The Effect of Local News on Political Knowledge*†

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Abstract

The quality of democratic representation is often thought to be predicated upon a robust fourth estate: the news media provides voters information about the identity and performance of elected officials, which voters can use to hold them accountable. Under weak monotonicity assumptions, we estimate nonparametric bounds for the causal effect of local news availability on voters' general political knowledge, accounting for information spillovers due to social interactions. We show that increasing the number of local print or TV news sources in a media market unambiguously improves voters' factual knowledge about incumbent politicians. In recent years, local newspapers in the U.S. have experienced a well-publicized decline. We document a concomitant rise in local TV news programming, which we show has offset the informational losses that would have accrued due to the contraction in local print news alone.

Keywords: voter knowledge, local news, partial identification of causal effects, social spillovers, monotone comparative statics

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†Researcher(s)' own analyses calculated (or derived) based in part on data from The Nielsen Company (US), LLC and marketing databases provided through the Nielsen Datasets at the Kilts Center for Marketing Data Center at the University of Chicago Booth School of Business.

The conclusions drawn from the Nielsen data are those of the researcher(s) and do not reflect the views of Nielsen. Nielsen is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein.

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The moment we no longer have a free press, anything can happen. What makes it possible for a totalitarian or any other dictatorship to rule is that people are not informed; how can you have an opinion if you are not informed?

– Hannah Arendt (October 28, 1978)

It is widely held that democratic accountability is facilitated by the existence of a free press (Schultz, 1998; Bennett and Serrin, 2005; Norris, 2014). A robust news media transmits information about the identity and performance of elected officials that voters can use to hold them accountable (Strömberg, 2004; Besley and Prat, 2006; Repetto, 2018). Yet quantifying a causal relationship between news exposure and voter knowledge is not straightforward. In this paper, we nonparametrically identify and estimate sharp bounds for the causal impact of local news availability on factual political knowledge in the United States. Importantly, our approach accounts for potential knowledge spillovers arising from voters' day-to-day social interactions. We show that increasing the number of local print or television (TV) news sources in a media market unambiguously improves voters' awareness of incumbent politicians.

Both folk theories and formal models of accountability treat information—specifically, voters' ability to infer the effort or quality of an incumbent politician—as a crucial factor for both selecting and disciplining the behavior of those in elected office (Zaller 2003; Arnold 2004; for a review, see Ashworth 2012). Relatedly, scholars of political behavior have long noted a correlation between news consumption and political knowledge (Price and Zaller, 1993; Eveland and Scheufele, 2000; Jerit, Barabas and Bolsen, 2006). However, establishing a causal link has been challenging.

One difficulty is measurement. Because trends in news consumption have frequently involved substitution from easily observable media like print news to less easily monitored forms like online or social media, empirical estimates that rely on changes to a single type of news source may understate their effects (Prior, 2007; Dimitrova et al., 2014). Another measurement challenge arises from self-reported news consumption habits, which suffer from well-known social desirability bias (Bartels, 1993; Prior, 2009). Other approaches based upon aggregate data have relied on indirect measures, exploiting features of media-market "mismatch" under the

assumption that political geographies that are largely contained in other areas' media markets receive less relevant news about the performance of their elected representatives (Stewart and Reynolds, 1990; Strömberg, 2004; Moskowitz, 2021).

A second—and more critical—difficulty entails obtaining plausibly exogenous variation in news exposure. Experimental work that cleanly identifies the causal impact of news coverage on voters' knowledge may be subject to external validity concerns and is typically underpowered (Norris and Sanders, 2003; Gerber, Karlan and Bergan, 2009).[1] Observational work has, of course, thought deeply about identification but often relies upon strong selection-on-observables or parallel-trends assumptions (Barabas and Jerit, 2009; Hayes and Lawless, 2015, 2018; Peterson, 2019). What is more, almost uniformly, both experimental and observational studies have overlooked information spillovers among individuals, which, outside of the controlled laboratory setting, are likely to drive a non-trivial portion of voters' knowledge (Huckfeldt and Sprague, 1987; Halberstam and Knight, 2016; Carlson, 2019).

We exploit advances in the partial identification of treatment effects (Manski, 2013; Lazzati, 2015) to place sharp bounds on the causal impact of U.S. local news availability on voters' knowledge of incumbent politicians' identities and parties, accounting for the spread of information among voters. Our approach rests solely on a pair of monotonicity assumptions. First, we assume that exposure to more news sources weakly increases—but may have no effect on—voters' political knowledge. Specifically, an additional local newspaper or TV news program in the marketplace *does not reduce* the likelihood that an individual learns the name and party of their state and federal elected representatives.[2] Second, we assume that social spillovers are also weakly positive with regard to this type of factual knowledge. That is, as an individual becomes more informed about the identities and parties of incumbent officials, others residing in the same media market do not become *less* knowledgeable than

[1] Moreover, randomized trials studying the causal impact of (especially online) news are typically only designed to pick up relatively short-run effects. See, for example, Allcott et al. (2020), Levy (2021), and Guess et al. (2023). Our paper, by contrast, targets the causal impact of structural media-market trends rather than that of transient perturbations to individual consumption.

[2] As discussed below, this is akin to the standard "no defiers" assumption in instrumental-variables analyses introduced by Angrist, Imbens and Rubin (1996).

they would be otherwise. To add credibility to this pair of monotonicity assumptions, we deliberately limit our analysis to factual knowledge of incumbents' identities and parties. We set aside more subjective evaluations—for example, questions of job performance—which, in light of U.S. news sources' increasing partisan slant (Gentzkow and Shapiro, 2010; Martin and Yurukoglu, 2017), may not respond monotonically to changes in the local news supply.

Coupling data describing the number of competitors in local news markets across the U.S. with survey evidence from the Cooperative Congressional Election Study (CCES) capturing individual voters' ability to correctly identify the name and party of elected officials, we find that increased local news competition substantially improves voters' knowledge of both state and federal office holders.[3] Based on self-reported measures of media consumption or interest in current affairs and politics, we find that the impact of local news on political knowledge is concentrated among high-consumption or high-interest voters, which is indicative of a strong direct effect of news exposure. Nevertheless, we also provide some evidence of an indirect effect to low-consumption or low-interest voters consistent with informational spillovers. This suggests that the no-interference assumptions typical of most research designs may not be innocuous in this setting.

Furthermore, our analysis can help reconcile the implications of two countervailing trends in U.S. local news markets. On one hand, the U.S. print news industry has experienced dramatic and well-documented consolidation (Pew, 2016; Abernathy, 2020). In our data, the number of local newspapers in the average media market decreased from 45 at the turn of the twenty-first century to 33 two decades later.[4] Related work has shown this can hinder electoral accountability and contribute to rising polarization (Rogers, 2017; Hayes and Lawless, 2018; Djourelova, Durante and Martin, 2021). On the other hand, we document (for the first time, to our knowledge) a considerable expansion of local TV news programming over the same

[3]While our results, due to data limitations, focus on the informational value of the *number* of available news sources in a media market, a related strand of literature suggests the ownership structure of news outlets can also significantly affect the quality of political news coverage, both in print and on TV (Dunaway, 2008; Archer and Clinton, 2018; Martin and McCrain, 2019; Archer and Torres, 2022).

[4]We define media markets according to The Nielsen Company's Designated Market Areas (DMA). Nielsen divides the U.S. into 210 DMAs.

period. In 2010, the first year in our data, the average media market had just over 149 local TV news broadcasts, and this number increased to 523 in 2020. This may have offset the informational losses for voters due to dwindling local newspapers. Indeed, the proportion of Americans who can correctly identify the party and name of all elected officials included in the CCES surveys increased from 22% in 2010 to 31% in 2020.[5]

To formally assess which trend is likely to dominate, we conduct a two-dimensional version of our analysis, estimating bounds on political knowledge for all combinations of local print and TV news competition intensities. We find strong evidence that the rise in local TV news has more than compensated for the decline in local print news. Using past trends to project into the future, our results suggest that frequently expressed concerns about the disappearance of local newspapers may overstate its consequences, at least for the type of factual political knowledge we examine.[6]

The Inference Problem

We begin by briefly describing the inference problem we face, the monotonicity assumptions we invoke, and our identification strategy. Technical details can be found in Appendix B.

As previewed, we are interested in estimating the impact of local news availability on voters' factual knowledge of their political environment. Voters can be exposed to a varying number $t \in \{0, 1, 2, \ldots, T\}$ of local news sources. In our empirical analysis, this corresponds either to the number of local newspapers in circulation in a voter's media market or to the number of local TV news broadcasts. In standard potential-outcomes fashion, let $y_i(t) \in \{0, 1\}$ be a binary indicator of whether voter i is informed ($y_i(t) = 1$) or not ($y_i(t) = 0$) about her political environment when exposed to t local news sources. Our goal is to estimate $p(t) \equiv P(y_i(t) = 1)$, the potential fraction of informed voters in the population given t.

[5]Figure A1 in Appendix A depicts all three trends.

[6]Of course, threats to democratic accountability may nevertheless arise from consolidation in local news markets if perceptions about the performance of politicians or institutions are distorted as a result of shifts in the type or quality of news coverage (Fan, 2013; Turkel et al., 2021; Mastrorocco and Ornaghi, 2022).

Let τ_i denote the realized level of local news availability to which voter i is exposed. This is determined by the structure of the news industry in the market where she lives. Voter i's realized knowledge is then $y_i = \sum_{t=0}^{T} y_i(t)\mathbf{1}_{\tau_i=t}$. Thus, $y_i(t)$ is observed only if $\tau_i = t$. By the law of total probability, the potential fraction of informed voters, $p(t)$, can be written as

$$\begin{aligned} p(t) &= P(y_i(t) = 1|\tau_i = t)P(\tau_i = t) + P(y_i(t) = 1|\tau_i \neq t)P(\tau_i \neq t) \\ &= P(y_i = 1|\tau_i = t)P(\tau_i = t) + P(y_i(t) = 1|\tau_i \neq t)P(\tau_i \neq t). \end{aligned}$$

Given a random sample of voters, $P(y_i = 1|\tau_i = t)$, $P(\tau_i = t)$, and $P(\tau_i \neq t)$ are all identified nonparametrically from the data.[7] However, without additional information about the empirical relationship between local news availability and voter knowledge, the data does not identify $P(y_i(t) = 1|\tau_i \neq t)$.

As first noted by Manski (1989), although $p(t)$ cannot be pinned down exactly in this case, one can exploit the fact that $P(y_i(t) = 1|\tau_i \neq t) \in [0, 1]$ to derive the following "naive" bounds:

$$p(t) \in \big[P(y_i = 1|\tau_i = t)P(\tau_i = t), P(y_i = 1|\tau_i = t)P(\tau_i = t) + P(\tau_i \neq t)\big]. \qquad \textbf{(N)}$$

Interestingly, the width of the interval in which $p(t)$ is guaranteed to lie is given by $P(\tau_i \neq t)$. Thus, how informative (**N**) is about $p(t)$ depends entirely on the distribution of local news sources—i.e., on the market structure of the news industry.

Since Manski's (1989; 1990) seminal work, this bounding approach has been refined in hopes of obtaining more precise information from the data. We follow Lazzati (2015) and impose additional structure on the inference problem that allows us to improve upon (**N**) and instead rely on the following:

$$p(t) \in \big[P(y_i = 1|\tau_i \leq t)P(\tau_i \leq t), P(y_i = 1|\tau_i \geq t)P(\tau_i \geq t) + P(\tau_i \not\geq t)\big]. \quad \textbf{(PSI \& MTR)}$$

[7] That is, they can all be consistently estimated using analogous sample averages.

To see that (**PSI & MTR**) is indeed tighter and thus more informative about $p(t)$ than (**N**), note that the lower bound uses $P(y_i = 1|\tau_i < t)$ instead of 0 to bound $p(t)$ in the event that $\tau_i < t$.[8] Similarly, the upper bound uses $P(y_i = 1|\tau_i > t)$ instead of 1 in the event that $\tau_i > t$. Both bounds again involve probabilities that are identified nonparametrically from the data.[9] Their validity rests on a pair of monotonicity assumptions that we describe next.[10]

Identifying Assumptions

The first assumption underpinning (**PSI & MTR**) concerns the way in which political knowledge can spread among voters in a given media market via their day-to-day social interactions.

Assumption 1 (Positive Social Interactions)**.** *Given any level of local news availability, a voter does not become less informed about her political environment if the proportion of informed voters in the same media market increases.*

This positive social interactions (**PSI**) assumption can be interpreted as a "no defiers" condition, constraining voters who are initially informed. That is, an informed voter, regardless of the means by which she obtained factual political information, should not unlearn what she knows after being exposed to a higher proportion of informed voters in her day-to-day life.[11] Moreover, although (**PSI**) has no (direct) implications for individuals who are initially uninformed, it is natural to view additional informed voters as a potential source of information, which the uninformed could, at worst, simply ignore.

