}_i$	4.880	1.018	−8.870	4.237	8.033**	−0.466	−0.373	2.227	1.010	0.408
	(3.059)	(3.924)	(9.892)	(3.628)	(3.400)	(1.383)	(1.876)	(5.240)	(1.735)	(1.452)
2004 $Fox_i \times \widehat{treatable}_i$					2.166					−0.357
					(3.051)					(1.402)
Adjusted R^2	0.188	0.197	0.190	0.173	0.187	0.220	0.210	0.220	0.205	0.219
N	23,880	16,580	11,670	16,627	19,620	25,236	17,474	12,308	17,674	20,713
Y-mean	64.758	66.664	63.942	72.258	64.264	46.107	44.749	45.323	50.476	45.795
2004										
$Fox_i \times \widehat{treatable}_i$	7.208**	7.320*	11.818***	8.555**	6.075*	3.212	3.889	6.623**	−0.688	3.994
	(3.377)	(3.931)	(4.297)	(4.067)	(3.443)	(2.600)	(3.190)	(3.272)	(2.946)	(2.708)
Lag $Fox_i \times \widehat{treatable}_i$					3.548					−2.466
					(2.315)					(1.764)
Adjusted R^2	0.211	0.215	0.206	0.185	0.211	0.216	0.199	0.217	0.207	0.216
N	14,141	9597	7081	10,509	14,141	14,141	9597	7081	10,509	14,141
Y-mean	55.362	56.028	54.270	61.285	55.362	54.491	51.537	52.952	58.718	54.491
00–04–08										
$Fox_i \times \widehat{treatable}_i$	2.175	3.166*	3.169*	3.199*	3.237**	−0.719	0.026	0.854	−0.583	−0.262
	(1.456)	(1.669)	(1.895)	(1.708)	(1.483)	(0.862)	(1.119)	(1.546)	(0.948)	(0.928)
Lag $Fox_i \times \widehat{treatable}_i$					0.046					−0.458
					(1.119)					(0.957)
Adjusted R^2	0.213	0.217	0.209	0.213	0.210	0.255	0.244	0.257	0.247	0.258
N	52,667	35,682	25,376	39,830	47,323	52,346	35,485	25,236	39,407	46,860
Y-mean	56.145	57.205	55.543	60.831	55.667	48.894	47.180	47.920	53.495	49.015
Non-Democrat		✓					✓			
Low Channels			✓					✓		
Follow News				✓					✓	

Notes: LHS is respondent-level percentage of all knowledge questions answered correctly. $\widehat{treatable}_i$ is an estimate of the probability respondent i could receive the hypothesized Fox News effect; this is the probability of being incorrect for pro-Repub. questions, and probability of being correct for anti-Repub. questions ($\bar{y}_j^i$ is the fraction of respondents with $Fox = 0$ who answered correctly questions j received by respondent i). $\widehat{treatable}_i$ also included separately in all models (but not reported). All estimates from OLS and include county FEs. Standard errors in parentheses, clustered by cable system (2000, 2004) or media market. NAES political, demographic and question controls, Census controls, cable system controls and year effects included in all models, as described in body text. "Pro (Anti)-Republican questions" are those for which the correct Republican position is the preferred policy of over (under) 50% of non-Democrat respondents. "Non-Democrat" models restricted to respondents who did not identify as Democrats; "low channels" restricted to observations with fewer than median number of channels (in that year); "follow news" restricted to respondents who said they followed the news most or some of the time. Lag Fox_i is Fox_i in 2000, 2004 for observations in 2004, 2008, respectively.

* Denotes 10% significance.
** Denotes 5% significance.
*** Denotes 1% significance.

5.3. Variation across questions: transcript content

These results are presented in Table 7. For the 04 data, the coefficients on *Fox* remain positive, but are never significant; the coefficients on the *Fox* × *TInfo* interaction terms are similarly positive and insignificant. Significant results are found, however, in the 00 and 00–04–08 regression results, which display a consistent pattern: negative coefficients for *Fox*, and positive for the interaction term. For the 00–04–08 full sample, the interaction term has a coefficient of around 1.6, significant at 1%, indicating that an increase of one unit on the informativeness scale (equivalent to one more informative mention in ten transcripts) increases knowledge by 1.6 percentage points. The coefficient on *Fox* is −1.2, also significant at 1%. Therefore on a question for which *TInfo* = 0, meaning Fox News ignored the issue, the estimates imply that the presence of Fox News actually caused knowledge to decrease. These results are stronger for the non-Democrat subsample, but weaker for the other subsamples. Results across subsamples are similar for 2000, except for the low channels subsample, for which the signs are reversed (and insignificant). Results are generally similar for a robustness check in which we use an alternative method to code *TInfo*.[24] Again, in unreported analysis we replace Fox_i with $WatchFox_i$ and find qualitatively similar results.[25]

