# Media and Polarization

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**Abstract**

This paper provides a model of how media environments affect political polarization. We first develop a model of how media environments, characterized by their levels of accessibility and variety of content, interact with citizens' ideological views and attitudes and political motivation. We then embed it in a model of majoritarian electoral competition in which politicians react to those media-influenced views. We show how equilibrium polarization is affected by changes in the media environment, through two channels: the variety effect, whereby a decrease in media variety leads to convergence in citizens' views and hence to lower polarization; and the composition effect, whereby a lowering of barriers to media accessibility increases turnout and hence lowers polarization, since newly motivated voters are relatively more moderate. We take the model's predictions to the data, in the US context of the introduction of broadcast TV, in the 1940s and 1950s, and radio, in the 1920s and 1930s. We show that, consistent with the model's predictions, TV decreased polarization, and exposure to (network) radio was correlated with lower polarization. The evidence suggests that the variety effect was more important than the composition effect.

*Keywords*: Media; Political Polarization; Turnout; Ideology; TV; Radio.

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# 1 Introduction

Polarization has been one of the dominant themes in discussions of US politics in recent years. The recent rise in partisan polarization, starting in the 1970s, has been well-documented by scholars (Sinclair 2006, McCarty et al 2007) and widely discussed by pundits and commentators (Dionne 2004, Krugman 2004, *inter alia*).[1] Of most concern to economists, the policy consequences of polarization are very important. There is strong evidence that it is associated with increased levels of gridlock in the political system (Binder 1999, Jones 2001), which in turn means much reduced rates of policy innovation and a decreased ability to adapt to changes in economic, social, or demographic circumstances (McCarty 2007).[2] These concerns, of course, are not limited to the US or to developed democracies (e.g. Ellner and Hellinger 2003, on Venezuela).

What explains these movements in polarization? Many hypotheses have been raised and confronted, ranging from changes in political or electoral institutions to big societal shifts such as inequality and immigration patterns (McCarty et al 2007). While all of these may have played important roles, one element is often mentioned as an important driver and propagator of those movements: the role of a changing media landscape. There has been growing evidence to substantiate the widespread perception that the introduction of different media technologies has had substantial impact on political outcomes (Stromberg 2004, Gentzkow 2006, Gentzkow et al. 2009), and on individual views and attitudes on and beyond politics (Della Vigna and Kaplan 2007, Gentzkow and Shapiro 2004, Gerber et al. 2009, Jensen and Oster 2009, La Ferrara et al. 2008). In other words, the media help propagate and diffuse views and attitudes, with whatever explicitly political content that they carry, but also with entertainment content that often conveys subtle or less-than-subtle ideological cues – movies, soap operas, talk shows, even sports features. All of these should affect individuals' views and political behavior, and it is only natural that this would translate into an impact on polarization.[3]

But how are we to think of the connection between media and polarization? After all, different channels may be in play. On the one hand, it has been argued that new media technologies have tended to increase polarization, as crystalized in the so-called "echo chamber" argument (Bishop 2008, Sunstein 2009): new media such as cable TV or the internet have allowed individuals to select media outlets that conform to their prior ideological views, thus reinforcing polarization. On the opposite direction, a longstanding view on "mainstreaming" (Gerbner et al. 1980) has held that mass media have tended to induce conformity and lower polarization. We thus need a framework that is able to encompass these

[1] Fiorina (2006) argues that the rise in polarization, while very real, is a phenomenon restricted to partisan elites, and not true of the general public.

[2] Interestingly, this rise in polarization followed a substantial drop in the preceding half-century, which at the time highlighted negative effects of a depolarized polity in terms of demobilization in the face of a lack of clear choices (APSA, 1950).

[3] Note in particular that this does not imply or require that the media are the original source of those shifts; more often than not they will rather amplify movements originated elsewhere. By the same token, this does not imply or require that they propagate specific views with a deliberate political agenda, nor that individuals are passive consumers of those views.

different possibilities and illuminate how they will play out in equilibrium.

Our paper proposes such a conceptual framework, to make sense of the links between media environments and political polarization. We start by characterizing a media environment according to two central dimensions: *accessibility* (or *barriers*, for short-hand) and *variety*. The former refers to the fact that different media technologies impose different intrinsic barriers to access by consumers, whether driven by regulation (e.g. licenses), supply factors (e.g. prices, coverage), and/or demand-side factors such as cognitive barriers – for instance, newspapers or blogs require an ability to read (and a taste for reading), which is not the case for TV or radio. The latter relates to technological or regulatory features that affect the level of choice that is available to media audiences – while there are hundreds of newspapers, dozens of cable TV channels, and a virtual infinity of websites with very distinct contents, broadcast TV or network radio had only a handful of channels that were highly homogeneous. A new media technology will thus mean that a new environment will be introduced that might contrast with the environment that characterized the prevailing media *substrate*.

These dimensions of barriers and variety will interact with individual characteristics that are crucial to their political behavior: *motivation* and *ideology*. Starting from the premises that exposure to political information affects the levels of political motivation, and that exposure to politically and/or ideologically charged content affects individual views and attitudes, changes in media environment that transform either type of exposure will in turn affect political behavior. Politicians and parties will follow suit.

We put this basic intuition to work in a framework that starts with a model of how media environments interact with individuals' ideological views and attitudes – where individuals, who start with a given ideological position, are influenced by what they see in the media, but can also choose which combination of available views to watch or read. (This model delivers testable predictions on the demand for ideological variety – e.g. that moderates are more likely to simultaneously consume content from sources with different ideological varieties – for which we find empirical support.) We then embed this into a model of electoral competition in a majoritarian, "winner-take-all" system, with endogenous turnout. In this model, two office- and ideology-motivated parties adopt (one-dimensional) platforms while taking into account individuals' views and turnout decisions, driven by intrinsic motivation and by the relative positions of the platforms. We first characterize how the individuals' media choices are affected by the variety that is available in the media environment, and then characterize the political equilibrium in terms of platforms and turnout, as a function of the media-conditioned distribution of motivation and ideology.

With those characterizations at hand, we then show how changes in media environment affect the political equilibrium. Our results distinguish between two separate channels: the *variety effect* and the *composition effect*. The variety effect refers to the impact of those changes on individuals' ideological positions: the introduction of a media environment with lower variety, such as when broadcast TV is introduced into a substrate where newspapers or local radio are dominant, will engender a compression

in the distribution of those positions, and parties will naturally react by moving their platforms in a more moderate direction. In other words, less variety induces lower polarization. The composition effect, on the other hand, refers to changes in access barriers: if a media environment with lower barriers is introduced, such as when TV or radio are introduced into a substrate where newspapers were dominant, then a larger number of individuals will be motivated to vote. The basic intuition implies that, because those who did not vote before are disproportionately likely to be moderate (which is not assumed in our model, but rather emerges endogenously from the assumption that voters are more likely to turn out when they perceive the differences between candidates to be large), it follows that most of these new voters will be relatively moderate. This will provide parties with an incentive to moderate as well. In other words, lower barriers reduce polarization, even if individual views are left unaffected by exposure to a new media environment.[4]

The model also provides us with a strategy to distinguish between the two effects. The theory suggests an intimate connection between polarization and turnout, which is evident in the case of the composition effect, where a change in turnout is the driving force behind the change in polarization. The connection is also present in the opposite direction, again because voters care about how different the candidates are: lower polarization will tend to reduce turnout. In light of that, the drop in polarization driven by the variety effect is accompanied by a reduction in turnout, whereas that which is driven by the composition effect is associated with increased turnout.

We then take the framework's predictions to the data. The theory in principle applies to any change in media technology, but an ideal context to test it is the introduction of radio, in the 1920s and 1930s, and broadcast TV, in the 1940s and 1950s, in the US. These were massive changes in media technology, and they coincided with a period over which there was a very substantial drop in measured polarization. For the case of TV, which we argue constituted a low-barrier, low-variety medium, we follow an empirical strategy inspired by Gentzkow (2006), and show evidence that counties that got TV relatively early displayed a decrease in polarization as measured by their representatives' ideological position, when compared to latecoming counties. This result is robust to a variety of specifications, and is consistent with the empirical prediction that TV would reduce polarization. We also show that the effect on turnout was substantially different depending on the media substrate. Specifically, in those counties where radio penetration had been small (and hence where TV represented a more important lowering of access barriers), turnout increased – consistent with the logic of the composition effect – whereas counties with a strong radio presence saw a decrease in turnout – consistent with the variety effect. Finally, we show that the drop in polarization is quantitatively less important in relatively poorer, less educated places – exactly where one would expect the lowering of barriers to have had a greater impact. This suggests

[4]We also show that this result is reversed in the case of a proportional representation system. This is because, lying beneath the basic intuition, there is a second effect, whereby having fewer low-motivation citizens means that parties have to worry less about the extensive margin of getting them to turn out, and thus have more leeway to move towards their preferred platforms. This second effect, which tends to increase polarization, is dominated in a majoritarian system, but turns out to prevail under proportional representation.

that the drop in polarization was driven mostly by the variety effect.

The case of radio does not provide us with as clean a strategy as for TV, but its history gives rise to some interesting evidence for our theory. In particular, while radio was certainly a low-barrier medium, with respect to variety there was interesting variation, as the increasing share of network-affiliated stations provides a contrast of a lower-variety environment encroaching the high-variety substrate of local radio and newspapers. The data show a negative correlation between radio exposure and polarization – consistent with both of our effects – but they also show that this correlation was present only for exposure to network-affiliated stations. This again seems to suggest a predominance of the variety effect, since composition would predict no difference between affiliated and unaffiliated stations.

In sum, we have robust evidence that TV and radio contributed to reductions in polarization. We also have evidence that this contribution operated mostly through their direct effect on ideological views. All in all, this suggests that the substantial reduction in polarization that occurred in the US around the mid-20th century was helped by those changes in media environment (as had been argued for instance by Prior (2007)) – not necessarily as the ultimate causes of this reduction, but rather likely as propagation mechanisms amplifying changes originated from other societal shifts.