Importantly, in addition to the identifying power (**PSI**) confers in combination with our second assumption below, it provides coherence to the underlying data generating process. Notice that we allow the (binary) information status of a voter to potentially affect that of

[8] This follows from $P(y_i = 1|\tau_i \leq t)P(\tau_i \leq t) = P(y_i = 1|\tau_i = t)P(\tau_i = t) + P(y_i = 1|\tau_i < t)P(\tau_i < t)$.

[9] Because we rely on survey data (described below), which comprises only a representative sample of voters from the population, the (**PSI & MTR**) bounds must be estimated. Our results account for this estimation uncertainty with a confidence region based on Stoye (2009). See Appendix B for technical details.

[10] We relegate formal statements of the assumptions to Appendix B.

[11] A potential concern in a highly polarized political environment is mistrust among voters. For this reason, we focus our analysis on factual knowledge of incumbents' identities and parties, setting aside more subjective questions (like job performance) susceptible to partisan biases. Furthermore, (**PSI**) simply constrains informed voters to not lose the knowledge they already have.

others. Such simultaneous equations models for discrete outcomes are known to suffer from incoherence—i.e., the system of equations may have no solution (Tamer, 2003; Chesher and Rosen, 2012). Under (**PSI**), however, a social knowledge equilibrium is guaranteed to exist in every media market.[12]

Our second assumption constrains the direction of local news availability's impact on voter knowledge.

Assumption 2 (Monotone Treatment Response)**.** *A voter does not become less informed about her political environment if she is exposed to a higher level of local news availability.*

This monotone treatment response (**MTR**) assumption can again be viewed as a "no defiers" condition.[13] Being exposed to additional sources of information—in this case, more local newspapers or local TV news programs—should not cause an informed voter to become uninformed. And uninformed voters, while unconstrained by (**MTR**), may, at worst, ignore the additional sources.

Together, as is well known from the literature on monotone comparative statics (Milgrom and Roberts, 1990), positive social interactions and monotone treatment response imply the existence of a minimally-informed social knowledge equilibrium as well as a maximally-informed equilibrium, each of which is non-decreasing in the level of local news availability. That is, there exist $y_i^L(t)$ and $y_i^U(t)$ such that $y_i^L(t) \leq y_i(t) \leq y_i^U(t)$, and both are non-decreasing in t, the number of local news sources. Yet, without additional information about which equilibrium is played in the data, potential outcome $y_i(t)$ may be non-monotonic in t.

The bounds in (**PSI & MTR**) don't require individual potential outcomes to be monotonic in t, only the fraction of informed voters in each media market must be monotonic. The formal statement of assumption (**MTR**) in Appendix B imposes a sufficient condition to that effect, which can take one of two forms: either (i) equilibrium selection is such that only $y_i^L(t)$ or $y_i^U(t)$ are played in the data, or (ii) the treatment is strong enough that, as t

[12]This is true regardless of whether information acquisition is presumed strategic or passive. See Appendix B for a formal statement of this result and further discussion.

[13]We use "monotone" instead of "positive" to label (**MTR**) because analogous bounds for $p(t)$ can be obtained in settings with positive social interactions and *negative* treatment response—see Lazzati (2015).

increases, equilibrium sets are non-overlapping with respect to the fraction of informed voters. As discussed in Appendix B, version (i) can be justified in a number of ways. It is trivially satisfied when equilibria are unique, a common assumption in empirical work.[14] And it is a natural consequence of simple equilibrium adjustment dynamics or of coordination based on Pareto dominance. Alternatively, version (ii) can be invoked without placing any restrictions on equilibrium selection.

We use (**PSI & MTR**) to examine voters' knowledge of both their state and federal incumbent representatives. We separately estimate bounds on the effect of local news availability for two media types—newspapers and TV—using a variety of data sources. We also conduct a two-dimensional analysis, letting $t = (t_{\text{PN}}, t_{\text{TV}})$ explicitly describe the intensity of market exposure to both media types (print news and TV, respectively). This multidimensional analysis relies on the same set of assumptions and bounds as the one-dimensional case, and it enables us to assess past and future trends in voter knowledge, taking into consideration observed trends in market structure across both types of news media.

Data

Political Knowledge

We rely on the Cooperative Congressional Election Study (CCES) surveys for our measures of voters' political knowledge. First, we construct indicators of whether or not respondents recognize the name and can correctly identify the party of their governor, both of their senators, and their member of Congress. Second, we construct a set of binary indicators of whether respondents can correctly identify the party that has a majority of seats in the U.S. House of Representatives, U.S. Senate, their state's lower chamber, and their state's upper chamber. Finally, we create a pair of indicator variables denoting complete knowledge of state-level politics (i.e., they can correctly identify the party that controls both chambers of state govern-

[14] See Gibilisco and Montero (2022) for an overview of the literature in political science and a method for structurally estimating equilibrium selection.

ment and their governor) and complete knowledge of federal politics (i.e., they can correctly identify the party that controls the House and Senate as well as identify their congressperson and senators). Table 1 provides descriptive statistics.

From the CCES, we also obtain individual-level measures of political interest and media consumption. Respondents are asked the question, "Would you say you follow what's going on with government and public affairs...," which has four response levels: "most of the time," "some of the time," "only now and then," and "hardly ever." The proportion of respondents who categorize themselves as falling into each of these categories of interest is reported in Table 1. Similarly, respondents are asked whether or not they have read a newspaper (print or online) in the last twenty-four hours as well as whether they have watched a local or national TV news broadcast (or both) over the same period.[15] Summary news-media consumption statistics are presented in Table 1.

Local Newspapers

To measure local print news availability, we rely on the "Expanding News Desert" database of the Center for Innovation and Sustainability in Local Media at the University of North Carolina's Hussman School of Journalism and Media (Abernathy, 2020). For the years 2004, 2014, 2016, and 2020, the data strive to identify all active local newspapers in the U.S. by county. Although there is no guarantee of universal coverage, this database—derived from multiple industry and government sources, supplemented with several layers of verification—provides the most comprehensive publicly available account of the state of the U.S. local print news industry.

Local Television

To obtain a measure of local TV news availability, we rely on the Ad Intel database from The Nielsen Company provided through the Kilts Center for Marketing at the University of

[15]This question is only available in the 2020 survey. All other CCES questions are available for the same years as our measures of news availability.

Table 1: Descriptive Statistics (using CCES survey weights)

	Mean	St. Dev.	Observations	Years
		Individual-Level Data (CCES)		
		State Politicians		
Know State House Majority	0.52	0.50	179,371	'14,'16,'20
Know State Senate Majority	0.54	0.50	179,477	'14,'16,'20
Know Governor	0.78	0.43	180,266	'14,'16,'20
Know All State	0.45	0.49	178,607	'14,'16,'20
		National Politicians		
Know Both Senators	0.61	0.49	180,002	'14,'16,'20
Know Congressperson	0.63	0.49	178,655	'14,'16,'20
Know House Majority	0.61	0.49	180,780	'14,'16,'20
Know Senate Majority	0.62	0.49	180,694	'14,'16,'20
Know All National	0.41	0.49	177,687	'14,'16,'20
Know All (State and National)	0.31	0.45	176,068	'14,'16,'20
		Political Interest		
		Would you say you follow what's going on with government and public affairs...		
...most of the time	0.49	0.50	180,905	'14,'16,'20
...some of the time	0.27	0.45	180,905	'14,'16,'20
...only now and then	0.14	0.32	180,905	'14,'16,'20
...hardly at all	0.07	0.26	180,905	'14,'16,'20
		Media Consumption		
		In the last 24 hours, have you....		
...read a newspaper	0.37	0.47	60,672	'20
...watched (only) local TV news	0.17	0.39	60,672	'20
...watched (only) national TV news	0.15	0.35	60,672	'20
...watched local & national TV news	0.28	0.44	60,672	'20
		Media-Market-Level Data (UNC and Nielsen)		
# of Local Newspapers	33.40	36.89	210 (per year)	'14,'16,'20
# of Local TV News Programs	402.564	149.87	210 (per year)	'14,'16,'20

Chicago Booth School of Business. In their raw form, the data describe advertisements sold across a variety of media types in each of Nielsen's 210 Designated Market Areas (DMAs) in the U.S. Every year, Nielsen—an industry leader in this type of market research—actively monitors all local TV stations in each DMA that reach at least a 3% share of the viewing public. For each ad broadcast by a monitored station, Nielsen provides a basic description of the program on which it aired, including a classification of "news" programs. Between 2010 and 2020, we ascertain the total number of local TV news programs broadcast in each media market every year. Finally, we link individuals in the CCES to DMAs via survey respondents' zip codes,[16] and we tally the number of local newspapers in each DMA by summing over the counties it comprises.[17] Descriptive statistics are given in Table 1.

Bounds on Political Knowledge

Newspapers

We first bound the impact of local newspaper availability on voter knowledge. Results are presented in the top row of Figure 1. We consider three measures of political knowledge: correct responses to all politics questions as described in Table 1 (top left), correct responses to all state-politics questions (top center), and correct responses to all national-politics questions (top right). In each case, a 95% confidence region for the (**PSI & MTR**) bounds is plotted in red. Across observed levels of local newspaper competition—the histogram of which is plotted in gray—we see that both the lower and upper bounds on voter knowledge are increasing in the number of local newspapers in a media market.[18]

At the lowest observed competition level in the data,[19] a local newspaper monopoly, the

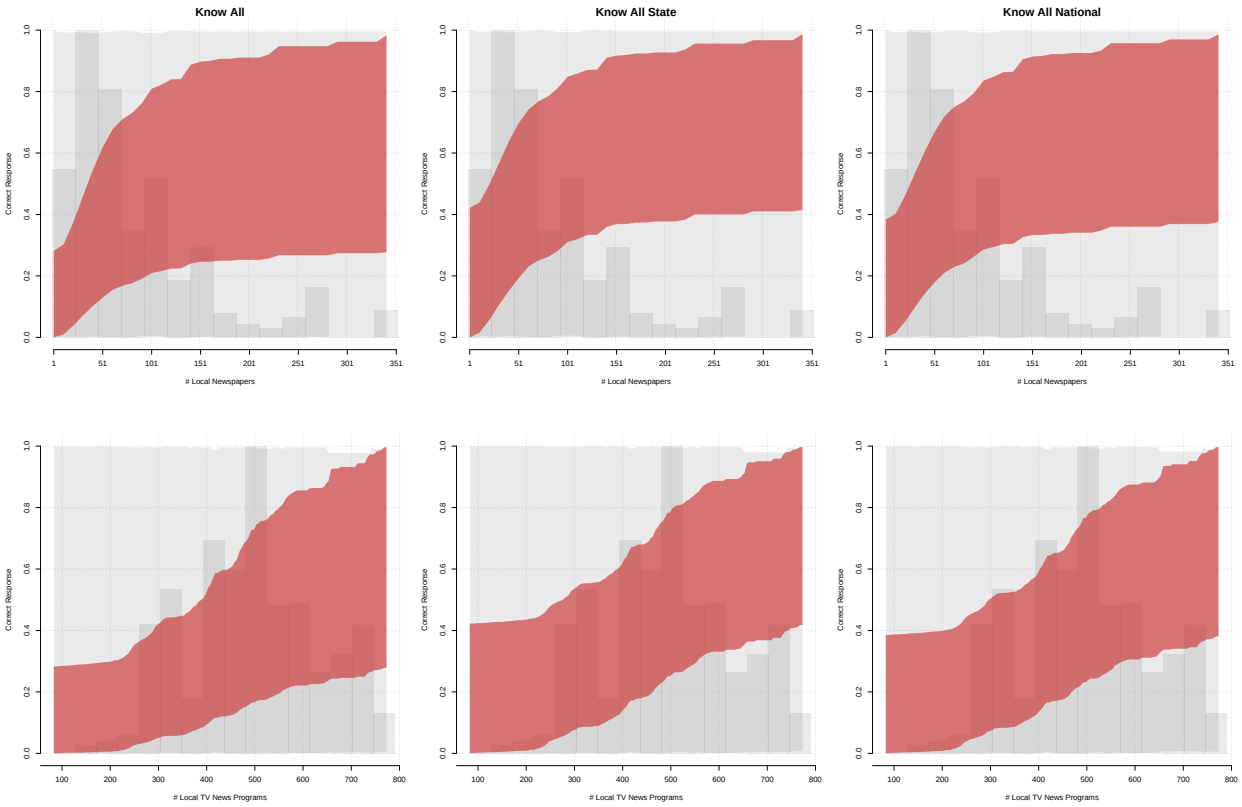
[16]For individuals whose zip codes straddle media markets, we assign them, in the main text, to the overlapping DMA with the largest number of news sources. In the Appendix, we conduct the same analysis assigning respondents instead to the overlapping DMA with the fewest sources. Our results are virtually unchanged.