These results indicate that the null aggregate effects found for the 2000 and 00–04–08 samples in the main regression mask differences in effects across questions, and identify a channel through which the impact of Fox News on knowledge operated. Our model predicts that a partisan media outlet would report on certain issues relatively frequently, both to attract viewers and/or to influence voting. The results in Table 7 imply that Fox News's choices about what issues to cover did affect viewers' information, increasing knowledge on questions about which Fox was relatively informative and decreasing information on those issues it covered less. The negative effect for issues not covered could be the result of substitution by Fox viewers away from other news outlets that would have covered those issues more intensively. We investigate this topic in the next section.

Table 7
Transcript informativeness.

	(1)	(2)	(3)	(4)	(5)
2000					
Fox_i	−1.207	−2.637**	7.097	−1.298	−0.231
	(0.827)	(1.090)	(4.880)	(0.991)	(0.926)
$Fox_i \times TInfo_i$	2.441*	4.853***	−13.774	3.614**	1.475
	(1.440)	(1.794)	(9.565)	(1.602)	(1.691)
04 Fox_i					−0.083
					(0.971)
04 $Fox_i \times TInfo_i$					0.136
					(1.835)
Adjusted R^2	0.261	0.258	0.259	0.248	0.260
N	29,912	20,659	14,759	20,831	24,543
2004					
Fox_i	0.504	0.711	1.454	0.526	0.344
	(1.035)	(1.222)	(1.277)	(1.210)	(1.071)
$Fox_i \times TInfo_i$	0.404	0.454	0.389	−0.166	0.543
	(0.735)	(0.878)	(0.917)	(0.857)	(0.788)
Lag Fox_i					0.439
					(0.785)
Lag $Fox_i \times TInfo_i$					−0.342
					(0.687)
Adjusted R^2	0.363	0.367	0.365	0.354	0.363
N	22,929	15,656	11,584	15,506	22,929
00–04–08					
Fox_i	−1.155***	−1.254**	−0.533	−0.781	−0.258
	(0.437)	(0.566)	(0.884)	(0.485)	(0.804)
$Fox_i \times TInfo_i$	1.624***	2.247***	1.284	1.019*	0.766
	(0.575)	(0.708)	(0.945)	(0.599)	(0.782)
Lag Fox_i					−0.264
					(0.625)
Lag $Fox_i \times TInfo_i$					0.101
					(0.582)
Adjusted R^2	0.305	0.304	0.305	0.285	0.339
N	79,285	53,512	38,318	58,847	47,517
Non-Democrat		✓			
Low Channels			✓		
Follow News				✓	

Notes: LHS is respondent-level percentage of all knowledge questions answered correctly. $TInfo_i$ refers to transcript informativeness for *i*, a measure of extent to which Fox News provided accurate information on questions received by *i*, defined in text. $TInfo_i$ also included separately in all models (but not reported). All estimates from OLS. Standard errors in parentheses, clustered by cable system (2000, 2004) or media market. NAES political, demographic and question controls, Census controls, cable system controls and year effects included in all models, as described in body text. "Non-Democrat" models restricted to respondents who did not identify as Democrats; "low channels" restricted to observations with fewer than median number of channels (in that year); "follow news" restricted to respondents who said they followed the news most or some of the time. Lag Fox_i is Fox_i in 2000, 2004 for observations in 2004, 2008, respectively.
* Denotes 10% significance.
** Denotes 5% significance.
*** Denotes 1% significance.

6. Interpretation

6.1. Individual-level effects

What do our results imply about the knowledge effects of watching Fox News for individuals who actually watched? Answering this question requires that we first assess what effect Fox_i had on Fox News viewership. DVK address this issue head on, combining proprietary microviewership data with their cable system data, and then estimating that Fox News availability increased the population share who watched Fox for at least a full half-hour block over a 7-day period by 2.5–3.5%, and caused an 8.6–12.7% increase in the channel being watched at all over the period.[26]

Our estimated effects of *Fox* on *WatchFox* are close to the lower end of DVK's estimates of Fox News access on weekly half-hour block viewership. But these results are not directly comparable. Watching Fox "most often" is not the same as watching a specific amount of time weekly. In fact, in our 2004 data, 22.8% of respondents with $Fox_i = 0$ had $WatchFox_i = 1$ (compared to 25.4% for those with $Fox_i = 1$). The 22.8% is likely driven in part by measurement error, but self-reported media exposure tends to be unreliable regardless (Prior, 2013).[27] It is possible that respondents in areas without Fox News access still claimed to watch it, e.g., for ideological reasons. Given this ambiguity, a fairly simple and cautious path forward is to use the lower bounds for DVK's viewership effect estimates: 2.5% and 8.6%. Besides being lower bounds, these numbers are conservative in a few other ways. Fox News viewership was in general higher in 2004 and 2008 than 2000, and higher in months closer to the election, when most of the surveys were conducted. Moreover, this approach does not incorporate spillover effects, or that our estimates of voting effects were larger than those found by DVK.