Our paper relates directly to the growing literature that has examined the interaction between media and politics. It builds on Prior (2007), who has posited that changes in media technology have been an important determinant of changes in polarization. His intuition is related to our composition effect: he argues that media affects polarization because different levels of choice afforded by different technologies would differentially affect the turnout of individuals according to their intrinsic level of political motivation (which is in turn correlated with their ideological position).[5] However, he does not develop a formal model, and ours reveals that this intuition is incomplete. In fact, the results require assumptions on the institutional details that condition the incentives faced by politicians: it holds true under a majoritarian system, which is our benchmark in light of our empirical context, but not under proportional representation.

The paper also relates to the aforementioned literature that has analyzed the impact of new media technologies on turnout; in particular, our auxiliary results on turnout are consistent with, and also extend in new directions, the findings of Gentzkow (2006), who found a negative effect of TV on turnout, and Stromberg (2004), who found a positive effect of radio on turnout. We are also directly connected with the (also aforementioned) literature that shows how the media affect views and beliefs – our framework provides a missing link in that it enables us to think coherently about how media jointly affects these views and beliefs along with turnout, and how polarization is affected as a result.

The model we propose relates to the growing literature on persuasion and media markets that followed

[5] Prior (2007) focuses on the choice between news content and entertainment content – as distinct from that between different ideological views – and argues for the assumption that individuals who prefer news content (who are, of course, more politically motivated) tend to be ideologically less moderate. We believe, as argued above, that the separation between news and entertainment content is not as important, particularly when we consider the effect of media on individual views, which he leaves aside.

Mullainathan and Shleifer (2005). A central theme in this literature is to assess the extent to which consumer preferences (e.g. the extent to which they care about learning the truth versus confirming their prior views) and the degree of market competition affect the extent of media bias supplied by one or more market competitors.[6] In contrast to this literature, our model provides a simple economic framework to assess the influence of market variety and access barriers on consumers' political attitudes and ideologies. By focusing on the ideological influence of the media rather than the truthfulness of informational content, we explore a complementary dimension that we think is important to the study of the cultural and political impact of the media over time.[7] Importantly, our model of ideological influence can be then used to organize the impact of the media on political outcomes such polarization and turnout. Finally, the electoral model we study is in turn related to Glaeser et al. (2006), where office-motivated candidates may strategically choose to polarize, especially if they can target more extreme voters, who are more likely to turn out. In our model, in contrast, polarization is the result of a party ideological motive, as in Alesina and Rosenthal (1995), but we focus on how ideologies and political motivation are affected by changes in the media environment, thus changing the incentives to polarize faced by candidates.

The remainder of the paper is organized as follows: Section 2 lays out the model of how media environment interacts with individual views and attitudes. Section 3 embeds this model into a model of electoral competition, showing how changes in media technology translate into changes in polarization in the political equilibrium. Section 4 tests the predictions of the theory in the context of the introduction of broadcast TV and radio in the US. Section 5 concludes and points at future research directions.

## 2 Media Environment and Citizens' Attitudes

A *media environment* refers to the complex array of technological, cultural, legal, market, and socioeconomic variables that determine the type of media and the content that are available and consumed by individuals in a particular time and location. In this section we introduce a formal definition of a media environment that focuses on two specific dimensions: the *barriers* to media access faced by citizens/consumers, and the ideological *variety* of content available in the media market. While this definition entails some heroic simplifications, our hope is that they allow us to distill some of the main empirical facts on the impact of media on political behavior. Towards this end, we provide a simple model that aims to capture how different media environments affect political motivation and ideological preferences. These predictions will then serve as input for the model of electoral competition presented in the sequel.

[6] Gentzkow and Shapiro (2008) and Della Vigna and Gentzkow (2009) provide excellent surveys.

[7] In this sense, our paper is in the spirit of Murphy and Shleifer (2004), who provide a model in which individual views are partly shaped by the drive to conform to the "average views" of the people they interact with. In our model, views are influenced by the endogenous choice of media content consumers make. This choice is in turn driven by minimizing dissonance with their pre-existing views, as in Mullainathan and Shleifer (2005).

## 2.1 Media Environment and Citizens' Heterogeneity

We focus on two sources of heterogeneity across individuals (*citizens*): their propensity to engage in political activities (*political motivation*) and their ideological views and attitudes (*ideology*). We hold the view that the media can influence both of these characteristics over time. On the latter, we think of a citizen's ideology as her preferred position in a unidimensional (liberal-conservative) scale. The space of ideologies is denoted by $X$ and it is assumed to be a subset of $\mathbb{R}$. With regard to political motivation, our definition is operational: we identify motivation with a composite of individual characteristics that are independent of ideology and affect her willingness to vote. In practice, we can think of variation in political motivation as differences in the cost or benefit of voting that may arise from cognitive skills (e.g. processing political information) or tastes (e.g. interest in politics, civic duty, opportunity cost of voting). We denote the space of possible levels of political motivation as $\Pi$, which can be any ordered space.

We thus assume that each voter $v$ is characterized by a pair $(x_v, \pi_v)$ where $x_v \in X$ is a preferred ideology and $\pi_v \in \Pi$ is political motivation. Ideology and political motivation are assumed to be independently distributed.[8] The p.d.f of citizens on $\Pi$ is denoted by $f$, while the distribution of citizens' ideology is denoted by $g$ with an associated c.d.f. $G$. For simplicity, we consider political motivation to be a binary variable – i.e. $\Pi = \{\underline{\pi}, \overline{\pi}\}$ where $\underline{\pi} < \overline{\pi}$. The fraction of citizens with high motivation ($\overline{\pi}$) is denoted by $p$, and the fraction with low motivation ($\underline{\pi}$) is $1 - p$.

There are at least two independent channels through which the media can influence voters' behavior. First, to the extent that the media carry politically relevant content, increased exposure to the media increases an individual's political learning, which can trigger or increase political participation.[9] Access to the media is in turn affected by regulatory and technological features, which we call "barriers" to access. For instance, conditional on a medium being geographically available at a given location, all else equal, there is substantial variation in the cognitive requirements each medium imposes on consumers. Reading a newspaper presumes a certain degree of literacy, perhaps a taste for reading and a non-trivial ability to comprehend a text. In contrast, watching TV and listening to the radio seems to be associated with lower cognitive requirements.[10] We assume that each media environment is associated with an access barrier $b$. We think of this as a number, and the set of access barriers is denoted by $B$.

The second type of media influence we are interested in is the potential effect on citizens' political and ideological views and attitudes. We assume that each media outlet offers content with a certain

[8] As shown later, the fact that political motivation is independent of ideology does not imply that the willingness to vote of a citizen is independent of her ideology in equilibrium.

[9] There is considerable evidence consistent the idea that higher levels of political learning are associated with greater participation. Potential reasons include a reduction in the uncertainty about the platforms and individual qualities of politicians, a reduction in the cognitive costs associated to the choice of a political option, and/or increased awareness about politics leading to a heightened sense of duty.

[10] On this see the references in Prior (2007, p. 72-73). While in the context of the US illiteracy (strictly speaking) would not be of much importance, functional illiteracy is: those who "eschew any serious reading that is not imperative" could be "estimated'to be [as much] as 60 per cent" of the population. (Converse 1962, p. 592)

ideological "slant" or "editorial line". Our focus is not so much on the informational content and how the "truth" viewers are presumably seeking may or may not be distorted by a particular outlet. It is rather on the ideological content that may be explicit or implicit in media content. This is not to say that direct informational content is not a crucial dimension of the market for news, for example.[11] However, the media provide consumers with volumes of content that is hardly ideologically neutral and that oftentimes conveys little or no direct information.[12] Anecdotal evidence and introspection suggests that, beyond information, the impact of the media on societal attitudes and values can be substantial, as has been shown by a growing literature on the causal effect of the media on attitudes.[13]

Our aim is to provide a framework that allows us to describe this impact as a function of characteristics of the market structure. In particular, we assume that each media outlet can be identified with an ideological position $m \in X$. The set of ideological positions supplied in the market, which we refer to as the *market variety*, is denoted by $M$, $M \subseteq X$. Note that, unless providers are completely differentiated in the ideological dimension, the number of positions supplied in the market is less than the number of content providers.[14]

We are now ready to provide a formal definition of a media environment:

**Definition 1** *A local media environment is pair $E = (b, M) \in B \times 2^X$ where $b \in B$ is an access barrier and $M \subseteq X$ is the market's ideological variety.*

We postulate that the distributions of voter characteristics are affected by the media environment. Formally, let us consider a change in media technology, in which an existing media environment, which we call a *media substrate* and denote with a subscript $s$, is being replaced by a new environment, denoted with a subscript $n$. Let $f_b$ denote the distribution of political motivation for a market with barriers $b$. We assume that, if barriers to access are lowered from $b_s$ to $b_n < b_s$, then the distribution $f_n$ associated with the new environment first order stochastically dominates the distribution $f_s$ corresponding to the substrate. If $\Pi = \{\underline{\pi}, \overline{\pi}\}$, this translates simply into $p_n > p_s$: an environment with lower barriers to access entails a greater share of citizens with high levels of political motivation.

The relationship between market variety $M$ and citizens' ideological preferences is not as obvious. In particular, citizens can choose to consume more than one ideological variety if available. Even if a citizen

[11] See Gentzkow and Shapiro (2008) for interesting discussion on the role of market competition, regulation and truthful reporting in the market for news.

[12] As an illustration, in recent years, echoing the political debate, a number of primetime TV dramas have provided us with positive or negative portrayals of topics such as the rights of homosexuals to raise a family, the issues surrounding civil liberties and the "war on terror", to mention a few examples. The same is true for a wide variety of entertainment (as opposed to news) content, from movies and soap operas to sports features.

[13] Recent work includes Jensen and Oster (2009) and La Ferrara et al. (2009). These papers show the powerful impact of TV entertainment content on individual attitudes towards fertility control and women's role in the labor market. While entertainment offers information content (e.g. social learning) we think this evidence points to the broader cultural impact of TV and the arts, affecting values and attitudes beyond providing information or improving accuracy.