[17]Each U.S. county is wholly contained in a DMA.

[18]All results in the main text are presented using CCES survey weights. Figure A4 in Appendix A presents analogous unweighted results, which are virtually identical.

[19]This corresponds to the Zanesville, Ohio, and Victoria, Texas, media markets, where the lone newspapers published in 2020 were the Gannet-owned *Times Recorder* and M. Roberts Media-owned *Advocate*, respectively.

Figure 1: **Bounds on Impact of Local Print and TV News on Political Knowledge**



Notes. This figure depicts 95% confidence regions for three measures of political knowledge: correct knowledge of all CCES politics questions described in Table 1 (column 1), correct knowledge of all state-politics questions (column 2), and correct knowledge of all national-politics questions (column 3). The first row gives bounds across observed values (histogram in dark gray in the background) of local print news availability, and the second row gives analogous bounds for local TV news. Bounds assuming (**PSI & MTR**) are shown in red, and the naive bounds, (**N**), in light gray.

estimated lower bound on the probability of correct responses to all political knowledge questions is effectively zero (0.01%), while the upper bound is 28.06%.[20] At the other extreme, given a maximum observed value of 369 local newspapers in a media market,[21] the lower bound on correct responses to all questions is 28.06%,[22] and the upper bound is 98.27%.[23] Across all intermediate levels of local newspaper competition, knowledge is increasing in the number of sources. Yet the ascent (width of the bounds) is notably steeper (narrower) for lower levels of competition, which is unsurprising given the considerable right-skewness of the distribution of local newspaper availability.

Compare our bounds with the "naive" bounds (**N**), which are plotted in gray. Across the range of our data, the naive bounds are wholly uninformative of voters' political knowledge. At their *narrowest*, they are consistent with anywhere between 2% and 97.14% correct responses to all political knowledge questions. At their widest, they cover $[0.01\%, 99.76\%]$. In other words, without our additional monotonicity assumptions, nothing can be said about the causal impact of local newspaper availability on political knowledge.

Our results are virtually unchanged when we focus on knowledge of state or national politics alone. In the case of state politics, at the lowest level of newspaper competition (monopoly), the estimated bounds cover $[0.02\%, 42.08\%]$. At the highest level of competition, the estimated knowledge interval shifts upward to $[42.08\%, 98.61\%]$. Similarly, focusing on knowledge of national politics alone, we obtain bounds for the least and most competitive markets covering $[0.01\%, 38.26\%]$ and $[38.26\%, 98.62\%]$, respectively. In Appendix A, we produce the same set of results for each individual question that enters into these composite knowledge measures (see Figures A2 and A3), and our findings are very similar.

[20] The corresponding 95% confidence set is $[0.01\%, 28.15\%]$.

[21] This corresponds to the New York City media market in 2014.

[22] Note that, by construction, the lower bound at the maximum treatment level and the upper bound at the minimum coincide, and they are equal to the (unconditional) mean outcome.

[23] The 95% confidence set is [27.96%,98.28%].

Television

Next, we bound the impact of local TV news programs on political knowledge. These results are presented in the bottom row of Figure 1. The bounds we obtain when we focus on TV largely mirror those using print news as our indicator of news availability. Taking correct responses to all political knowledge questions as our outcome (bottom left), the bounds we obtain at the lowest observed level of local TV news availability are $[0.00\%, 28.03\%]$.[24] At the highest level of local TV news availability, we obtain bounds of $[28.03\%, 99.06\%]$.[25] Again, both the lower and upper bounds on political knowledge are increasing across all intermediate levels of local TV news exposure.

As with newspapers, our results about television's impact on knowledge taking correct responses to all state- (bottom center) or national-politics (bottom right) questions as the outcome of interest are qualitatively and quantitatively similar to those in the bottom-left panel of Figure 1. Furthermore, once again (in gray), the naive bounds are completely uninformative. In sum, we find that, across media types and regardless of how we operationalize our outcome measure, exposure to additional news sources shifts upward—unambiguously and significantly—the interval in which the proportion of informed voters in a media market is guaranteed to lie. To address concerns that this may be driven by media-market characteristics glossed over by our focus on average voter knowledge, Figure A5 in Appendix A shows nearly identical results if we restrict our analysis to the subsample of either large (above-median population size) or small media markets.

Informational Spillovers?

As an informal way of evaluating the informational impact of local news that operates through social interactions, we explore heterogeneity across survey respondents' stated interest in

[24] This corresponds to the Juneau, Alaska, media market, which Nielsen records as having zero local TV news programming. The 95% confidence set here is $[0.00\%, 28.12\%]$. The media markets with the second-lowest TV news exposure are Mankato, Minnesota, and Bend, Oregon, with 55 local programs each in 2014.

[25] The most competitive local television news market in our data is Las Vegas, Nevada, in 2020, with 777 programs. The 95% confidence set in this case is $[27.93\%, 99.60\%]$.

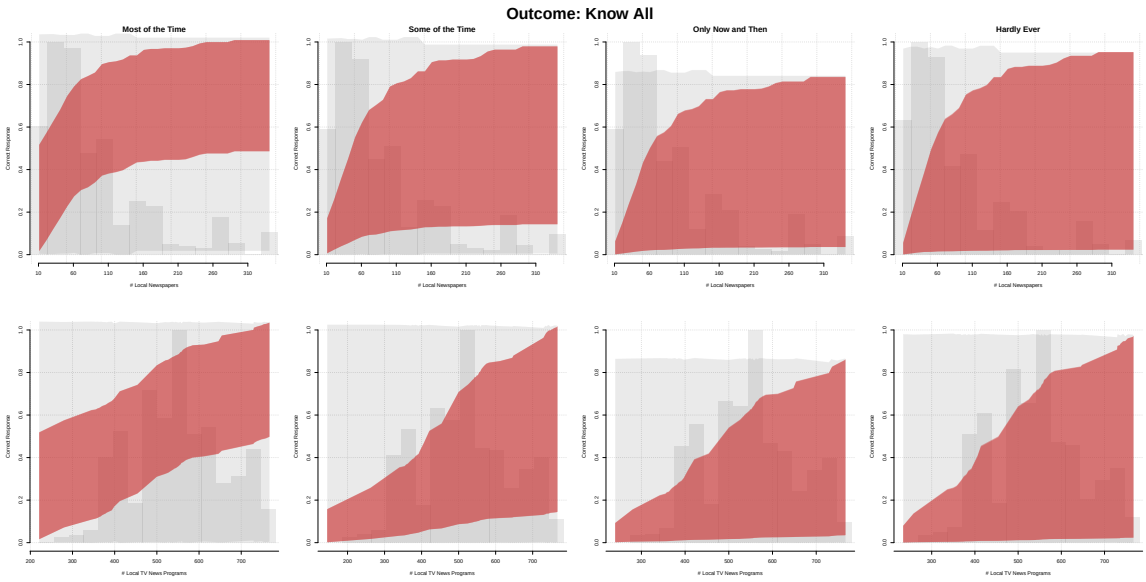
political news. We contrast our bounds for voters who express little interest in following what is going on in government and public affairs with those we estimate for high-interest voters. Our expectation is that, if local news has mainly a direct effect concentrated on individuals who actively seek out political information in the media, then estimated political knowledge bounds for those who profess to hardly follow public affairs and those who claim to follow the news intently should be markedly different—in particular, we would expect the bounds for low-interest voters to be less informative as well as unresponsive to the level of local news availability. On the other hand, if the bounds closely approximate each other, we would take this as suggestive evidence of an indirect informational effect of local news that operates through social interactions.

We estimate our bounds in four mutually exclusive subsamples of our data defined by responses to the CCES question "Would you say you follow what's going on with government and public affairs: (i) most of the time, (ii) some of the time, (iii) only now and then, (iv) hardly at all." These groups correspond, respectively, to the columns of Figure 2. As before, we estimate our bounds separately for local print (top row) and TV (bottom row) news availability, taking as our measure of political knowledge correct responses to all CCES politics questions.

Three notable patterns emerge. First, across levels of expressed interest in current affairs, both the lower and upper bounds on political knowledge are increasing in the availability of local print and TV news. Second, the rate of increase in the upper bound is decreasing in political interest. That is, the slope of the upper bound is largest for voters who "hardly ever" follow current affairs and smallest for those who follow the news "most of the time." Third, the slope corresponding to the lower bound is greater for high-interest than for low-interest voters. This is partly driven by high-interest voters simply being, on average, more informed than low-interest voters.

The patterns yield some suggestive evidence of informational spillovers. The bounds for those with the least interest in current affairs—and thereby most likely to exhibit evidence

Figure 2: **Bounds on Political Knowledge by Interest in Current Affairs**



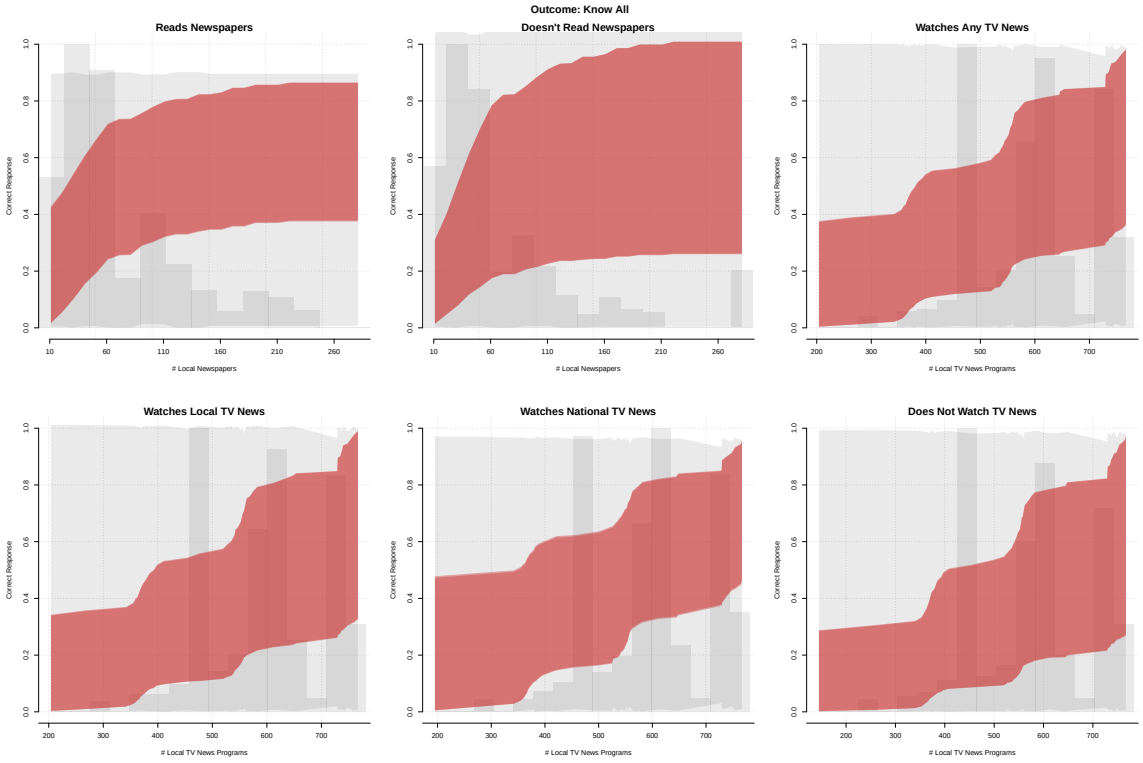
Notes. This figure, analogous to Figure 1, depicts 95% confidence regions for correct knowledge of all CCES politics questions across levels of self-reported political interest—i.e., following government and public affairs: most of the time (column 1), some of the time (column 2), only now and then (column 3), or hardly at all (column 4). The top (bottom) row corresponds to local print (TV) news.

of spillovers—are indeed increasing in local news availability although much wider than those for high-interest voters—who are most likely to exhibit direct effects.

To supplement this evidence, we also look at CCES respondents' self-reported media consumption. The first two panels of Figure 3 provide results for CCES respondents who, in the last twenty-four hours, reported having read a newspaper (top left) or not (top center). Next, we classify respondents according to their TV news consumption. In this case, we have four groups—those who, in the last twenty-four hours, watched: (i) any TV news (top right), (ii) only local TV news (bottom left), (iii) only national TV news (bottom center), or (iv) no TV news (bottom right). Note that groups (ii) and (iii) are both subsets of (i).