Using the 2.5% figure, Fox News would have to have a greater than 17.6 point, or less than −31 point, effect on knowledge to fall outside our confidence interval for the 00–04–08 data, for knowledge across all questions. Using the 8.6% figure, the analogous effects are 5.1 and

[24] For the pooled data, full sample, this method yielded point estimates of −0.81 and −0.54 for *Fox* and 1.37 and 1.38 for *Fox* × *TInfo* for models with county and state FEs, respectively, with p values of 0.026, 0.102, 0.003, and 0.002, respectively. The details of this method are in the appendix.

[25] The coefficient for the $WatchFox_i$, *TInfo* interaction term is positive and significant at 10%.

[26] They also note that 2.6% of the population in towns with Fox News access coded as zero watched Fox News for a full half-hour block in the week, so their measure of Fox News access only picked up about half the viewership effect.

[27] Prior discusses how in the first half of 2008, 24% of Americans self-reported watching Fox News "regularly," but in reality only 6–8% watched at least 60 minutes per week in March/April.

−9.0 points; the latter is about the equivalent of one question. Thus, roughly speaking, our pooled data general knowledge results imply watching Fox News likely did not change knowledge by more than 31 points for those who watched Fox News for 30 minute blocks, and watching Fox News did not change knowledge by more than 9.0 points for those who watched Fox News at all. The latter figure implies a fairly tight bound.

The persuasion rate of 7.3 for 2004 (significant at 10%) in the full sample of pro-Republican questions (Table 7) implies an implausibly large per viewer effect for the low viewership figure. Even for the high viewership figure, the implied persuasion rate of 85% seems too large. The point estimates for the models with *TInfo* imply effects per viewer of around −10 points for questions *Fox* did not report on at all, and of around 10 points for questions *Fox* reported on most often (*TInfo* = 2, i.e., an informative mention every five episodes), using the higher viewership numbers. These numbers seem somewhat high (by comparison, the estimated effect of completing college, versus completing high school, from the same models, is around 11 points). Moreover, the numbers corresponding to the lower viewership numbers certainly seem high, further indicating that all of these results should be treated cautiously.

6.2. Other dependent variables

Much of the empirical and theoretical literature in this area studies media consumption substitution patterns (George and Waldfogel, 2006). Did watching Fox News cause consumers to reduce other media consumption? If so, which types and by how much? Or did Fox News spark interest in news and cause other media consumption to increase? These questions are important for understanding possible mechanisms behind our results.

We regress variants of three other variables available in the NAES in all three years – reading the newspaper, reading news online, and general interest in news – on Fox News access and our standard set of controls, and report results in Table 8. These results are in general less precise than those for knowledge since we cannot weight the regressions. There is some evidence of Fox News causing a decline in newspaper consumption over the full time-frame, and especially in 2000. This could help explain the negative effects on less-covered issues in 2000 and the full time-frame, found in the *TInfo* models; if Fox News neglected issues viewers would have read about in newspapers, Fox News could have reduced knowledge on these issues without misinformation.

There is also evidence of Fox News causing an increase in online news consumption in 2004, and an insignificant 2.1 point increase in interest in news that year. These results suggest that Fox's positive knowledge effects that year may have been caused partly by Fox motivating consumption of news from other sources. This would be consistent with the lack of significant *TInfo* effects for that year, implying that the positive effects were not for issues that Fox covered most.

6.3. Voting, knowledge, and overall interpretation

To briefly review our voting and knowledge results: we find evidence of pro-Republican voting effects in 00 and 08, positive (negative) knowledge effects for more- (less-) covered issues in those years, weaker evidence of positive effects for "pro-Republican" issues in those years and stronger effects for those issues in 04. In this subsection, we discuss implications for the relationship between voting and knowledge, and the overall interpretation of our results.

First, we again acknowledge the limited precision of many of our estimates; despite our effort to construct the best possible data set to address our research question, our study still has significant limitations. Thus, we urge the reader not to take any one of our particular point estimates at face value, but to consider the body of evidence we present as a whole. This evidence generally suggests that Fox News influenced knowledge in a partisan way. We analyze two measures of issue type (those of Tables 6 and 7). Although there are differences across years as to which measures pick up the effects of Fox, we do not view these results as incompatible. Since both measures are noisy, they are intended to complement one another.