[14] Importantly, as shown by Groseclose and Milyo (2005) and Gentzkow and Shapiro (2009), the market ideological variety can be measured with considerable precision, at least for some types of media. In any event, even in the absence of a precise measurement, one can still make qualitative inferences about changes in variety associated to the introduction of a new media.

consumes a single variety, which one does she choose? How do these choices translate into their views? We provide a simple model to answer these questions.

## 2.2 Demand For Ideological Content

In practice, individuals choose the mix of media they consume. In principle, each media outlet in a given media market can be conceived as a bundle that offers entertainment, information, and ideological content, but a complete theory of media consumption is beyond the scope of this paper. Instead, our focus is to provide a simple theory of how an individual's demand for ideological content determines that choice. This model will be an input into our theory of media and polarization, but will turn out to have independent interest as well.

The consumption of media content requires deploying time and financial resources. We capture this in a simplified manner by assuming that an individual has a fixed budget to be spent on media consumption. To fix ideas, we can think of this budget as an amount of time to be allocated to different providers – "channels", "stations", "newspapers", "blogs". Each citizen-consumer has a fixed time budget of 1, and decides the time of exposure to each media outlet.[15]

We assume that each outlet differs exclusively on the ideological content it provides. We can thus think of the citizen's allocation problem as defined over each of the ideological positions offered in the market, the set of which we have defined as $M$. Let $\Delta(M)$ be the set of probability distributions on $M$. We denote by $\tau_v \in \Delta(M)$ the vector describing the exposure times chosen by consumer $v$. If $M = \{m_1, ..., m_N\}$ has $N$ points then $\tau_v = (\tau_{v1}, ..., \tau_{vN})$ such that $\tau_{vj} \geq 0$ and $\sum_{j=1}^{N} \tau_{vj} = 1$.[16] We refer to $\tau_v$ as consumer $v$'s *demand for ideological content.*

We assume that exposure to a particular ideological content affects a citizen's preferred ideology. If the citizen has an initial ideology $z_v$, her "ex-post" ideology following media exposure is denoted by $x_v$. We assume that $x_v$ is a function of $z_v$ and the demand for ideological varieties $\tau_v$, i.e, $x_v = H(z_v, \tau_v)$. The map $H : X \times \Delta(X) \to X$ is referred to as an *influence function*, the properties of which we define as follows. (Note that for any $m \in X$ we use $\delta_m \in \Delta(X)$ to denote a mass point on $m$.)

**Assumption (A1)** There exists a continuous influence function $H : X \times \Delta(X) \to X$ such that the ex-post ideology $x$ for a citizen with (ex-ante) ideology $z \in X$ and exposure to content $\tau \in \Delta(X)$

[15] The assumption of a budget of size one is immaterial, but the fact that it is set exogenously, which in particular leaves aside the extensive margin of whether to consume media content at all, is more consequential: one could assume that the size could depend on ideology, say with more extreme individuals dropping out of media consumption. Having said that, there are a number of factual considerations that make it a plausible approximation for the applications we focus on. First, in the case of radio and television the relevant factors that determined the amount of resources devoted to consumption could be primarily determined by the entertainment and information value of these broadcasts, rather than ideological considerations. Indeed, as emphasized by Downs (1957) the political influence of the media could easily result from of the involuntary and passive absorption of information and views while seeking entertainment. In this line, our model is consistent with a market in which each media option is relatively homogeneous with respect to entertainment value but possibly differentiated with respect to ideology. Second, if the segments who opt out for ideological reasons are a relatively small share of the population, our setup is a close approximation.

[16] In a more general case, each station would be characterized by a multidimensional bundle of characteristics that include potentially differentiated entertainment varieties, ideological slant, information values, etc.

is given by $x = H(z, \tau)$. The function $H$ satisfies the following properties:

(H1) $H(z, \tau)$ is increasing in $z$;

(H2) $H(z, \delta_m) - m$ has the same sign as $z - m$ (In particular, $H(z, \delta_z) = z$);

(H3) For any $m \in X$, $\tau \in \Delta(X)$, $\epsilon \in [0, 1]$, if $\tau_\epsilon = \epsilon\delta_m + (1 - \epsilon)\tau$, $|H(z, \tau_\epsilon) - m|$ is decreasing in $\epsilon$.

Condition $(H1)$ just says that, given the same pattern of media exposure, the ex-post ideology of an individual moves with her ex-ante ideological position. The idea is that, if a right-wing citizen and a left-wing citizen are both exposed to the same content, the ex-post view of the left-winger will be to the left of that of the right-winger. Conditions $(H2)$ and $(H3)$ capture the idea that more exposure to a particular view pushes a citizen towards that view.[17]

We provide an example that illustrates how the ex-post position can be thought of as a weighted average between a prior (or "natural" ideology) and media influence.

**Example 1** *A family of influence functions satisfying the above properties is described by*

$$H(z, \tau) = z + \sum_{i=1}^{N} h(|z - m_i|, \tau_i)(m_i - z)$$

*where $h(\cdot, \cdot)$ measures the influence of a specific ideological content as a function of its distance to the consumer's initial ideology and the time of exposure, and satisfies $\sum_{i=1}^{N} h(|z - m_i|, \tau_i) = 1$ for all $z, \tau$, and $M$.*

*A special case is $h(z, \tau_i) = a\tau_i$, $a < 1$, which yields*

$$H(z, \tau) = (1 - a)z + a\overline{m}(\tau), \tag{1}$$

*where $\overline{m}(\tau) = \sum_{i=1}^{N} \tau_i m_i$ is the time exposure-weighted average of the ideologies to which the consumer is exposed. The formula above can be obtained as an approximation for a general influence function for the case in which the consumer is exposed to a single ideology.*[18]

In the spirit of Mullainathan and Shleifer (2005), we assume that the consumer chooses the demand for varieties $\tau$ "as if" she minimizes the dissonance between her prior ideology $z$ and her posterior ideology $x = H(z, \tau)$. The disutility of dissonance is measured by a loss function $\lambda(|z - H(z, \tau)|)$, where $\lambda$ is

[17] This seems like a reasonable benchmark, but it is not entirely obvious. For example, confirmatory bias and motivated reasoning may lead an individual to drift further apart from views that are dissonant with her prior view. Note also that there is a strong parallel between the assumptions above and the properties of Bayesian updating. Specifically, the mean of a posterior distribution is monotonic in the value of the mean of the prior, it coincides with the mean of the prior if all the signals observed have that particular value, and it is closer to a given value of a signal the larger the number of signals of that particular value. However, it is not at all obvious that the update in ideological views is a perfect parallel of information processing. For example, interrupting exposure to the media might be associated with changes in ideology: the agent could revert to prior views. This is plausible if prior experiences – sampling from memories – affect current attitudes.

[18] Indeed, if $\tau = \delta_m$ for some $m$ and observing that any $H(\cdot, \cdot)$ respecting (A1) satisfies $H(m, \delta_m) = m$, we have that the first-order Taylor approximation yields $H(z, \delta_m) \approx (1 - a)z + am$ where $1 - a = \frac{\partial H}{\partial z}(m, \delta_m)$.

strictly increasing and continuous. We also allow for the the possibility of costs associated to "switching" between different media, captured by a cost function $\phi(\tau)$.[19] In sum, the demand $\tau^*(z, \phi, M)$ for content of a consumer with ex-ante ideology $z$ in a market with variety $M$ solves

$$\max_{\tau} \quad W(z, \tau) \equiv -\lambda(|z - H(z, \tau)|) - \phi(\tau).$$

We focus on the simple case in which there is a fixed cost of switching. This allows us to illustrate the main issues at hand, and to easily explain the more general case. Formally, we assume that $\phi(\tau) = 0$ if $\tau = \delta_m$ for some $m \in M$ and $\phi(\tau) = \phi$ otherwise.

Before fully characterizing the demand for content, let us introduce some terminology. The *ideology span* $\Sigma(M) \subseteq X$ *of a market with variety* $M$ is the subset of ideologies that are covered by the the ideological variety of the market. Formally, $\Sigma(M) = \{z \in X | \ m \leq z \leq m' \text{ for some } m, m' \in M\}$. In particular, if $M = \{m\}$ then $\Sigma(M) = \{m\}$; if $M$ contains extreme ideologies then $\Sigma(M) = X$. We use $m^*(z) \in M$ to denote the ideological position closest to ideology $z$, i.e., $m^*(z) = \arg\min_{m \in M} |m - z|$. We can now state the following proposition, characterizing the individual demand for ideological content:

**Proposition 1** *Let $\tau^*(z, \phi, M)$ be the demand for ideological content for a citizen of ideology $z$ and switching cost $\phi$ in a market with variety $M$. There exists a positive, monotonically decreasing and bounded function $K : \mathbb{R}_+ \to \mathbb{R}_+$ such that*

*(i) If $\phi < K(|z - m^*(z)|)$ and $z \in \Sigma(M)$ then $\tau^*(z, \phi, M)$ is such that $H(z, \tau^*(z, \phi, M)) = z$.*

*(ii) Otherwise, if $z \notin I(M)$ or $\phi > K(|z - m^*(z)|)$ then $\tau^*(z, \phi, M) = \delta_{m^*(z)}$.*

*(iii) The ex-post ideology $H(z, \tau^*(z, \phi, M))$ is strictly increasing in the ex-ante ideology $z$.*

This result is very intuitive, and follows from the simple observation that if the fixed cost $\phi$ is small enough, it has no effect in the decision. In contrast, if this cost exceeds a threshold, the consumer will choose a single media position. Part (i) implies that if the cost is sufficiently small (e.g. $\phi \equiv 0$) then a consumer with an ideology in the ideology span of the market demands a content mix that counteracts any ideological influence. This "conscientious" exposure (to adapt Mullainathan and Shleifer's (2005) terminology), that counterbalances opposing ideological messages, is more valuable for citizens whose prior views are further away from the closest position supplied by the market. Part (ii) says that citizens with relatively "extreme" views (in the sense that they are not in the ideology span of the market), or

[19] There are several potential sources of switching costs. First, if the entertainment or information value across providers is similar, habituation to a particular provider (e.g. a voice, a face, an image, style) can increase the cost of switching. Second, while we do not model this explicitly, in media markets where pricing to consumers is relevant (e.g. cable TV, newspapers and magazines) it is often the case that subscribers pay lower prices than non-subscribers for the same content. Finally, switching a channel, station, or blog, requires some effort. This cost seems negligible with a remote control or the Internet, but it need not be so for the early days of TV or radio. Thus, $\phi$ can be associated to individual, market, or technological factors.

those whose ideology is sufficiently close to an ideology supplied by the market (and are thus not willing to pay the switching cost required by mixing), will not diversify their ideological consumption – they will rather pick the one outlet that is closest to their original view. As will be seen shortly, part (iii), which comes directly from Condition ($H1$), will be instrumental in deriving the properties of the distribution of citizens' views as a function of $M$ and the distribution of prior views.