Echoing the case of self-reported interest in current affairs, the baseline level of knowledge among those who have, in the last day, read a newspaper is higher than among those who have not. But, again, even among respondents who have not consumed print news, both the lower and upper bounds on political knowledge are increasing in local newspaper availability, though less informative overall. The same is true for TV news consumption. Moreover, here,

Figure 3: **Bounds on Political Knowledge by Media Consumption**



Notes. This figure, analogous to Figure 1, depicts 95% confidence regions for correct knowledge of all CCES politics questions across levels of self-reported news media consumption—i.e., having in the last twenty-four hours: read a newspaper (top left), not read a newspaper (top center), watched local or national TV news (top right), watched only local TV news (bottom left), watched only national TV news (bottom center), or not watched TV news (bottom right).

the differences across groups are much less pronounced. In fact, the bounds for all four TV-consumption groups are remarkably similar. Perhaps this indicates that the CCES TV news consumption question provides a less discriminating measure of voters' media habits. Yet there is little reason to think so, and estimated bounds for TV news are consistently more informative than those for print news given increased variability and lower skewness in the empirical distribution of TV news availability across media markets.

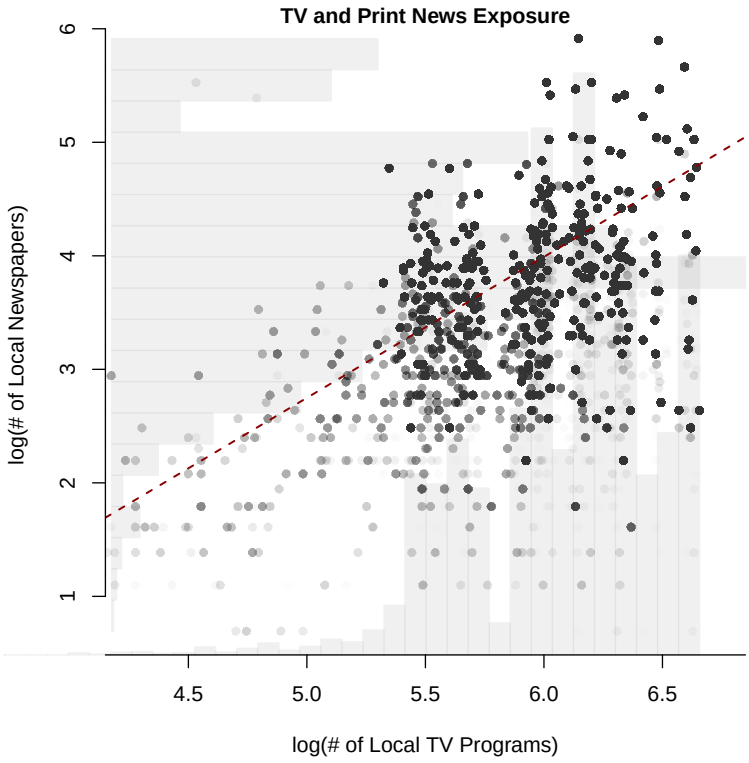
In sum, these results provide suggestive (but not conclusive) evidence that social interactions matter for the dissemination of political knowledge. Using both interest-in-politics and media-consumption measures, the bounds we estimate for those least likely to obtain information directly from news sources are nevertheless increasing in the availability of both local print and TV news. As such, we encourage researchers to explicitly account for the possibility of informational interdependence across units. Plainly, our findings caution that the no-interference assumptions typical of most research designs may not be warranted.

Multidimensional Treatment

So far, we have considered the problem of bounding political knowledge as a function of a one-dimensional treatment, separately estimating bounds for the impact of print and TV news. We now consider the multidimensional problem, estimating bounds for all observed combinations of newspaper and TV news competition intensities. This allows us to evaluate the consequences of two recent countervailing trends in the marketplace for news media: the simultaneous contraction of local print news and expansion of local TV news. As shown in Figure 4, there is a strong association across media markets between the number of local newspapers available and that of local TV news programs. Yet, as we document in more detail below, U.S. media markets have experienced varying and conflicting trends in recent years. Our one-dimensional bounds alone, which indicate print and TV news both increase political knowledge, are insufficient to determine which trend is likely to dominate. However, as noted above, our (**PSI & MTR**) assumptions and bounds can be directly applied to the

case of a two-dimensional treatment $t = (t_{\text{PN}}, t_{\text{TV}})$, which explicitly describes the intensity of market exposure to both media types (print news and TV, respectively).

Figure 4: **Bivariate Relationship Between TV and Print Local News**



Notes. This figure plots the bivariate relationship between TV and print news exposure at the media-market (DMA) level. (The histogram of CCES respondents across levels of exposure is given on each axis.) The shading of each point is proportional to the number of DMA-years at that combination of exposures, with darker colors reflecting a larger number of observations. The estimated elasticity (in red) is 1.24, with a standard error of 0.005 and an R^2 of 0.27.

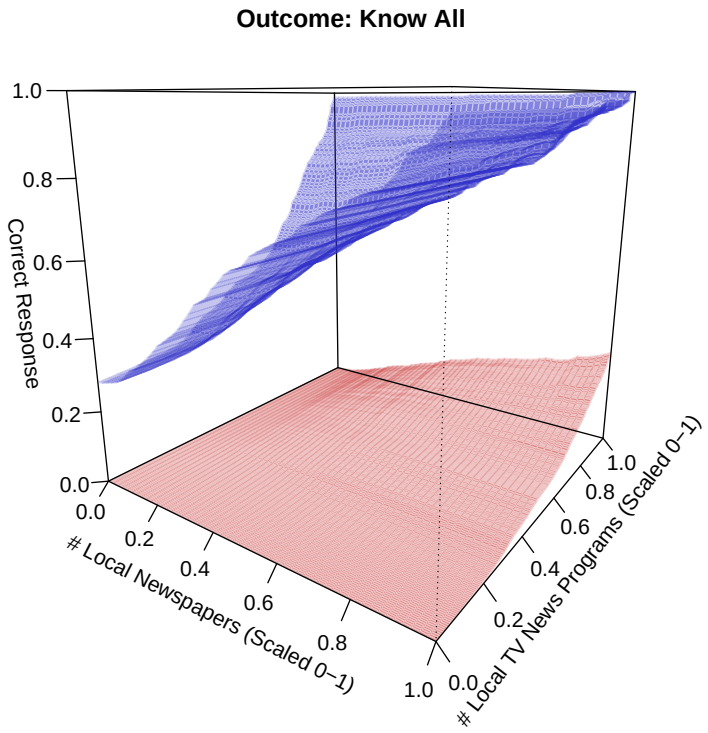
Figure 5 plots our multidimensional results. The blue (red) surface delimits the 95% confidence region for political knowledge—measured as correct responses to all CCES politics questions—from above (below). As expected, the estimated lower and upper bounds on political knowledge are largest when both print and TV news exposures are greatest. At the maximum possible exposure to local news, the bounds are $[28.06\%, 99.79\%]$.[26] On the other hand, at the lowest exposure (none at all), the bounds are $[0\%, 28.06\%]$.[27] At intermediate exposure levels, both bounds are increasing, although slopes for the upper bound are noticeably

[26] The corresponding confidence set is $[27.96\%, 99.79\%]$.

[27] With a confidence set of $[0\%, 28.15\%]$.

steeper. When either TV or print news exposure is close to its maximum, the upper bound becomes relatively flat, but the lower bound remains increasing along the other dimension.

Figure 5: **Bounds on Political Knowledge by Simultaneous Print and TV Local News Exposure**



Notes. This plot presents the 95% confidence region for political knowledge (measured as correct responses to all CCES politics questions) at observed levels of both TV and print local news availability.

Print and Television as Substitutes

Our multidimensional results indicate that TV and print media may serve as informational substitutes. Of course, the most informed of all electorates is one where many forms of news media proliferate. Nevertheless, our findings suggest that a secular decline in one type of media need not impede voters' ability to obtain factual political information if it is accompanied by a compensating expansion in another type.

The top panel of Figure A1 in Appendix A plots trends in the average number of newspapers and TV news programs available in U.S. local media markets over time. Between 2004

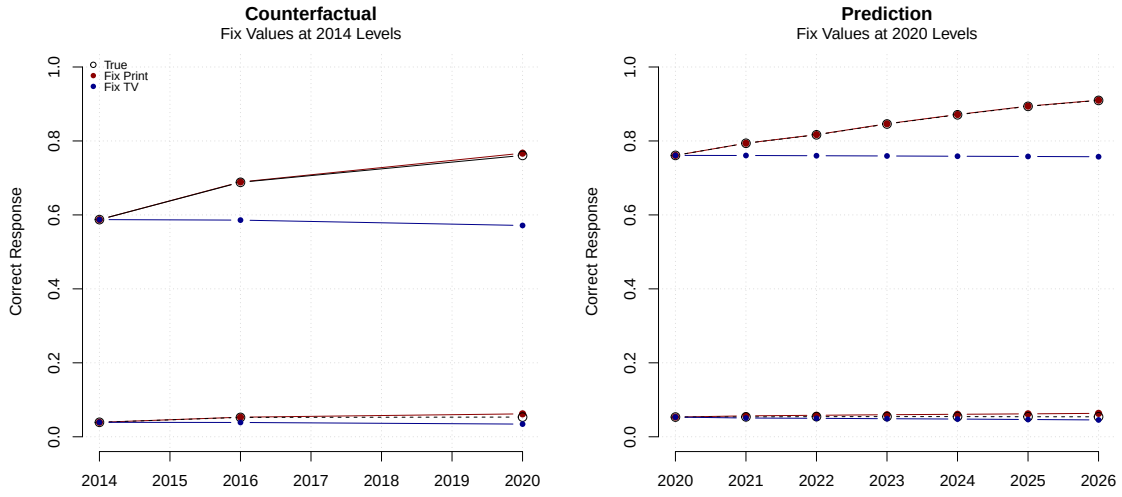
and 2020, the average DMA lost 10 local newspapers, a decline of 23%. This contraction of U.S. local newspapers has been well-documented and is appreciable not only in the number of available outlets but also in circulation figures (Pew, 2016; Abernathy, 2020). In contrast, between 2010 and 2020, the average DMA gained 374 local TV news programs, an increase of 351%. To our knowledge, we are the first to document this striking expansion of local TV news programming.[28] In order to assess the implications of these countervailing trends for factual political knowledge, we conduct two exercises, one counterfactual and one prospective.

First, we retrospectively characterize the relative impact of print news' decline and TV news' expansion. For each DMA, we hold fixed the level of local TV (print) news at its 2014 value—the first year for which we have data on both media types—and then allow print (TV) news to vary as observed in the data. Using our two-dimensional bounds (Figure 5), we compare estimated political knowledge for the average DMA under this counterfactual evolution of media availability versus the true evolution in the data. The results of this exercise are plotted in the left-hand panel of Figure 6. In black, we show bounds for the average level of political knowledge under the truth; in blue, we hold fixed TV news at 2014 levels; and, in red, we hold fixed print news. The takeaway from this exercise is clear: the informational gains from the expansion of TV news have dominated. When we hold fixed print news at 2014 levels and allow TV news to evolve as observed in the data, the true upper and lower bounds for the average DMA and those derived from the counterfactual are *nearly identical*. When we do the converse and fix TV news, there is a substantial reduction in the upper bound of political knowledge and a small reduction in the lower bound (which is already close to zero).

Second, we prospectively forecast the evolution of political knowledge under different assumptions about future trends in local print and TV news. Specifically, for each DMA, we

[28]In Appendix A, to mitigate concerns about potential measurement error in TV news, we limit our sample to consider only TV news programs broadcast between 5PM and 11:30PM. This excludes daytime programming most likely to be (potentially) misclassified as "news." Similarly, for newspapers, we restrict our sample to daily publications, excluding weeklies. Although there are, naturally, differences in levels, Figure A7 shows the trends in Figure A1 are robust to this restricted sample. Furthermore, Figure A8 shows our bounds on political knowledge remain nearly identical.

Figure 6: **Counterfactual and Prospective Average Bounds on Political Knowledge**



Notes. This figure gives results for a set of counterfactual (left) and forecasting (right) exercises. The black points give our bounds, for the average DMA, allowing news exposure to follow its observed trend (left) or using predicted future levels of news exposure based upon past trends (right). The blue points hold fixed TV news at observed levels in the initial year and allow print news to evolve using observed (left) and projected (right) trends. The red points hold fixed print news and allow TV to evolve using observed (left) and projected (right) trends.