Moreover, as the voting and knowledge effects were consistent (similarly partisan) in 00 and 08, there is circumstantial evidence of a relationship between these effects, at least in those years. The evidence

Table 8
Other outcomes.

	Newspaper		Online news		Follow news	
	Def. 1	Def. 2	Def. 1	Def. 2	Def. 1	Def. 2
	(1)	(2)	(3)	(4)	(5)	(6)
2000						
Fox_i	−0.132*	−0.024**	0.014	0.004	−0.024**	−0.012
	(0.070)	(0.011)	(0.047)	(0.010)	(0.011)	(0.011)
Adjusted R^2	0.185	0.080	0.100	0.116	0.169	0.172
N	29,874	29,912	29,816	29,912	29,744	29,744
Y-mean	3.879	0.793	1.048	0.249	0.700	0.352
2004						
Fox_i	0.005	−0.005	0.109**	0.020*	−0.009	0.021
	(0.086)	(0.014)	(0.052)	(0.012)	(0.014)	(0.015)
Adjusted R^2	0.184	0.085	0.093	0.111	0.150	0.150
N	22,900	22,929	22,883	22,929	20,266	20,266
Y-mean	3.917	0.784	0.827	0.226	0.765	0.399
00–04–08						
Fox_i	−0.027	−0.011*	0.016	0.002	−0.008	0.004
	(0.042)	(0.006)	(0.026)	(0.005)	(0.006)	(0.006)
Adjusted R^2	0.191	0.118	0.192	0.188	0.159	0.153
N	79,081	79,285	78,961	79,285	76,322	76,322
Y-mean	3.620	0.732	1.402	0.310	0.771	0.391

Notes: All estimates from OLS. Standard errors in parentheses, clustered by cable system (2000, 2004) or media market. NAES political, demographic controls, Census controls, cable system controls and year effects included in all models, as described in body text. Definition 1 for newspaper and online news is number of days in past week respondent got that type of news (0, 1, 2, … 7); definition 2 is binary, equal to one if the respondent at all got the type of news in last week. Definition 1 of follow news equals one if the respondent said she/he follows news most or some of the time, and definition 2 equals one only if the respondent follows news most of the time (both equal zero otherwise).

* Denotes 10% significance.
** Denotes 5% significance.
*** Denotes 1% significance.

is only circumstantial since we do not know why voters acted as they did; perhaps survey data on these motives could be used to investigate this connection in future work. The lack of voting effects in 04, despite evidence of knowledge effects in that year, is more puzzling. Again, this variation may simply be due to sampling or other error, or subtle endogeneity; perhaps there was a voting effect for that year that we did not find, or Fox entered towns in 04 that were relatively Democratic (in a way that our analysis failed to detect). It is also possible that the interaction of knowledge and voting varied across years. Perhaps issues on which Fox was informative in 04, though "pro-Republican," were not vote changers, maybe due to the Republican candidate (George W. Bush) being an incumbent with whom voters were already very familiar. It is also possible that Fox's influence on voting was lower that year due to the relatively prominent and perhaps influential "Swift Boat" national advertising campaign (against Bush's opponent, John Kerry). This year (04) was also the one year without significant evidence of negative knowledge effects from issues being neglected; perhaps these negative effects had a greater influence on votes. These ideas are speculative, and we share them partly to underscore the point that context matters and varies in any number of ways from year to year.

7. Conclusion

We study the effects of the introduction of a major partisan news source, the Fox News cable station, on citizen knowledge. We find near-zero knowledge effects across years and questions on average, but evidence of both positive effects and negative effects (likely due to substitution away from other news sources) for specific types of issues, consistent with Fox's coverage varying in a partisan way. We note that these results, given some inconsistency and imprecision, should in general be treated cautiously.

Fox's knowledge effects may have contributed to its influence on voting. However, given the presence of both positive and negative knowledge effects, with an average near zero, it is unclear whether any resulting influence on voting served voters' interests or not. That is, we do not know whether votes changed due to information gained or lost (or for other reasons). This ambiguity is somewhat disappointing, given the connection between knowledge and welfare that motivated our paper. Still, it is of course useful to rule out uniform increases or decreases in knowledge due to Fox, and to better understand Fox's effects. Our results might also motivate future theory work to focus more on multidimensional news.

The polarization of knowledge suggested by our results could be significant in ways other than direct voting effects. Other potentially important effects of media in the context of presidential voting are those on: the content of other (competitor) media; the actions and platform choices of candidates; and other attitudes, beliefs, and actions (e.g., activism) of voters. Citizens do not just vote, they hold opinions (which politicians consider even once in office), communicate with each other and the media, donate time and money, etc. The relation between these actions and media should continue to be studied.

Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.jpubeco.2015.03.009.

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