A basic message of the proposition is that, if the costs of switching are small, consumers can significantly neutralize the media's ideological influence by suitably choosing exposure. Because of that, only those with relatively extreme views, as defined above, will be significantly affected. Indeed, if $\phi \equiv 0$ and $\Sigma(M) = X$ then $H(z, \tau^*(z, \phi, M)) = z$ for all $z$. This can be interpreted as a generalized "echo chamber" effect: after exposure consumers' views remain unchanged either because they consume a single variety that matches their pre-existing view, or else, because they can combine exposure to ideological messages that balance each other out.

Proposition 1 has direct testable implications on patterns of media consumption as a function of individual ideology. To fix ideas suppose that the market has two suppliers, 1 and 2, respectively supplying positions $m_1$ and $m_2$, where $m_1 < m_2$. Suppose that the span is "balanced" in the sense that the span $\Sigma(M) = [m_1, m_2]$ contains the moderates (as will be defined more formally below). For a low enough $\phi$, our result implies that, all else equal, moderates are more likely to be conscientious viewers, in the sense of consuming both $m_1$ and $m_2$, than extremists are.

As it turns out, there is direct suggestive evidence in favor of this implication. Using data from the Pew Research Center (2008), we can run a regression where the dependent variable is the likelihood that an individual (conditional on watching cable news channels) will watch both Fox News Channel and MSNBC, which are widely perceived to be the most conservative and most liberal of the three major cable news outlets (Hamilton 2004). Our RHS variable of interest is the degree of self-described ideological extremism, and Table A1 in the Appendix reveals a negative impact of that measure, significant at the 10% level. In other words, moderates do seem more likely to simultaneously watch sources across the spectrum.[20]

The model also predicts that, if both suppliers move in the same direction, say to the right, then conscientious consumers will adjust their consumption, substituting away from 2 (the more right-wing source) and consuming more from supplier 1 (the relatively left-wing option) to counteract the market shift to the right. This is precisely what Durante and Knight (2009) find for the case of Italy, where a change in government shifted (relatively left-wing) public television coverage to the right, and right-wing viewers reacted by consuming more public TV news. In sum, there seems to be evidence in favor of both central predictions of our simple framework.

[20]This is consistent with the finding that strong partisans tend to segregate into different news sources, as documented by Pfau et al. (2007).

### 2.3 Market Variety and the Distribution of Ideologies

With this simple model of individual behavior at hand, we can turn to the effects that changes in the supply of different ideologies in the market will have on the distribution of individual views and attitudes. From Proposition 1(iii), the ex-post view $H(z, \tau^*(z, \phi, M))$ is strictly increasing in the ex-ante view $z$, and is thus invertible (and differentiable almost everywhere). For a fixed $H$, let $R_{M,\phi} : X \to X$ denote this inverse function.[21] Let $G_0$ be the c.d.f. of citizens' prior ideologies (i.e. in the absence of exposure to the new media environment) and $g_0$ for the corresponding density. Note that the c.d.f. of ex-post ideologies for market with variety $M$ (with switching costs given by $\phi$) is

$$G_{M,\phi}(x) = G_0(R_{M,\phi}(x)). \tag{2}$$

Our next goal is to characterize how this distribution depends on $M$. Intuitively, we might expect that decreases in variety may lead to a "compression" of ideological preferences, as per the logic of the "mainstreaming" effect that we have alluded to. To make this precise we introduce the following definition, which is reminiscent of a mean-preserving spread.[22]

**Definition 2** *Let $G$ and $\widetilde{G}$ be two unimodal distributions on $X$ with the same median $\widehat{x}$. We say $\widetilde{G}$ is a compression of $G$ if $\widetilde{G}(x) \leq G(x)$ for all $x < \widehat{x}$ and $\widetilde{G}(x) \geq G(x)$ for all $x > \widehat{x}$. If the opposite inequalities hold, $\widetilde{G}$ is a dispersion of $G$*

The main question is whether we would confirm the intuition of a monotonicity property, namely that greater variety in the media environment always induces greater dispersion in the distribution of ideologies. In light of our empirical application, where both for radio and TV we can assume that switching costs are relatively minor, we will now focus on the case where $\phi = 0$.[23] (With some abuse of notation we omit $\phi$ and write $G_M(x)$ for $G_{M,\phi}(x)$.) For future reference, we state:

**Assumption (A2)** $\phi = 0$.

We will also focus our attention on symmetric (*balanced*) cases, by which we mean that the set of ideologies that is covered by media environments is symmetric around the median ideology. In other words, the most extreme ideological positions in offer are equally distant from the median individual in the initial distribution of views. To make this precise, let us use $\sigma_-(M)$ and $\sigma_+(M)$ to designate the two extremes of the ideology span of $M$, i.e., $\Sigma(M) = [\sigma_-(M), \sigma_+(M)]$. We can thus define a balanced media environment as:

[21] $R_{M,\phi}(x)$ has a simple interpretation: it is the prior ideology that would be mapped into $x$ following an endogenously chosen exposure pattern to media content if the market variety is $M$ and the switching cost is $\phi$.

[22] A mean-preserving spread is equivalent to a single-crossing property of the distributions such as the ones in this definition, plus a mean preservation condition.

[23] The general case of $\phi > 0$ is trickier, and we give it a more complete treatment in the Appendix. Broadly speaking, our results go through when the switching costs are sufficiently small.

**Definition 3** *(Balanced Media Environment) A media environment with variety $M$ is said to be balanced with respect to the unimodal distribution $G_0$ if the two extremes $\sigma_-(M)$ and $\sigma_+(M)$ of the ideology span of $M$ are symmetrically positioned relative the the median ideology $\widehat{x}$ of $G_0$ or $|\sigma_-(M)-\widehat{x}| = |\sigma_+(M)-\widehat{x}|$.*

Under assumption (A2), from Proposition 1(i), the distribution $G_M(x)$ depends on $M$ solely through the ideology span $\Sigma(M)$. As a result, we can define an increase (or decrease) in variety very simply as:[24]

**Definition 4** *(Increase in Variety) A market with variety $M'$ is said to be a decrease in variety with respect to $M$ if $\Sigma(M') \subset \Sigma(M')$. Conversely, $M$ is an increase in variety with respect to $M'$.*

We can finally show that a decrease in variety for this class of distributions is associated with a compression of the citizens' ideological preferences:

**Proposition 2** *Suppose assumptions (A1)-(A2) hold. If $M$ and $M'$ are two markets balanced with respect to the distribution $G_0$, and $M'$ is a decrease in variety with respect to $M$ then $G_{M'}$ is a compression of $G_M$.*

This proposition synthesizes our main intuition: if a new media environment is introduced that comprises a narrower set of varieties available to consumers in comparison to the media substrate, then one will observe a compression of citizens' ideological views in response to that introduction. In other words, less variety induces mainstreaming, and more variety induces dispersion of views.

# 3 Media and Polarization in a Model of Electoral Competition

What are the consequences of the role of the media, as described in the model from the previous section, for the political equilibrium? We can answer this question in the context of a relatively standard model of electoral competition model with endogenous turnout. For simplicity, let us consider two parties, Left ($L$) and Right ($R$). The candidates of each party choose platforms before the elections, $x_L$ and $x_R$, along our unidimensional ideology space $X$. In line with our empirical application, we think of candidates as the Democrat and Republican contenders for a seat in the House of Representatives. Their ideologies are interpreted as a position in the liberal-conservative dimension, in the spirit of the ideology scores that can be calculated for representatives (i.e. winning candidates), based on their roll-call votes in the legislature. (This is exactly what we will use in our empirical implementation, as we will discuss in detail later.)

We start by describing each citizen's electoral behavior as a function of the profile $\mathbf{x} = (x_L, x_R)$ of candidates' ideologies and their own individual characteristics – ideology and political motivation. Next, we describe the electoral game between the two candidates. Our main results will make use of the

[24] This statement defines a complete order in the subset of distributions that are balanced with respect to a distribution $G_0$.

microfoundations provided in the previous section to characterize the effects of introducing a new media environment on the equilibrium levels of polarization $|x_R - x_L|$ and turnout.

### 3.1 Voters

There is a continuum of citizens and a typical citizen is indexed by $v$. As previously argued, each citizen $v$ is characterized by a pair $(\pi_v, x_v)$ where $\pi_v \in \Pi$ represents $v$'s level of political motivation and $x_v \in X$ is her preferred ideology. Citizens make two decisions: whether or not to turn out and, conditional on turning out, whether to vote for $L$ or $R$.