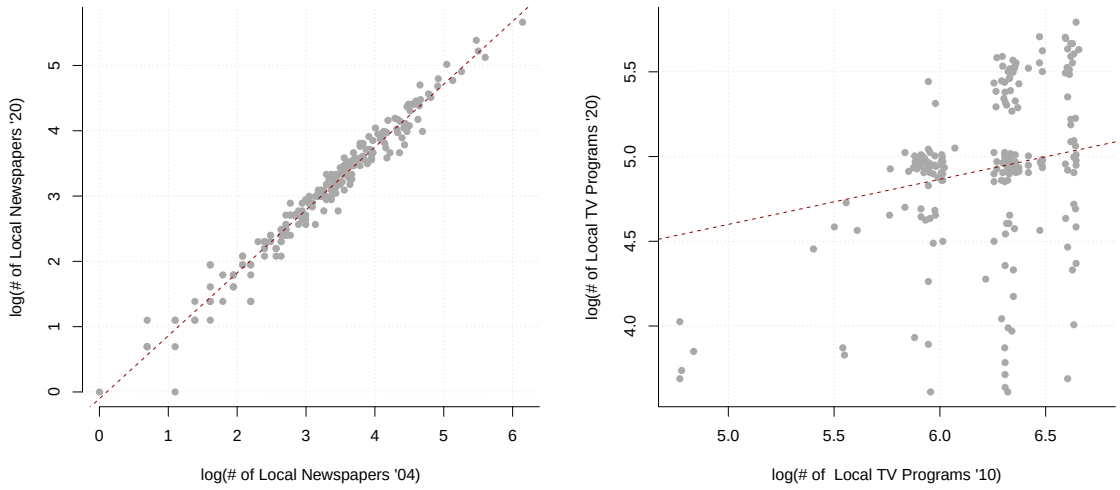
take our estimated bounds on political knowledge given observed levels of news exposure in 2020 as our starting point, and we then use the DMA's average trend over the previous six years for each media type to project another six years into the future. The results are plotted in the right-hand panel of Figure 6. Average bounds allowing both TV and print news to follow their past trajectories are plotted in black. In red, we hold fixed print news at 2020 levels and allow TV to evolve into the future. In blue, we hold TV news fixed at 2020 levels. Echoing our retrospective results, our forecasted bounds following both print and TV trends, when compared versus those with fixed print news, are nearly identical. And, again, when we instead hold fixed TV news at 2020 levels, we see a substantial reduction in our forecast of the upper bound on political knowledge and a small reduction in the lower bound.

In sum, these results indicate that the informational costs of reduced competitiveness in the market for local print news over the first two decades of the twenty-first century were, at least on the facet of political knowledge we investigate, mitigated by increases in the supply of local TV news. Moreover, it is not obvious that the continued contraction of local print

news warrants concern in this context absent a reversal of the continued expansion of local TV news.

Of course, these findings concern only the *average* media market. However, as shown in Figure 7, trends—especially in the expansion of TV news—were not uniform across DMAs. Indeed, the distribution of informational gains is rather variable across DMAs. Figure 8 reproduces the retrospective analysis depicted in the left-hand panel of Figure 6 but now plots the difference in bounds between 2020 and 2014 for each DMA decile. That is, instead of presenting the average over time, we take the difference in bounds at the last and first periods and report these differences across deciles.

Figure 7: **Changes in Local Print and TV News Over Time**

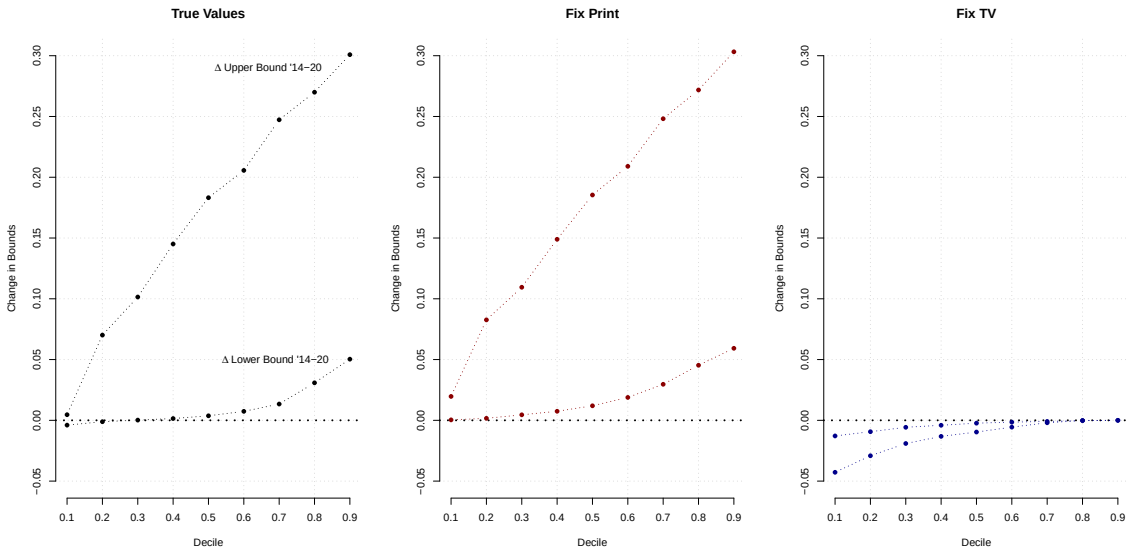


Notes. The left panel shows the bivariate association between the (log) number of local newspapers in each media market in 2004 versus 2020. The right panel does the same for local TV news programs.

The left-hand panel of Figure 8 corresponds to the case where we allow print and TV news to follow their observed trends in the data. Except for the first decile, changes in both the lower and upper bounds on political knowledge are positive, revealing broad informational gains despite local newspapers dwindling in this period. Again, holding print news fixed at 2014 levels (center) produces nearly identical results. Only when we hold fixed TV news at 2014 levels (right) do we see consistent reductions in both the upper and lower bounds of political knowledge. This confirms that—across the board, not just for the average media

market—expanding local TV news offerings more than compensated for the informational losses that would have otherwise accrued in recent years due to the decline in local newspapers.

Figure 8: **Counterfactual Changes in Bounds (2020 versus 2014) by Decile**



Notes. This figure reproduces the retrospective analysis depicted in the left-hand panel of Figure 6, plotting results by DMA decile. The left-hand panel presents changes between 2014 and 2020 in the lower and upper bounds on political knowledge, by decile, allowing news exposures to follow their observed trends. The center panel holds fixed print news at 2014 levels. The right-hand panel holds fixed TV news at 2014 levels.

Who Lost and Who Gained Information?

Although our analysis focuses on aggregate local news exposure and political knowledge at the media-market level, it is natural to wonder who gained or was harmed by the uneven expansion/contraction of U.S. local news in recent years. We descriptively investigate these differential impacts across demographic groups with the following ordinary least squares (OLS) regression on the sample of respondents in the 2014 wave of the CCES:

$$\Delta_{20-14}\text{Media}_{im} = \beta_0 + X_i'\beta_1 + X_m'\beta_2 + \epsilon_{im}.$$

The dependent variable is the change between 2014 and 2020 in either TV or print local news in DMA m for individual i. Coefficients β_1 measure the association between individual demographic characteristics and the corresponding change in media exposure, while coefficients β_2

do so for DMA-level characteristics.

Results from this exercise are given in Table 2. Corroborating Figure A1, the baseline trends in the bottom row of the main panel of the table indicate that, across model specifications, respondents in reference categories witnessed, on average, a considerable decline in local newspapers and a striking increase in local TV news programs in their media market.

We first consider differences by self-reported partisanship (model I) and find that respondents who in 2014 identified as Democrat (or Democrat-leaning) lived in DMAs that lost about three additional newspapers, on average, than respondents who identified as Republicans or independents. We find no statistically significant differences for TV news.

Second, we regress changes in media exposure on indicators of whether respondents identified as white/non-white and whether or not they considered themselves to be evangelical Christian (model II). Here, we see that white respondents lost more print media—by about five papers on average—but gained more TV news programs—by about 16 on average. In contrast, evangelicals lost three fewer newspapers, on average, and gained about nine fewer TV news programs.

Third, we include indicators for college education and for household income above $50,000.[29] We find no statistical differences between respondents with and without college education. However, high-income households lost about four additional local newspapers, on average, and gained about seven more local TV news programs.

Including all of the above individual-level covariates as regressors in the same specification (model IV), we obtain very similar results. The only exception is that the coefficient for the Republican indicator becomes positive and statistically significant (at the $p < 0.1$ level) when the outcome is the change in TV news programs.

[29]The median household income in 2014 was $53,700
https://nces.ed.gov/programs/digest/d15/tables/dt15102.30.asp.

Table 2: **Correlates of Increased Exposure to Local News Between 2014 and 2020**

	(I)		(II)		(III)		(IV)		(V)		(VI)	
Outcome:	Print '20-14	TV '20-14	Print '20-14	TV '20-14	Print '20-14	TV '20-14	Print '20-14	TV '20-14	Print '20-14	TV '20-14	Print '20-14	TV '20-14
Democrat	-3.287***	2.236					-2.692***	0.0200	-0.3013	-3.698*	0.0956	-0.3023
	(1.128)	(2.676)					(0.9659)	(2.529)	(0.2960)	(2.017)	(0.1218)	(1.154)
Republican	0.3471	-0.7430					-0.5714	2.828*	-0.2495*	1.949	-0.0744	0.9077
	(0.4113)	(1.478)					(0.4151)	(1.587)	(0.1414)	(1.488)	(0.0882)	(1.033)
White			-5.060**	16.48***			-5.032**	18.73***	-1.489**	10.43***	-0.2044	4.483***
			(2.036)	(3.637)			(2.219)	(3.949)	(0.5877)	(3.895)	(0.2204)	(1.534)
Evangelical			4.950*	-9.493**			4.085*	-8.958**	0.0947	-3.953	0.0853	-2.047**
			(2.683)	(3.964)			(2.370)	(3.515)	(0.3110)	(2.528)	(0.1057)	(0.8490)
College Educated					0.1433	2.142	0.3655	2.094	0.5228**	1.429	0.0890	-0.0055
					(0.4476)	(1.869)	(0.4828)	(1.838)	(0.2572)	(1.719)	(0.0718)	(0.7881)
HH Income > $50,000					-4.060**	7.221***	-4.363***	8.103***	-0.1567	1.975	0.0096	1.399*
					(1.609)	(2.551)	(1.668)	(2.665)	(0.3477)	(1.930)	(0.1259)	(0.8436)
Print '14									-0.2152***	0.1577**	-0.2151***	0.3154***
									(0.0163)	(0.0641)	(0.0088)	(0.0875)
TV '14									-0.0149**	0.1621**	-0.0211**	-0.0670
									(0.0073)	(0.0687)	(0.0103)	(0.0539)
DMA > Median Pop									1.617	7.032	3.670**	24.54*
									(1.092)	(15.46)	(1.480)	(12.87)
Constant	-17.18***	192.9***	-18.82***	192.5***	-16.47***	188.8***	-15.08***	185.3***	6.183***	110.5***		
	(3.959)	(7.807)	(4.587)	(8.472)	(3.588)	(7.480)	(3.298)	(7.462)	(1.759)	(17.47)		
F-Stat *Dem = Rep*	7.04***	1.20					6.13**	1.39	0.028	9.22***	2.46	1.92
p-value	(0.01)	(0.27)					(0.01)	(0.25)	(0.87)	(0.00)	(0.12)	(0.17)
State FE	No	No	No	No	No	No	No	No	No	No	Yes	Yes
N	55,325	55,325	55,228	55,228	48,981	48,981	48,910	48,910	48,910	48,910	48,910	48,910
R^2	0.00633	0.00037	0.01996	0.01305	0.00846	0.00306	0.03132	0.01736	0.83610	0.16144	0.93002	0.54852

****: 0.01, **: 0.05, *: 0.1*

Notes. This table gives individual- and market-level correlates of change in local print/TV news exposure between 2014 and 2020. Individual characteristics are taken from the 2014 CCES survey. Democrat and Republican are indicators taking on a value of one if respondents identify as a Democrat (Republican) or Democratic (Republican) leaner and zero otherwise. White is an indicator taking on a value of one if a respondent describes themselves as white and zero otherwise. Evangelical is an indicator taking on a value of one if respondents describe themselves as a "born-again" or evangelical Christian and zero otherwise. HHI > $50,000 is an indicator taking on a value of 1 if respondents' household income is greater than $50,000 and zero otherwise. DMA > Median Pop is an indicator taking on a value of one if a respondent lives in a DMA with above-median population size and zero otherwise. Standard errors clustered by DMA are in parentheses.