As is standard in the literature, we assume that the voter's utility when it comes to ideology $y \in X$ decreases with the distance to her own preferred ideology. For simplicity, we assume that utility is quadratic, i.e., $u_v(y) = -(y - x_v)^2$. In particular, this means that, conditional on voting, $v$ chooses the candidate with the ideology closest to $x_v$. For ease of notation, let $x_{1/2} \equiv \frac{x_L + x_R}{2}$, so that voter $v$ chooses $L$ over $R$ if $x_v < x_{1/2}$ and $R$ over $L$ if the opposite strict inequality holds. A voter who is indifferent between both ($x_v = x_{1/2}$) is assumed to randomize between both choices with equal probability.[25]

We consider three standard motives behind the turnout decision: *alienation*, the *consumption benefit of voting*, and *political motivation*.[26] Alienation refers to the idea that citizens are more likely to turn out the closer is their preferred ideology to the one supported by their preferred candidate. Conversely, a voter is alienated and abstains if this distance is too large. Formally, the likelihood that $v$ votes increases with $A_v(\mathbf{x}) = \max_{j \in \{L,R\}} u_v(x_j)$. The consumption benefit of voting is the difference between the utilities associated to each of the candidates' ideologies. This is to capture the idea that individuals are more likely to turn out if they perceive the stakes of the election to be high. For voter $v$, this is measured by $D_v(\mathbf{x}) = |u_v(x_L) - u_v(x_R)|$. Using the fact that $u_v(\cdot)$ is quadratic, we can write down:

$$D_v(\mathbf{x}) = 2|x_R - x_L| \left|x_{1/2} - x_v\right|.$$

Hence, for any $x_v$, changes in the candidates' ideological positions that increase polarization $|x_R - x_L|$, while keeping the average ideology $x_{1/2}$ constant, will increase the consumption motive $D_v(\mathbf{x})$. On the other hand, for any fixed level of polarization $|x_R - x_L|$ between the parties, $D_v(\mathbf{x})$ is larger for voter's with more extreme bliss points as we pull away from median ideology. Both the alienation and consumption motives depend on the profile of candidates platforms. The third motive, an individual's political motivation, is – by assumption – independent of platforms and captured by a "vertical" parameter $\pi_v$. As discussed earlier, there are a number of vertical factors that can influence a voter's willingness to vote including the extent to which the individual cares about politics, his sense of civic duty, and the opportunity cost of voting.

[25] This assumption is essentially irrelevant, as the p.d.f. $g$ is assumed to be absolutely continuous and hence this set has measure zero.

[26] Note that we assume that voters are infinitesimal, with a negligible probability of being pivotal. Their motivation is not instrumental. For more on this see Riker and Odershook (1968), Aldrich (1993), Glaeser et al. (2005).

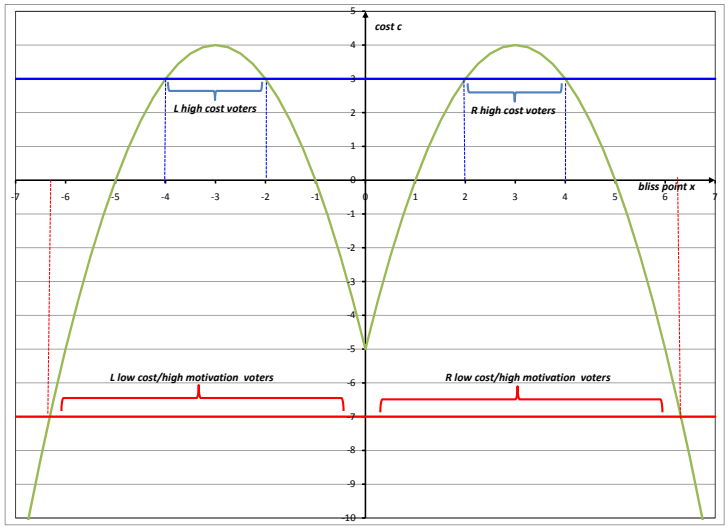



Figure 1: Ideology, Motivation and Turnout in a Model with Alienation

In sum, given $\mathbf{x}$, the utility of voting for citizen $v$ is given by $U(\mathbf{x},\pi_v, x_v) = q(A_v(\mathbf{x}), D_v(\mathbf{x}), \pi_v)$ where $q : \mathbb{R}^2 \times \Pi \to \mathbb{R}$ is a function decreasing in its first argument (alienation), and increasing in its second and third arguments (consumption and motivation). Without loss of generality, the utility of abstention is normalized to zero. It follows that a citizen votes if

$$U(\mathbf{x},\pi_v, x_v) \geq 0.$$

For a fixed profile of ideologies $\mathbf{x}$, the above inequality defines a turnout region in the $(\pi, x)$-space of voter characteristics. The following assumption, allows for an explicit characterization of this region.

**Assumption (P1)** $q$ is additively separable, i.e. the utility of turnout is given by

$$U(\mathbf{x},\pi_v, x_v) = -\alpha A_v(\mathbf{x}) + \beta D_v(\mathbf{x}) + \pi_v.$$

Figure 1 shows the turnout region for a generic case satisfying Assumption (P1). It is composed by two symmetric regions, one corresponding to "$L$ voters" who prefer $L$ to $R$, and the other corresponding to "$R$ voters" who prefer $R$ to $L$. For each fixed level of political motivation $\pi$, there are two types of citizens who abstain from voting: extreme voters who find themselves alienated, and those who have low enough political motivation and are relatively moderate (so that the consumption benefit of voting is relatively small). Figure 2 shows the region for the special case in which $\alpha = 0$ (no alienation motive). In this case, extremists always vote as the consumption motive is larger for them, and those who abstain are moderates with low political motivation levels.

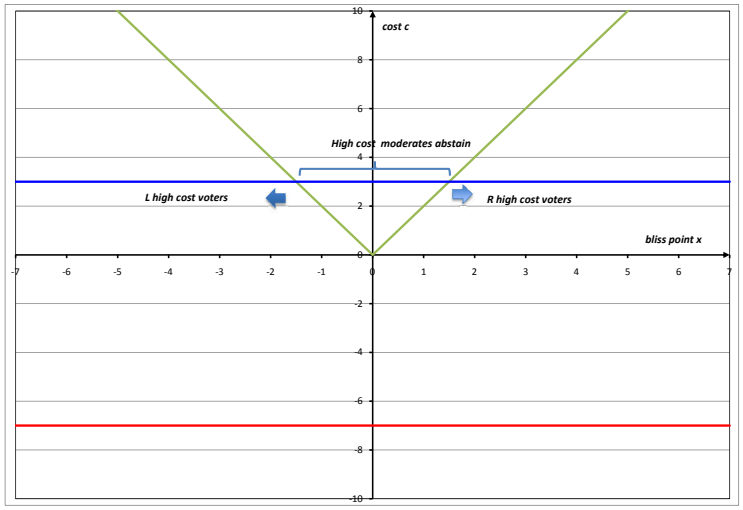



Figure 2: Ideology, Motivation and Turnout in a Model without Alienation

For ease of exposition, in what follows we make two simplifying assumptions. First, we focus on the case in which turnout is determined exclusively by the consumption motive and political motivation, as in Glaeser et al. (2006). As explained later, the main features of our predictions remain qualitatively unchanged if we allow for $\alpha > 0$ as long as the consumption motive is sufficiently strong. For future reference, we state that as:

**Assumption (P2)** No alienation motive for turnout ($\alpha = 0$).

Our second simplifying assumption just says that political motivation is binary. Low motivation citizens have $\underline{\pi} = -c$, where $c > 0$ is interpreted as a net cost of voting for those with low political motivation. For high motivation citizens, $\overline{\pi} = d$ is represents the net benefit of voting (e.g. civic duty). We state that as:

**Assumption (P3)** $\Pi = \{\underline{\pi}, \overline{\pi}\}$ where $\underline{\pi} = -c$ and $\overline{\pi} = d$, $c, d > 0$

This assumption implies that high motivation citizens vote regardless of candidate platforms. On the other hand, as illustrated by Figure 2, if assumption (P2) holds, there exist thresholds $y_L(\mathbf{x}) < x_{1/2}$ and $y_R(\mathbf{x}) > x_{1/2}$ such that all the low motivation citizens with ideologies between $y_L(\mathbf{x})$ and $y_R(\mathbf{x})$ abstain from voting. Thus, moderate low-motivation citizens do not turn out. Voters to the left of $y_L(\mathbf{x})$ vote for $L$ while those to the right of $y_R(\mathbf{x})$ vote for $R$. If the support of the ideology distribution $G$ is $[\underline{x}, \overline{x}]$, these thresholds are given by

$$y_L(\mathbf{x}) = \max\left\{\underline{x}, x_{1/2} - \frac{c}{2(x_R - x_L)}\right\} \text{ and } y_R(\mathbf{x}) = \min\left\{\overline{x}, x_{1/2} + \frac{c}{2(x_R - x_L)}\right\}.$$

Note that the set of (relatively) moderate voters who abstain increases as the platforms get closer and the consumption benefit of voting drops. The following lemma derives the turnout for each party $V_L$ and $V_R$ as a function of the profile of strategies $\mathbf{x}$ and the distribution of citizens characteristics.

**Lemma 1** *Suppose assumptions (P1) and (P2) hold. The levels of turnout for each parties and total turnout are given by*

$$\begin{aligned} V_L(\mathbf{x}) &= pG(x_{1/2}) + (1-p)G(y_L(\mathbf{x})), \\ V_R(\mathbf{x}) &= p(1-G(x_{1/2})) + (1-p)\left[1-G(y_R(\mathbf{x}))\right], \text{ and} \\ V(\mathbf{x}) &= 1-(1-p)\Delta G(\mathbf{x}), \end{aligned}$$

*where $\Delta G(\mathbf{x}) \equiv G(y_R(\mathbf{x})) - G(y_L(\mathbf{x}))$ is the share of low motivation citizens that do not vote.*

### 3.2 Political Competition

Having characterized the behavior of voters, we can now turn our attention to the politicians. We assume that candidates are both office- and policy-motivated. Candidate $j$'s policy motivation is represented by a decreasing function $u_j(x_j)$ of the distance between her proposed ideology $x_j$ and her preferred ideology, which we denote by $x_{0j} \in X$, where $x_{0L} < x_{0R}$. This preferred ideology, in our context, could represent the average ideological preference of a group of local constituencies, the national party's ideology, the candidate's intrinsic ideological preferences, or a combination of those. For simplicity, just as with voters, we assume that $u_j(x_j) = -(x_j - x_{0j})^2$.[27]

We use $W_j(\mathbf{x})$ to denote candidate $j$'s office motivation, $j \in \{L, R\}$, when candidates choose the profile $\mathbf{x} = (x_j, x_{-j})$, where as usual $-j$ stands for candidate $j$'s opponent. As it turns out, the qualitative nature of some of our results, as anticipated, will depend on the finer details of this motivation term. For our benchmark, we consider the case that is most descriptive of our empirical application, which focuses on legislative elections in the United States. For each congressional district, these are majoritarian, "winner-take-all" contests, so we assume as our benchmark that candidates care about winning the election. For simplicity, we operationalize this assumption as $W_j(\mathbf{x}) = V_j(\mathbf{x}) - V_{-j}(\mathbf{x})$, namely the margin of victory for candidate $j \in \{L, R\}$.[28] In contrast, in a proportional system it might be more natural to assume

[27] Most models of electoral competition with policy motivations consider candidates who care about the distance between their preferred ideology and the policy implemented in equilibrium rather than the policy they promote (See again, for example, Austen-Smith and Banks (2005).) This seems plausible in the context of a presidential election, but less so in the context of our empirical application. Indeed, if we think of candidates as contestants for a seat in the legislature, the policies implemented will normally result from the interaction between representatives of possibly hundreds of districts. In this context, it seems more plausible to identify the policy motive with the policies the candidates commit to support in the legislature if elected. More broadly, as emphasized by Alesina and Rosenthal (1995), the model is consistent with the idea that it may not be credible for political agents to depart from their preferred ideology even if they care mostly about electoral incentives.

[28] The direct alternative would be to assume that each candidate receives a payoff of 1 if he/she wins and 0 otherwise. However, in a model in which candidates are perfectly informed about the distribution of voter preferences, as is our case, it is well-known that this implies discontinuous payoffs as a function of the strategies, and consequent equilibrium existence problems. (See, for example, Austen-Smith and Banks (2005, ch. 7).) In contrast, in a probabilistic voting model in which

that maximizing the share of votes, so that $W_j(x) = V_j(\mathbf{x})/V(\mathbf{x})$, reflects more accurately the incentives of political competitors.

In sum, we are interested in the Nash equilibria of the game in which candidates choose ideologies to maximize the additive objective

$$O_j(x_j, x_{-j}) = W_j(x_j, x_{-j}) + \rho u_j(x_j),$$

where $\rho > 0$ measures the importance of the policy motivation relative to the office motivation. Our benchmark assumption on the nature of the latter can be stated for future reference as:

**Assumption (P4)** (Winner-takes-all) Each candidate's office motivation is captured by the margin of victory $W_j(\mathbf{x}) = V_j(\mathbf{x}) - V_{-j}(\mathbf{x})$.

We will also focus our attention in a symmetric case, in the sense that candidates are positioned symmetrically relative to the median individual. This ensures the existence of a symmetric equilibrium in which candidates choose equilibrium ideologies that are equidistant from the median ideology $\widehat{x}$. We state this assumption as:

**Assumption (P5)** $|x_{0L} - \widehat{x}| = |x_{0R} - \widehat{x}|$, where $\widehat{x}$ is the median of the distribution of ideologies $G$.

Let us discuss the intuition behind the electoral incentives captured by the model. Note that if $p = 1$, all citizens are highly motivated and vote. In this case, if $\rho$ is sufficiently small so that candidates care mostly about the electoral outcome, the unique equilibrium of the game involves both parties choosing converging ideologies, namely the median voter's preferred ideology $\widehat{x}$. If $p$ is small, on the other hand, in order to attract low-motivation voters to the polls, parties may face an incentive to choose policies that are more extreme. Still, the parties also face the convergence force driven by the incentive to steal voters from their competitor. It can be shown that for most reasonable distributions the convergence incentives prevail if $\rho$ is small.[29] Hence, in our model, ideological polarization exists in equilibrium only if $\rho$ is high enough, which is what we state precisely in:

**Assumption (P6)** $g(\widehat{x}) < \rho|x_{0R} - x_{0L}|$.

candidates are imperfectly informed about this distribution (e.g. the ideology distribution $G$ is a symmetric unimodal distribution, but its median is imperfectly known and distributed uniformly on a subinterval of $X$), the candidates' expected payoff from winning the election is simply the probability of winning the election. This is typically a continuous function of the strategies. Furthermore, under reasonable conditions on the voters' preferences over platforms, maximizing this probability is equivalent to maximizing the margin of victory computed for an "average distribution". Thus, an expression analogous to $W_j(\mathbf{x})$ can be derived if candidates care exclusively about winning rather than maximizing the margin of victory in a model with probabilistic voting. (For equivalence results of this type in elections with abstention see Leydard [1984], Coughlin [1992], and Duggan [2000].) Our specification is a reduced-form way of implementing this assumption.

[29] In Glaeser et al. (2005), divergence in equilibrium relies on the additional assumption that parties are able to target their messages. In particular, a more extreme voter is more likely to be informed about how extreme a candidate's policy really is than a moderate one.

If $p = 1$ the marginal electoral benefit associated with a small move towards moderation when both candidates choose the median voter's preferred ideology $\widehat{x}$ is $g(\widehat{x})$, while the marginal disutility of moving away from the candidate's preferred policy is $\rho|x_{0R} - x_{0L}|$. The assumption ensures that each candidate has an incentive to move towards their own preferred platform whenever both of them choose the median voter's preferred ideology $\widehat{x}$.

We are now ready to characterize the political equilibrium:

**Lemma 2** *If (P1)-(P6) hold then any symmetric equilibrium* $\mathbf{x}^* = (x_L^*, x_R^*)$ *of the electoral game is such that* $x_{L0} < x_L^* < x_R^* < x_{0R}$.

This lemma shows that our assumptions guarantee the existence of a symmetric equilibrium with a positive level of polarization, i.e. $x_R^* - x_L^* > 0$. At the same time, the equilibrium level of polarization is bounded by the candidates' preferred ideologies.

### 3.3 Main Results: New Media and Political Outcomes

We can now establish our main results, which describe how changes in the media environment will affect the political equilibrium of the electoral model we have just described. An equilibrium of the electoral game $\mathbf{x}^*$ is a function of the citizens' distribution of characteristics, i.e., the distribution of political motivation and the distribution of ideologies, $G$. Under our binary assumption, the former is determined by $p$, the fraction of high motivation citizens. We thus write $\mathbf{x}^* = \mathbf{x}^*(p, G)$.

As shown in the previous section, a media environment $E = (b, M)$ affects the distribution of citizens' characteristics. In particular, $p$ is affected by accessibility barriers $b$, and $G$ is affected by the market's ideological variety $M$ as described by proposition 2, so that $p = p_b$ and $G = G_M$. With some abuse of notation, we write $\mathbf{x}^*(E) = \mathbf{x}^*(p_b, G_M)$, so as to make explicit the connection between political outcomes and the media environment. Let $\Delta x^*(E) \equiv x_R^*(E) - x_L^*(E)$ and $V^* \equiv V(\mathbf{x}^*(E))$ designate the corresponding levels of equilibrium polarization and turnout. We are interested in how these quantities will change with changes in $E$.

Before we move on to the results, it is worth mentioning that while Lemma 2 guarantees the existence of equilibria, uniqueness is not guaranteed.[30] The comparative statics summarized by our results are robust in the sense that they apply to the largest and smallest selection – where the smallest (resp. largest) selection refers to the symmetric equilibrium having the smallest (resp. largest) level of polarization level.

#### 3.3.1 The Composition Effect

Our first prediction concerns the effect of a reduction in access barriers. A canonical example, as we will argue, is the introduction of radio or television in a society in which the new medium replaces

[30] For a uniform distribution of citizens' ideologies on any interval the equilibrium is unique under assumptions (P1)-(P5). However, this is not necessarily true for other distributions – for instance, multiple equilibria are possible for a triangle distribution.

newspapers as the primary source of news and entertainment. As argued in the previous section, an increase in access will be typically associated with an increase in political learning and, more generally, what we have referred as political motivation. In our model, this is captured by a first-order stochastic dominance transformation in the distribution of political motivation. (Given Assumption (P3), this can happen either by an increase in the fraction of citizens $p$ with high motivation $\overline{\pi}$, or by increasing one or both of the motivation levels – e.g. a reduction of the cost of voting for the low motivation $c$). For this case, we can state the following:

**Proposition 3** *Let $E_s = (b_s, M_s)$ and $E_n = (b_n, M_n)$ be respectively the substrate and the new media environments. Suppose that $b_n < b_s$ and $M_n = M_s$, i.e., the new environment lowers barriers to access. Then, if the the p.d.f. of ex-ante ideological preferences $g_0$ is log-concave, the political equilibrium is affected as follows:*

*(i) Polarization falls: $\Delta x^*(E_n) \leq \Delta x^*(E_s)$*

*(ii) Turnout increases: $V^*(E_n) \geq V^*(E_s)$.*

*The inequalities are strict if either $p_n > p_s$ or $c_n < c_s$.*

The result is very intuitive, although further probing will reveal some subtleties that we will discuss later on. To fix ideas, suppose that the reduction in barriers leads to an increase in the fraction of highly motivated citizens from $p_s$ to $p_n$. In our model, individuals vote either because they are sufficiently motivated or because their preferences are relatively extreme. Indeed, the turnout decision of citizens with low political motivation depends on the consumption benefit of voting. In particular, for a fixed profile of candidate ideologies, this benefit is larger for voters with extreme ideological preferences than moderates. Since all high-motivation citizens vote, the distribution of preferences of high-motivation voters is relatively more moderate than the one corresponding to low-motivation voters. Thus, ceteris paribus, an increase in the fraction of high motivation citizens is associated with a change in the composition of the preferences of those who turn out, increasing the share of moderates. As a result, each candidate has an incentive to moderate their ideology to compete for the vote of the "new moderates" who join the electorate. This leads to a drop in polarization. Because it is driven by a change in the composition of the electorate in equilibrium, we refer to this drop in polarization associated to a reduction in access barriers as the *composition effect*.[31]

Part (ii) seems quite natural: an increase in the share of high-motivation citizens should naturally lead to higher turnout. However, the model reveals a subtler intuition, which is apparent from Lemma

[31]The logic for a decrease in the cost $c$ of voting for low motivation citizens is similar. Note that an increase of the duty benefit of voting $d$ for high motivation citizens is insubstantial, as all citizens in this group vote to begin with.