Next, we include three DMA-level predictors alongside all of the individual-level covariates (model V): initial levels (in 2014) of local newspapers and TV news programs as well as an indicator of whether the DMA's population was above the median as derived from the distribution of survey-weighted observations in the CCES. When we condition on DMA characteristics, our results with respect to individual demographics are substantially altered. When the change in print news is taken as the outcome, the only individual-level trait that remains statistically significant is whether a respondent is white, and even this is attenuated by two-thirds. For the change in local TV news, the white indicator remains statistically significant but is 47% smaller, and TV news growth among Democrats is slightly smaller than among independents and Republicans.

Finally, we add a full set of state fixed effects to the last specification (model VI). In this case, none of the individual-level predictors are statistically significant when the outcome is the change in local newspapers. Concerning the change in local TV news, many of our baseline results remain. Even conditioning upon initial levels of news exposure, market size, and state fixed effects, white and higher-income individuals gained more TV news programs between 2014 and 2020, on average, and evangelicals gained fewer. These results, however, are considerably attenuated when compared with specifications without DMA-level controls.

Overall, although individual demographics are somewhat predictive of differences in changing news exposure, the latter seems to be mostly determined by fundamental market trends. Interestingly, however, Figure 7 and Table 2 suggest that consolidation in local print news markets has been more uniform and systematic than the countervailing expansion in local TV news programming.

Conclusion

Technological change in the business model for print journalism has proved disastrous for local newspapers. The resultant collapse in market competition for local print news has been met with a number of proposed policy interventions aimed at rejuvenating local print journalism.

For example, as part of the "Build Back Better Plan," the Biden administration proposed tax credits of up to $25,000 for the hiring and continued employment of local-news journalists.[30] The Local Journalism Sustainability Act, a bill with 58 Democrat and 28 Republican co-sponsors, goes even further. On top of subsidies for employing local reporters, this bill would offer individual tax credits of up to $250 for household expenditures on local news.[31]

Proponents of these sorts of interventions frequently use the expected informational externalities produced by the robust provision of local news to justify the cost of the various subsidies. For example, a Brookings Institution white paper arguing for government subsidization of local news justifies the expense because, in their view, "informed citizens are too essential to the health of America's democracy to let the local news industry that has long been responsible for performing this important task die off" (Hendrickson, 2019). The Local Journalism Initiative, a project aimed at expanding local news media through various forms of government intervention, describes an "information void" and "information crisis" in the electorate caused by the disappearance of local news outlets, linking this to the potential collapse of American democracy itself (McChesney and Nichols, 2022).

In this paper, we provide two pieces of evidence that should inform these policy debates. First, we show that increasing competition in the marketplace for local news improves voters' factual knowledge of politics. Standard attempts at establishing this causal relationship have typically relied upon strong ignorability assumptions. Instead, under a pair of weak monotonicity assumptions that take into consideration potential information spillovers among voters, we place sharp bounds on the informational impact of local news availability, focusing on competition in local print and TV news. Our results indicate that increasing the number of news sources in a media market unambiguously raises voters' factual awareness of their elected representatives.

We then use our bounds to assess the implications of two countervailing trends in U.S. local news markets. Alongside the well-publicized sharp decline in local newspapers in recent years,

[30] https://waysandmeans.house.gov/sites/democrats.waysandmeans.house.gov/files/documents/NEAL032xml.pdf.
[31] https://www.congress.gov/bill/116th-congress/house-bill/7640/text.

we document a striking increase in local TV news programming. Our estimates suggest the latter has more than compensated for the informational losses that would have accrued due to the contraction in local print news alone. At least for the specific type of factual political knowledge we consider, claims of an "information crisis" appear somewhat overstated. Threats to democratic stability would have to arise from distorted perceptions about the performance of politicians or institutions as a result of shifts in the type or quality of news coverage. Although considerable progress has been made, further research is needed to robustly establish these concerning causal effects.

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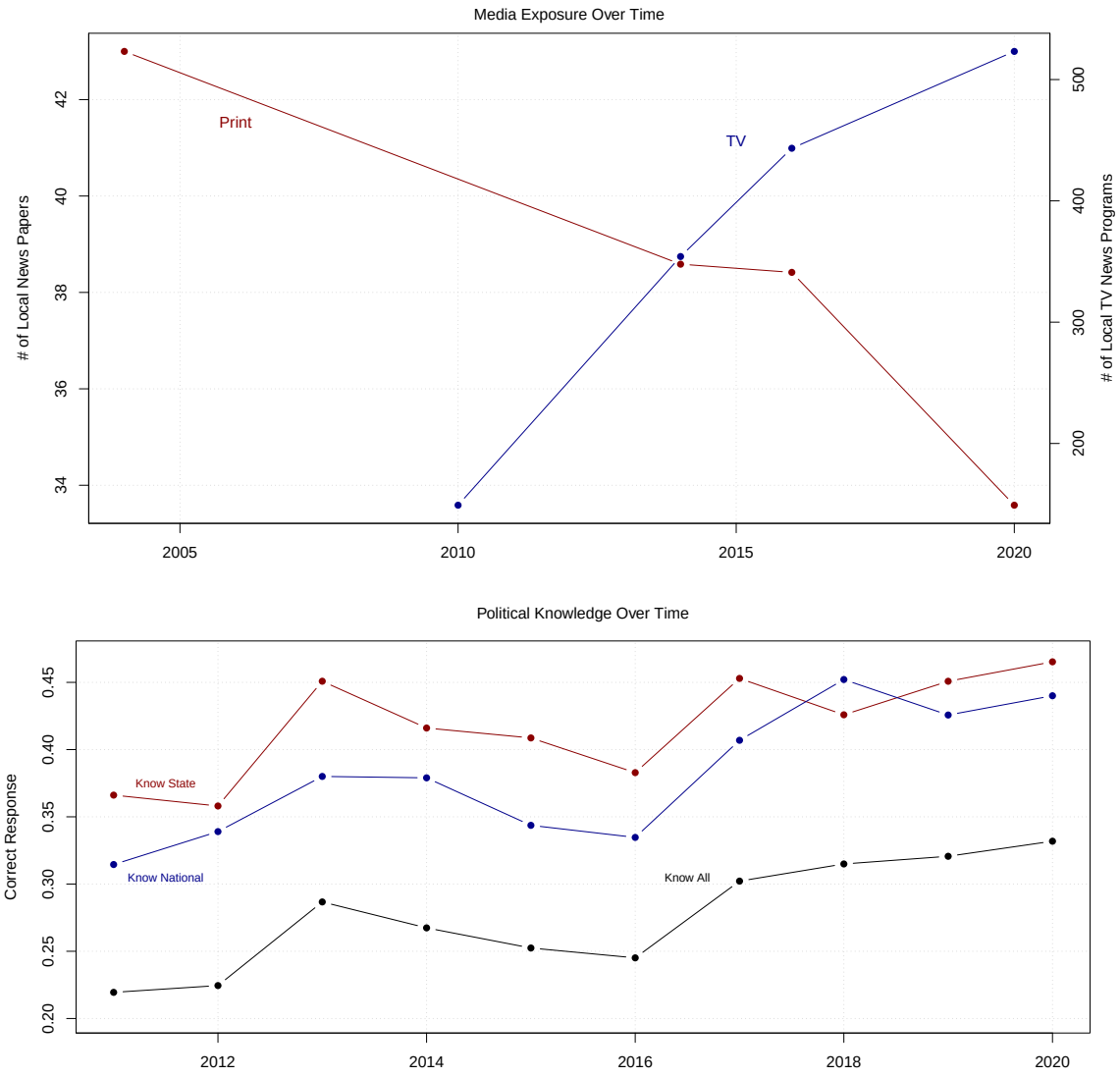
Online Appendix for
The Effect of Local News on Political Knowledge

Contents

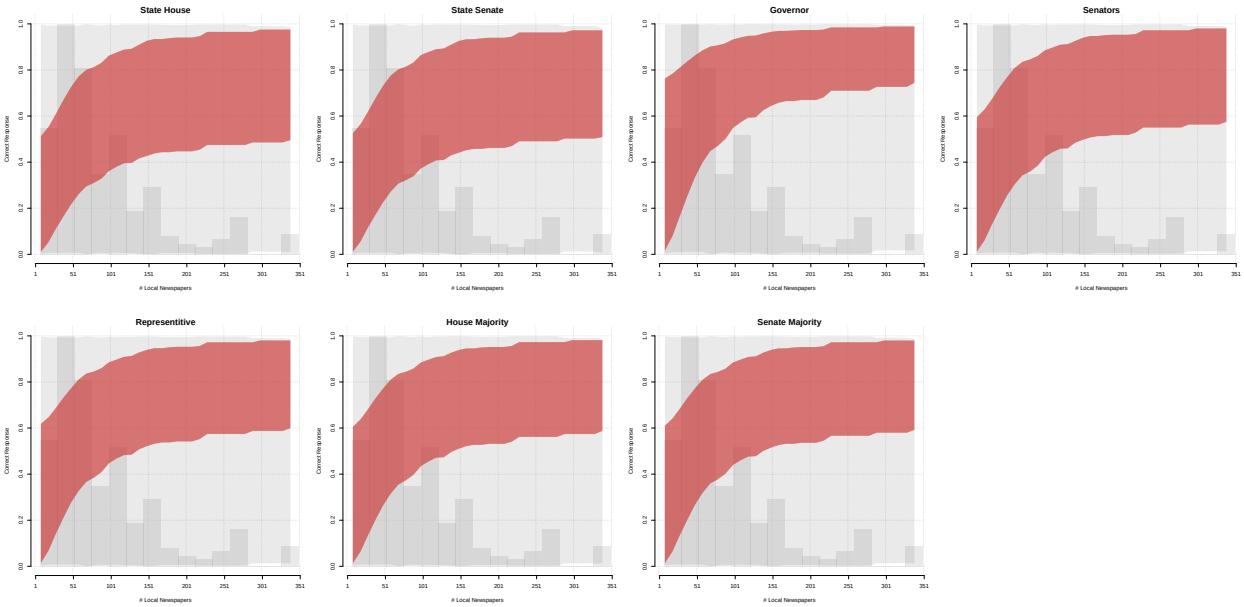
A Additional Figures

Figure A1: **News Media and Political Knowledge Over Time**



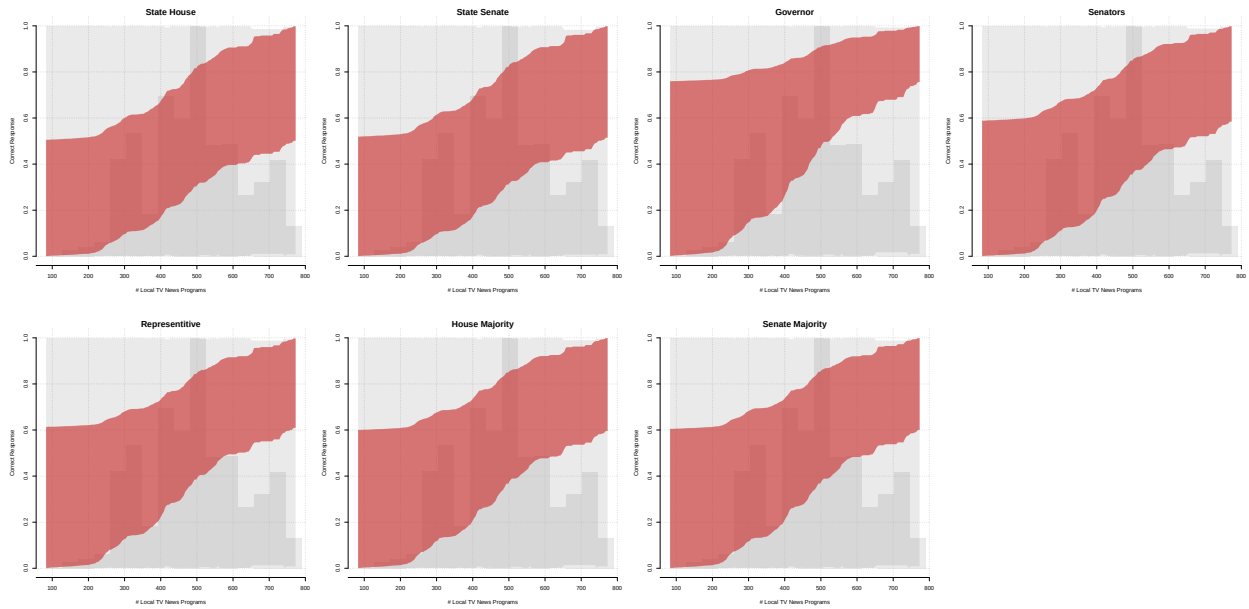
Notes. The top panel plots the average number of local newspapers (red) and local TV news programs (blue) across media markets over time. The bottom panel gives the proportion of informed voters over time, measuring political knowledge as correct responses to all CCES state-politics questions (red), all national-politics questions (blue), or both (black).