1. Let $\Delta g = g(y_R) - g(y_L)$ and observe that $y_j$, $j \in \{L, R\}$, depends on $p$. A small increase in $p$ yields

$$\begin{aligned} dV &= (\Delta G)dp + (1-p)\left[g(y_L)dy_L - g(y_R)dy_R\right] \\ &= (\Delta G)dp + (1-p)\left[-\Delta g dx_{1/2} + (g(y_R) + g(y_L))\frac{c}{2(\Delta x)^2}d(\Delta x)\right]. \end{aligned}$$

The first term is the direct effect, which is always positive: since high-motivation citizens vote, increasing their share increases turnout. This is precisely the intuition we have just mentioned. However, there is an indirect effect which is due to the fact that candidates' platforms will react, and that this will affect the turnout of the $1-p$ low-motivation citizens. This indirect effect is captured by the terms in brackets. For a symmetric equilibrium, $\Delta g = 0$ so the first term in brackets drops out. The second term in brackets is negative, though, as equilibrium polarization drops ($d(\Delta x^*) < 0$) decreasing the consumption benefit of voting. We can show that the direct effect dominates if $g_0$ is log-concave as we assume.[32]

### 3.3.2 The Variety Effect

We now turn our attention to the effect of changes in media variety on polarization. The assumptions behind Proposition 2 are maintained, from which a balanced increase in variety is associated with a compression while a balanced decrease in variety leads to a compression of the distribution of preferences. We can thus state the following:

**Proposition 4** *Let $E_s = (b_s, M_s)$ and $E_n = (b_n, M_n)$ be respectively the substrate and the new media environments. Suppose that $b_s = b_n$ and $M_n$ is a balanced decrease in variety with respect to $M_s$. Then, there exists $p_0 \in [0,1]$ such that if $p \geq p_0$ and the p.d.f. of ex-ante ideological preferences $g_0$ is log-concave, the political equilibrium is affected as follows:*

*(i) Polarization falls: $\Delta x^*(E_n) \leq \Delta x^*(E_s)$*

*(ii) Turnout decreases: $V^*(E_n) \geq V^*(E_s)$*

Here is the intuition for the result: as shown by Proposition 2, a balanced decrease in variety is associated with a compression of the distribution of citizens' ideologies. This means that the marginal electoral benefit of a policy movement towards moderation is higher for the new distribution, resulting in lower polarization.

In contrast with the composition effect, this reduction in polarization is accompanied by a decrease in turnout. Indeed, since all high-motivation citizens always vote, the decrease in variety only affects the turnout decision of low-motivation citizens. Formally, we can see from Lemma 1 that:

[32] Most of the familiar distributions are log-concave, including the uniform and the normal. (See Bagnoli and Bergstrom (2005).) Intuitively, log-concavity means that there is sufficient weight in the middle of the distribution, which is not too "polarized". As moderates are the ones driving the increase in turnout, this ensures that the overall effect will be positive.

$$
\begin{aligned}
dV &= (1-p)\left[-d(\Delta G) + g(y_L)dy_L - g(y_R)dy_R\right] \\
&= (1-p)\left[-d(\Delta G) - \Delta g dx_{1/2} + (g(y_R)+g(y_L))\frac{c}{2(\Delta x)^2}d(\Delta x)\right].
\end{aligned}
$$

For a compression, the mass of low-motivation citizens who abstain grows as the mass of moderates grows, and only those with sufficiently extreme preferences care enough about voting. Specifically, $d(\Delta G) > 0$ as the set of citizens with views on the symmetric interval $[y_L, y_R]$ that contains $\widehat{x}$ is larger following the compression. Hence, the direct effect is negative: an increase in the share of moderates among those with lower motivation decreases turnout. The second term is zero for a symmetric equilibrium as $\Delta g = 0$ and $dx^*_{1/2} = 0$. The third term is negative as polarization falls, so $d(\Delta x^*) < 0$.

In sum, we have uncovered two channels through which changes in the media environment affect equilibrium polarization: a decrease in barriers to access reduces polarization, because new voters brought into the electorate are relatively moderate, and so does a decrease in variety, because the resulting compression in citizens' ideological views increases politicians' incentives for moderation. In addition, we have derived different predictions stemming from each channel when it come to the effects on turnout, which decreases with the former and increases with the latter.

### 3.4 Discussion and Extensions

It is illuminating to consider what happens to our results when we modify two of our assumptions. Let us start by lifting Assumption (P2), thus allowing for an alienation motive behind the turnout decision. The results presented above remain true in this case. The only difference is that, with alienation, both moderate and extreme voters with low political motivation can abstain in equilibrium depending on the platforms chosen by the candidates. In particular, a decrease in media variety that leads to a decrease in polarization and turnout, as described by Proposition 4, can be associated with a drop in the vote by both moderates and extremists. Under Assumption (P2), in contrast, it is only the former who drop out.

Most interestingly, the "winner-take-all" assumption (Assumption (P4)) is indeed crucial for some of the results. Specifically, the qualitative nature of the composition effect summarized by Proposition 3 changes if we consider a different office motivation for the politicians. Let us make this precise by considering a model with proportional representation, where the politicians' office motivation is described as:

**Assumption (P4')** (Proportional Representation) Each candidate's office motivation is captured by the share of votes, i.e., $W_j(\mathbf{x}) = V_j(\mathbf{x})/V(\mathbf{x})$.

Under this assumption, the composition effect on polarization is reversed.

**Proposition 5** *Let $E_s = (b_s, M_s)$ and $E_n = (b_n, M_n)$ be respectively the substrate and the new media environments. Suppose that $b_n < b_s$ and $M_n = M_s$, i.e., the new environment lowers barriers to access. Then, if the cumulative distribution ex-ante ideological preferences $G_0$ is log-concave, the political equilibrium is affected as follows:*

*(i) Polarization increases: $\Delta x^*(E_n) \geq \Delta x^*(E_s)$*

*(ii) Turnout increases: $V^*(E_n) \geq V^*(E_s)$.*

*The inequalities are strict if either $p_n > p_s$ or $c_n < c_s$.*

Why does proportional representation lead to an increase in polarization, reversing the conclusion obtained for the "winner-take-all" case? As it turns out, the intuition behind the composition effect, which seemed very natural, is in fact a little more subtle than meets the eye. The fact that the electorate becomes more moderate as a result of the entry of previously low-motivation citizens into the voter pool is evidently present, but there is a second effect related to the extensive margin of those citizens who remain low-motivation. Becoming more extreme entails a cost of losing moderate low-motivation voters, who decide to abstain instead; if there are fewer low-motivation voters, this cost is correspondingly lower. This means that the parties will face a lower cost to moving towards their preferred ideologies (and away from the median). In sum, a reduction in barriers to access stimulates moderation in order to chase the intensive margin of those who decide to turn out, but it facilitates extremism because of the reduced importance of the extensive margin.

Both of these effects were already present in the "winner-take-all" case – our previous discussion of the intuition was deliberately simplified – but there it turns out that the moderating incentive prevails. Proposition 5 shows that this is no longer the case under Assumption (P4').[33] Why is that the case, intuitively? Under a majoritarian system, the intensive margin is always more important than the extensive margin, by a factor of two, because it represents an additional vote for $j$ *and* one fewer vote for

[33] To see this from a formal perspective, note first that $V_j(\mathbf{x})/V(\mathbf{x}) = \frac{1}{2}\left(V_j(\mathbf{x}) - V_{-j}(\mathbf{x})\right)/V(\mathbf{x})$, that is, the office-motivation component is proportional to the one under Assumption (P4) (margin of victory), but normalized by total votes. The latter will increase as a result of the reduced barriers, thus working in the opposite direction of Proposition 3. To look at the overall effect, it is useful to contrast the two extreme cases of $p = 1$ and $p = 0$. If $p = 1$ then all citizens turnout ($V(\mathbf{x}) = 1$ for all $\mathbf{x}$) and the first-order condition in a symmetric equilibrium is

$$g(\widehat{x}) = \rho(x_L^* - x_{L0}).$$

Instead if $p = 0$, $\frac{\partial W_L}{\partial x_L} = \frac{1}{V^*}\left(W_R^* \frac{\partial V_L}{\partial x_L} - W_L^* \frac{\partial V_R}{\partial x_L}\right) = \frac{1}{2V^*}\left(\frac{\partial V_L}{\partial x_L} - \frac{\partial V_R}{\partial x_L}\right)$, which yields

$$\frac{g(y_L^+)}{2G(y_L^+)} = \rho(x_L^+ - x_{L0}).$$

where $y_L^+ = \widehat{x} - \frac{c}{\Delta x^+} < \widehat{x}$. By log-concavity, the left-hand-side of the latter equation ($p = 0$) is greater than the one corresponding to $p = 1$. In short, the equilibrium platform will be farther to the left under the former than under the latter.

$-j$. Under proportional representation, in contrast, the two margins have essentially the same weight.[34] Because of this greater relative weight, the effect driven by the extensive margin is more important in the latter case, and will dominate as long as the distribution of preferences is log-concave.

The broader lesson is that the effect of changes in the media environment, when it comes to the composition effect, will depend on institutional features. Under majoritarian systems, as we will see, we would expect the introduction of a relatively low-barrier environment (say, radio entering a media substrate dominated by newspapers) to lead to lower polarization. The same change in media technology would be expected to lead to greater polarization under a proportional representation system, because the incentives faced by politicians would differ. An empirical investigation of this prediction remains for future research, but the prediction itself illustrates quite starkly the importance of a formal theory in elucidating the nature of these effects.