Figure A2: **Bounds on Political Knowledge by Local Print News Exposure for Each Component CCES Question**



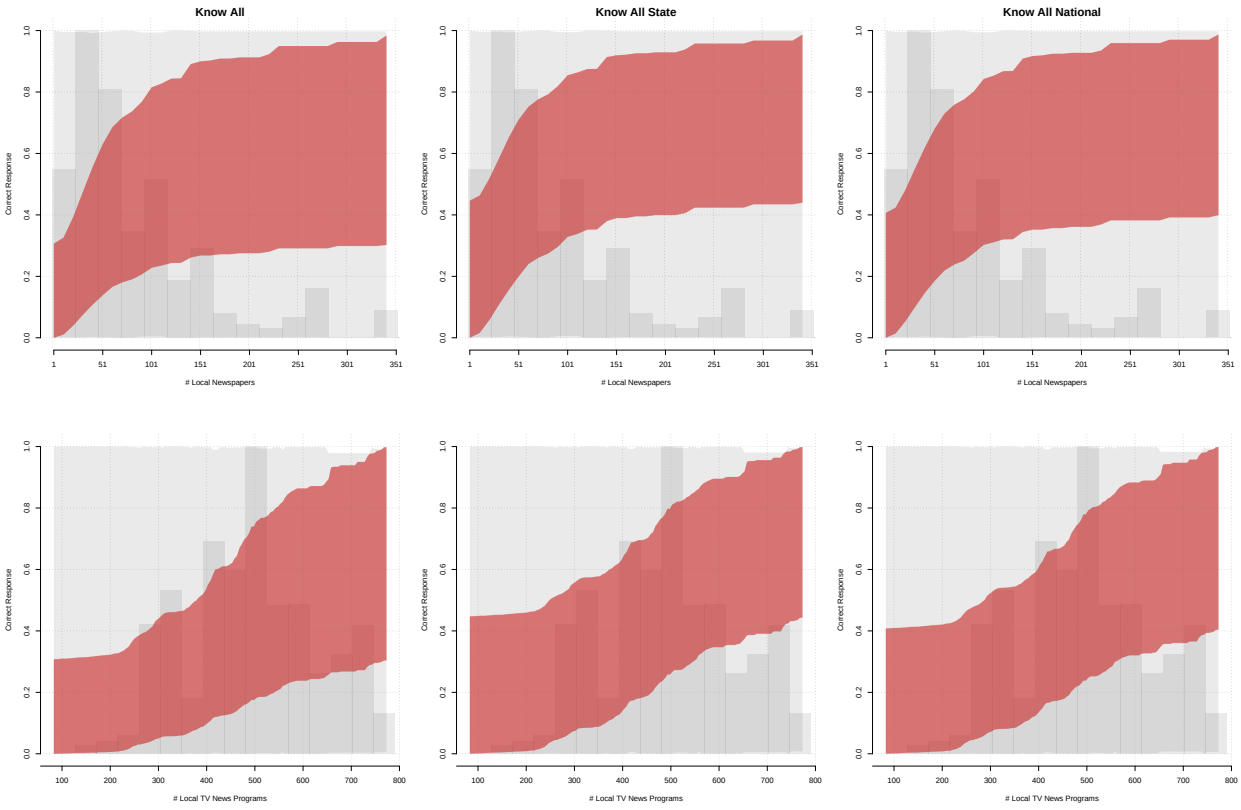
Notes. See Figure 1.

Figure A3: **Bounds on Political Knowledge by Local TV News Exposure for Each Component CCES Question**



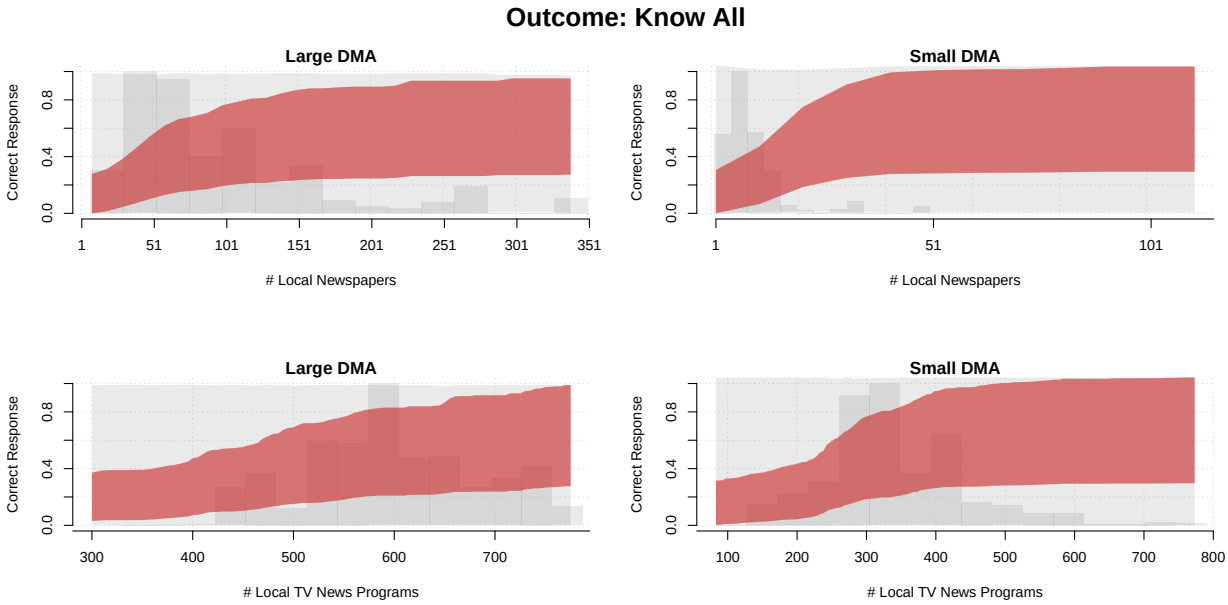
Notes. See Figure 1.

Figure A4: **Bounds on Political Knowledge Without Survey Weights**



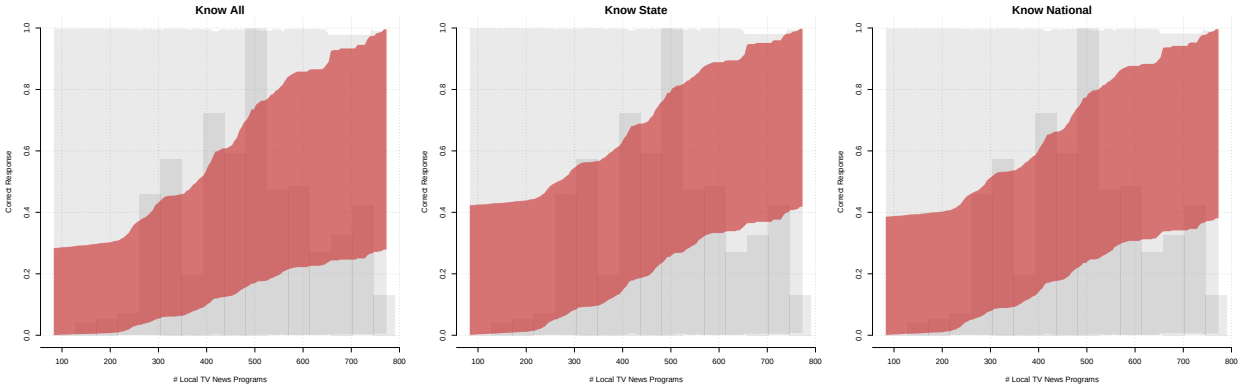
Notes. See Figure 1.

Figure A5: **Bounds on Political Knowledge by DMA Size**



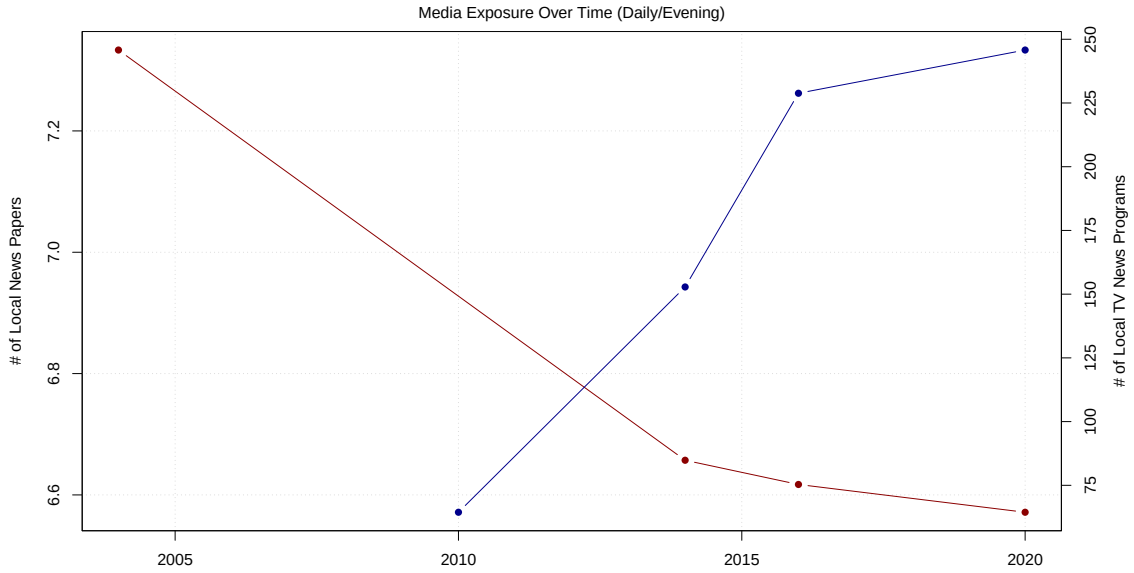
Notes. This figure depicts 95% confidence regions for political knowledge measured as correct responses to all CCES politics questions. The first (second) column focuses on media markets whose population size is above (below) the median. The top (bottom) row corresponds to local print (TV) news.

Figure A6: **Bounds on Political Knowledge Using Alternative Measure of Local TV News Exposure**



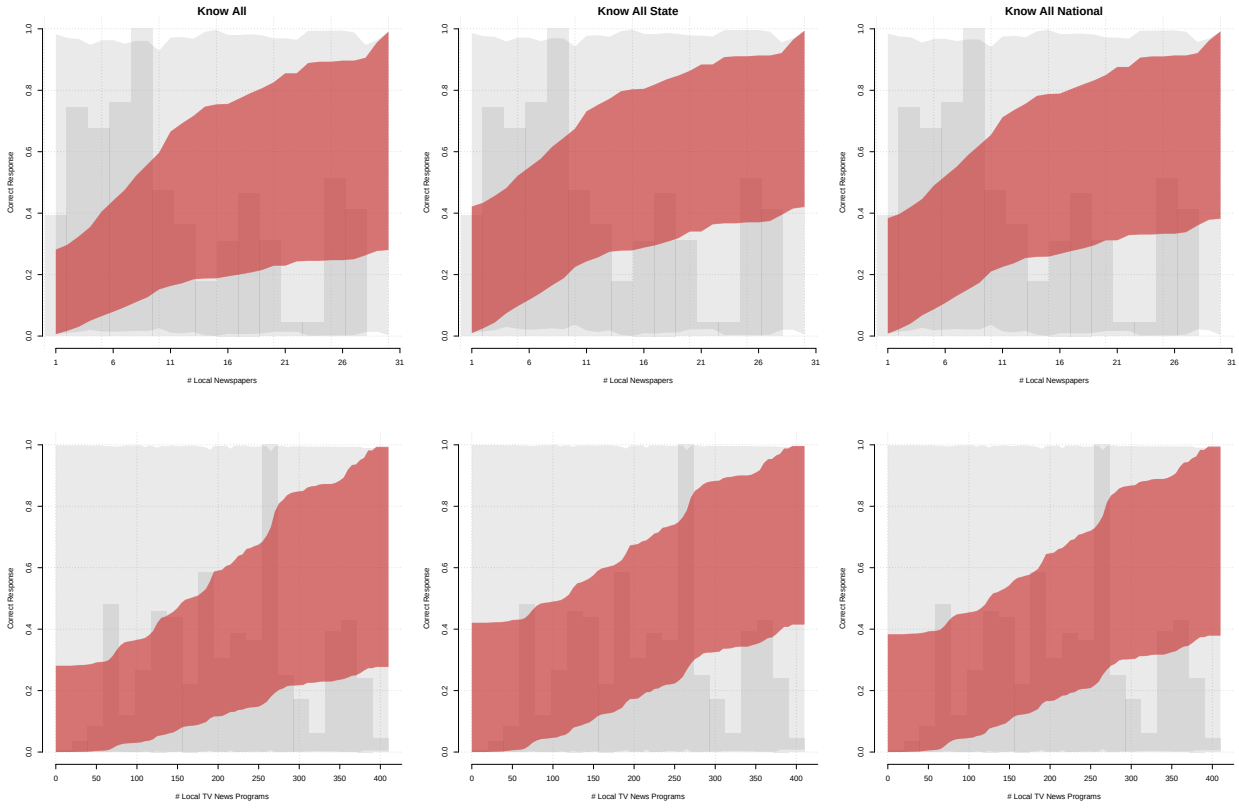
Notes. This figure reproduces the bottom row of Figure 1 using an alternative measure of TV news exposure wherein we assign CCES respondents whose zip codes straddle DMAs to the media market with the smallest (rather than largest) number of TV news programs.

Figure A7: **Media Trends Using only Daily Newspapers and Evening News Programs**



Notes. See Figure A1. TV news in this case considers only programs broadcast between 5PM and 11:30PM.

Figure A8: **Bounds on Political Knowledge Using only Daily Newspapers and Evening News Programs**



Notes. See Figure 1. TV news in this case considers only programs broadcast between 5PM and 11:30PM.

B Identifying Assumptions and Bounds Estimator

For completeness and convenience, we provide here technical details and formal statements of the assumptions underpinning our identification strategy and empirical results. See Lazzati (2015) for extensions to more general settings, formal proofs of all results, and an application studying the effect of policing on crime rates.

Voters are sorted into large (but finite) groups, which may differ in size. In our analysis, these groups correspond to media markets (DMAs). For each level of treatment $t \in T$ to be received by members of group G, let $\mathbf{y}_G(t) = [y_i(t)]_{i \in G}$ denote the corresponding vector of potential outcomes. Groups are characterized by their size and by the structural functions describing information acquisition within the group. A group G_k is of type $k \in K$ if its members have structural functions $\mathbf{f}_k(\cdot) = [f_{ki}(\cdot)]_{i \in G_k}$, where $f_{ki} : T \times [0,1] \to \{0,1\}$. Given treatment level t and a proportion $\bar{y} \in [0,1]$ of informed voters in G_k, voter i's structural function determines her knowledge status, $f_{ki}(t, \bar{y}) \in \{0,1\}$.[32] Thus, the vector $\mathbf{y}_k(t)$ of potential outcomes for group G_k must satisfy the system of structural equations

$$y_i(t) = f_{ki}\left(t, \tfrac{1}{|G_k|} \textstyle\sum_{j \in G_k} y_j(t)\right), \quad i \in G_k. \tag{B1}$$

Notice that social interactions are anonymous: voter i is influenced only by the expected level of knowledge in her media market, $\frac{1}{|G_k|} \sum_{j \in G_k} y_j(t)$. For large groups like DMAs, this should provide a good first-order approximation and can similarly be used to describe outcomes such as crimes, schooling, infectious diseases, or addictions.[33]

We now formally state our first assumption.

Assumption 1 (PSI). *For each $k \in K$, $i \in G_k$, and $t \in T$, $f_{ki}(t, \bar{y}) \leq f_{ki}(t, \bar{y}')$ whenever $0 \leq \bar{y} < \bar{y}' \leq 1$.*

As noted in the paper, this assumption can be interpreted as a "no defiers" condition. Moreover, crucially, (**PSI**) provides coherence to the model—i.e., a solution to the system of structural equations (B1) is guaranteed to exist, and thus the vector $\mathbf{y}_k(t)$ of potential outcomes is well defined. Indeed, letting $\varphi(t,k)$ denote the set of solutions to (B1) given $t \in T$ and $k \in K$, we have the following.

[32] These structural functions can be microfounded in multiple ways, either from a passive or strategic information-acquisition perspective. The passive case can be viewed as analogous to infectious diseases, where media sources and other informed voters are potential "vectors of contagion." In the strategic case, voters optimally choose whether to become informed, taking into consideration its cost given available sources (including other voters), and f_{ki} corresponds to voter i's best-response function.

[33] Similar identification bounds (see Lazzati, 2015, Section 3) can be obtained for situations where groups have fixed size (typically, small) but members have distinctive roles to play—e.g., married couples, teams of co-workers, or patients and doctors.

Lemma 1. *Under* (**PSI**) *and for each* $(t,k) \in T \times K$, $\varphi(t,k)$ *has a least and a greatest element.*

This result follows from Tarski's (1955) fixed-point theorem. It not only guarantees the existence of a social knowledge equilibrium in group G_k, but there is a maximally-informed equilibrium, $\mathbf{y}_k^U(t) \in \varphi(t,k)$, and a minimally-informed equilibrium, $\mathbf{y}_k^L(t) \in \varphi(t,k)$, such that $\mathbf{y}_k^L(t) \leq \mathbf{y} \leq \mathbf{y}_k^U(t)$ for all $\mathbf{y} \in \varphi(t,k)$.

The first part of our second assumption restricts structural functions to be non-decreasing in their first argument as well.[34]

Assumption 2.1 (**MTR1**). *For each* $k \in K$, $i \in G_k$, *and* $\bar{y} \in [0,1]$, $f_{ki}(t,\bar{y}) \leq f_{ki}(t',\bar{y})$ *whenever* $t,t' \in T$ *with* $t < t'$.[35]

Together, (**PSI**) and (**MTR1**) are sufficient to guarantee that $\mathbf{y}_k^U(t)$ and $\mathbf{y}_k^L(t)$ are both non-decreasing in t. However, unless the equilibrium selection rule that determines $\mathbf{y}_k(t)$ always picks one of the extreme equilibria, potential outcomes may be non-monotonic in t. The second part of our second assumption deals with that possibility but constrains only the proportion of informed individuals in a group, as that is ultimately the inferential objective. Given any $t \in T$, $k \in K$, $\bar{y} \in [0,1]$, and $\mathbf{y}(t) \in \{0,1\}^{|G_k|}$, let $\bar{\mathbf{y}}(t) = \frac{1}{|G_k|}\sum_{j \in G_k} y_j(t)$ and $\bar{\mathbf{f}}_k(t,\bar{y}) = \frac{1}{|G_k|}\sum_{j \in G_k} f_{kj}(t,\bar{y})$.

Assumption 2.2 (**MTR2**). *For each* $k \in K$, *one of the following holds.*

(i) For all $t \in T$, $\mathbf{y}_k(t) \in \{\mathbf{y}_k^L(t), \mathbf{y}_k^U(t)\}$. *Furthermore, if* $t,t' \in T$ *with* $t < t'$ *and* $\mathbf{y}_k(t) = \mathbf{y}_k^U(t)$, *then* $\mathbf{y}_k(t') = \mathbf{y}_k^U(t')$.

(ii) For all $t,t' \in T$ *with* $t < t'$, $\bar{\mathbf{y}}_k^U(t) \leq \bar{\mathbf{f}}_k(t', \bar{\mathbf{y}}_k^L(t))$.

Condition (i) of (**MTR2**) ensures $\mathbf{y}_k(t)$ is non-decreasing in t by selecting only the extreme equilibria, doing so in a non-decreasing fashion. It can be justified by Pareto dominance (with positive information spillovers, $\mathbf{y}_k^U(t)$ Pareto dominates all other equilibria) or via adaptive dynamics (e.g., starting from $\mathbf{y}_k^0(t) = \mathbf{0}$, with everyone uninformed, best-response iteration—i.e., $\mathbf{y}_k^{n+1}(t) = \mathbf{f}_k(t, \bar{\mathbf{y}}_k^n(t))$—converges to $\mathbf{y}_k^L(t)$). Condition (ii), on the other hand, ensures monotonicity of the proportion of informed voters without placing any restrictions on equilibrium selection. It is trivially satisfied when equilibria are unique, a common assumption in empirical work,[36] but it generally calls for a strong treatment that shifts solution sets so that they are non-overlapping (except, possibly, at the boundaries).

[34] As noted, analogous results can be obtained for functions that are *non-increasing* in their first argument (but non-decreasing in their second).

[35] In the case of a multidimensional treatment, $t \leq t'$ corresponds to the standard coordinatewise order, and $t < t'$ indicates that $t \leq t'$ but $t \neq t'$ (so the inequality is strict in at least one coordinate).

[36] See Gibilisco and Montero (2022) for an overview of the literature in political science and a method for structurally estimating equilibrium selection.

As summarized in the next lemma, the full power of assumption (**MTR**) in the paper formally requires both of its parts, (**MTR1**) and (**MTR2**), along with (**PSI**).

Lemma 2. *Under* (**PSI & MTR**) *and for each* $k \in K$*, if* $t, t' \in T$ *with* $t < t'$*, then* $\bar{\mathbf{y}}_k(t) \leq \bar{\mathbf{y}}_k(t')$.

This monotonicity of potential outcomes underpins the bounds used in our empirical analysis. Let M denote the set of groups (media markets) in the population. Realized treatments and outcomes are given by $[(\tau^m, \mathbf{y}^m)]_{m \in M}$, where $\mathbf{y}^m = \mathbf{y}_m(\tau^m)$. For each $t \in T$, our goal is to estimate (bound) $p(t) \equiv P(y_i(t) = 1)$, the potential fraction of informed voters in the population. Let $\Theta_0(t)$ denote the identified set of values of $p(t) \in [0, 1]$ consistent with realized treatments and outcomes and with the data generating process.

Proposition 1. *Under* (**PSI & MTR**) *and for each* $t \in T$*,*

$$\Theta_0(t) = \big[P(y_i = 1 | \tau_i \leq t) P(\tau_i \leq t), P(y_i = 1 | \tau_i \geq t) P(\tau_i \geq t) + P(\tau_i \not\geq t)\big].$$

As noted in the paper, all probabilities characterizing $\Theta_0(t)$ above are nonparametrically identified from the data. Moreover, the identified set is *sharp*—i.e., without further restrictions on the data generating process, the bounds are attained by corresponding instances of the model. To see this, consider a media market with empirical evidence $(\tau^m, \mathbf{y}^m)$. If $\tau^m \leq t$, then Lemma 2 ensures $\mathbf{y}^m$ is a lower bound for $\mathbf{y}_m(t)$, but it doesn't rule out the possibility that $\mathbf{y}_m(t) = \mathbf{y}^m$, so the bound is sharp. Similarly, if $\tau^m \not\leq t$, then the empirical evidence provides no informative lower bound for $\mathbf{y}_m(t)$, and Lemma 2 cannot rule out $\mathbf{y}_m(t) = \mathbf{0}$. Upper bounds are also sharp by an analogous argument.

Because we rely on the CCES surveys, our data comprises only a representative sample of voters from the population. Thus, the bounds characterizing $\Theta_0(t)$ must be estimated, and a confidence region is needed to account for estimation uncertainty. We estimate $p_L(t) \equiv P(y_i = 1 | \tau_i \leq t) P(\tau_i \leq t)$ and $p_U(t) \equiv P(y_i = 1 | \tau_i \geq t) P(\tau_i \geq t) + P(\tau_i \not\geq t)$ with their sample analogs:

$$\widehat{p}_L(t) = \frac{1}{N} \sum_i y_i \mathbf{1}_{\tau_i \leq t},$$
$$\widehat{p}_U(t) = \frac{1}{N} \sum_i \left[y_i \mathbf{1}_{\tau_i \geq t} + \mathbf{1}_{\tau_i \not\geq t} \right],$$

where N denotes the sample size.[37] We then report the following confidence region for $\Theta_0(t)$:

$$CI_\alpha = \left[\widehat{p}_L(t) - \frac{c_\alpha \widehat{\sigma}_L}{\sqrt{N}}, \widehat{p}_U(t) + \frac{c_\alpha \widehat{\sigma}_U}{\sqrt{N}}\right].$$

For confidence level $1-\alpha$, the critical value c_α solves

$$\Phi\left(c_\alpha + \frac{\sqrt{N}[\widehat{p}_U(t) - \widehat{p}_L(t)]}{\max\{\widehat{\sigma}_L, \widehat{\sigma}_U\}}\right) - \Phi\left(-c_\alpha\right) = 1-\alpha,$$

where Φ denotes the standard normal cumulative density function, and $\widehat{\sigma}_L, \widehat{\sigma}_U$ are simple sample variance estimators. Stoye (2009) shows CI_α is uniformly valid under standard regularity conditions.

[37] These estimators can be easily modified to accommodate survey weights. Our results are virtually unchanged.