# 4 Changes in Media Environment and Polarization: Empirical Evidence

We can now turn to the data to assess whether our framework's predictions can illuminate the effects of the introduction of new media technologies on political polarization. To motivate the context in which we will pursue this, we can look at the data on polarization that is presented by McCarty et al. (2006, p. 8) for the case of the US over the 20th century. As displayed in Figure 3, they display a remarkable decrease in polarization (measured in this case by the distance between the two-party difference in average Nominate scores in the US House of Representatives) from the 1920s and into the 1960s.[35] While many societal changes beyond the introduction of media technologies lie behind this trajectory, many of which (such as immigration) are analyzed in their book, the variation that it entails gives us hope that, in this context, we may be able to identify effects that are quantitatively important.

As it turns out, this variation in polarization is roughly contemporaneous with two instances in which new media technologies were adopted very fast and very broadly, which also gives us hope that any potential effects are more easily detectable. We are obviously referring to the introduction of the radio, in the 1920s and 1930s, and later of broadcast TV, in the 1940s and 1950s. The share of US households with radio sets went from around zero to 80 percent in roughly 15 years, between the early 1920s and late 1930s; that same share for TV sets went a similar distance over an even shorter span of time, between the late 1940s and late 1950s (Prior 2007, p. 13). Both media carried substantial amounts of explicitly political content (Prior 2007, Benjamin 2001), and their effect on general attitudes

[34] To see this schematically, consider the effect of one additional vote for candidate $j$ in each of the margins, under the different systems, in a model with a discrete set of voters. Under Assumption (P4), an extra vote in the intensive margin yields $V(x_j) + 1 - (V(x_{-j}) - 1)$, while the extensive margin yields $V(x_j) + 1 - V(x_{-j})$ – the difference is 2 for 1. Under Assumption (P4'), the contrast is between $\frac{V(x_j)+1}{V(x)}$ and $\frac{V(x_j)+1}{V(x)+1}$ – for a difference of $\frac{1}{V(x)}$ versus $\frac{1}{V(x)+1}$. The factor here is always smaller than 2, for any $V(x) > 1$, and approaches 1 for a large $V(x)$.

[35] The fall in polarization between the 1940s and 1960s seems dwarfed by that over the two preceding decades, but was still quite important. See McCarty, et al. (undated).

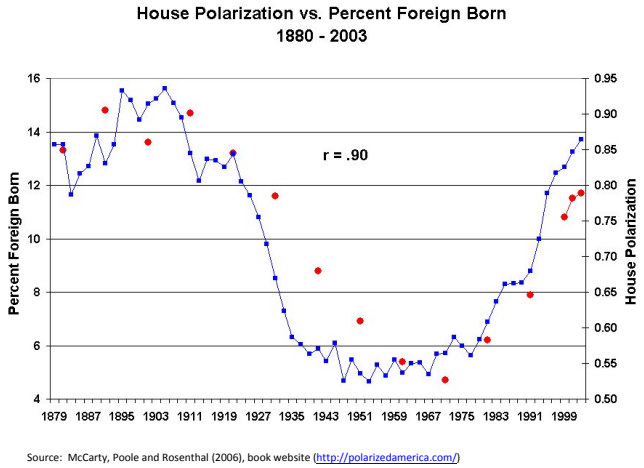



Figure 3: US House Polarization (and Immigration), 1880-2003

and beliefs, with natural ideological and political implications, certainly went beyond that.

In sum, rapid and important change in media environments, plus substantial variation in polarization, create an ideal context in which to test the predictions of our framework.

## 4.1 TV and Radio: Context and Characteristics

What should we expect these predictions to be for the episodes we focus on? For this we need to understand their characteristics and the context in which they took place. Let us start with the introduction of TV in the US, in the 1940s and 1950s.[36] The impact of television was immense in terms of popularity, which makes it an obvious candidate for identifying effects on political behavior. Particularly interesting for our purposes, the early days of television were marked by low variety: "the most popular mass medium ever offered the lowest degree of content choice of any mass medium." (Prior, 2007, p. 68) First of all, few channels were available – an average of three stations per market in 1965. Second, even if the average viewer had access to a few additional channels from signals traveling from other markets, these were essentially retransmitting network programming, exposing different markets to very similar content. Last but not least, both because of FCC regulation and market-driven choices, the content provided by each network was quite similar to what was offered by the others: as put by Webster (1986, p. 79), "there is no significant difference in what a viewer can see on ABC, CBS, and NBC", the three major networks at the time. This narrow set of options, not surprisingly, tended to be restricted to middle-of-the-road,

[36]The discussion in the following two paragraphs largely follows information gathered from Sterling and Kittross (2002) and Prior (2007).

"mainstream" content.[37] In sum, using the language from our theory, TV was a low-variety medium, both within and across localities.

Just as importantly for our purposes, TV was unquestionably a highly accessible medium. It required considerably less attention and cognitive ability than newspapers or magazines. As such, it was also much more amenable to the kind of incidental learning that would particularly affect individuals who are not that motivated for politics to begin with, as emphasized by Prior (2007). In addition, while it might be the case that the price of buying a TV set would represent a significant barrier in many contexts, the very rapid pace at which Americans bought them upon the introduction of TV broadcasting belies this concern in our context. In short, we can also characterize TV as a low-barrier medium.

How about radio? Similarly to the case of TV, as we have noted, the diffusion of radio was also very fast and its influence widespread, starting in the 1920s and through the 1940s.[38] It is rather clear that radio also constituted a relatively high-accessibility alternative to the print media, the dominant media technology of the day: it did not require literacy, nor reading skills or habit.[39] In other words, radio was a low-barrier medium.

The story is somewhat more complicated when it comes to variety, which will in fact turn out to be useful for our empirical exercise. Initially, in the 1920s, radio was a local phenomenon, with lots of variety in terms of content.[40] Nevertheless, an interesting and somewhat unexplored aspect of the rise of radio was the "networkization" phenomenon that occurred in the 1930s and 1940s. Starting in the late 1920s – after the creation of the first two major networks (NBC and CBS) in 1926-27 and the Radio Act of 1928, which favored consolidation as a way of organizing the allocation of the radio spectrum – and picking up speed in the 1930s and 1940s, the dominant trend was the spectacular rise of the networks that underpinned the so-called "golden age" of radio. By the late 1940s, almost all stations were affiliated to one of the four major networks, as ABC (which was spun off by NBC due to regulatory pressure) and Mutual had joined the first two. (The pattern is depicted in Figure 4.) While a full history of that process is beyond the scope of the paper (Sterling and Kittross 2002), the fact is that these networks introduced a much more homogenous content to their affiliates across the country.[41] This means that,

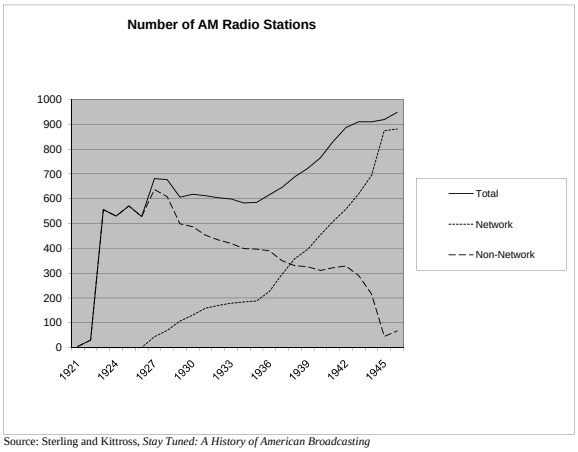
[37] According to Gerbner et al (1980, p. 19-20), "television does contribute to the cultivation of common perspectives. In particular, heavy viewing may serve to cultivate beliefs of otherwise disparate and divergent groups toward a more homogeneous "mainstream" view."

[38] The fact that radio was overtaken by TV soon thereafter as a mass media technology has made the study of its political effects relatively less salient. A prominent exception is Stromberg (2004).

[39] Prior (2007) argues that radio audience still displayed an upper-class bias when it comes to the news, which was not the case with TV. In any case, there is little doubt that radio was a mass medium with a much broader reach than newspapers: by 1938, even at the lowest level of income (below $1,000 a year) 57% of households had at least one radio set (Sterling and Kittross 2002, p. 204). Considering how radio was often a communally shared experience (Cohen 1990), this understates the true reach of the medium.

[40] This is vividly described, for the particular example of Chicago, in Cohen (1990): radio stations would often cater to specific ethnic groups, for instance.

[41] As Sterling and Kittross (2002, p. 284) describe, " the national networks exercised great power over individual affiliates. In several cases, when local radio stations wanted to substitute a local program for a network program, network officials threatened to reconsider the station's affiliation contract. (...) [S]uch threats had great effect, for network affiliation was the key to success."



Source: Sterling and Kittross, *Stay Tuned: A History of American Broadcasting*

Figure 4: The Rise of Radio Networks

while radio started as a high-variety medium, it gradually moved towards lower levels of variety.

We can thus characterize the different media involved in the episodes to be considered in our empirical exercise according to the stylized depiction in Figure 5.

## 4.2 Empirical Predictions

Figure 5 helps us interpret the transitions in media technologies in terms of the theory. Given a certain media substrate, it lets us map out whether the introduction of the new technology represents a decrease or increase in access barriers, and/or a balanced decrease or increase in variety with respect to that substrate. Note that, in our context, the substrate could well vary across different locations: for instance, TV could be introduced into a market with a strong radio presence (network or not), or into a market where radio was sparse and newspapers still dominant. Note also that we are considering a context of majoritarian elections, which means that we would describe it with Assumption (P4).

Based on that, we can spell out what are the empirical predictions we should expect to see in the data:

**Empirical Prediction 1: TV reduces polarization** The introduction of TV can be interpreted as a balanced decrease in variety, regardless of the substrate. It also represents a lowering of access barriers – or a non-increase, at the very least. In that case, both the variety and composition effects work in the same direction, unambiguously reducing polarization.

**Empirical Prediction 2: The effect of TV on turnout is ambiguous (depends on substrate)** While our main focus is polarization, of course, our theory also has predictions on the effects of media

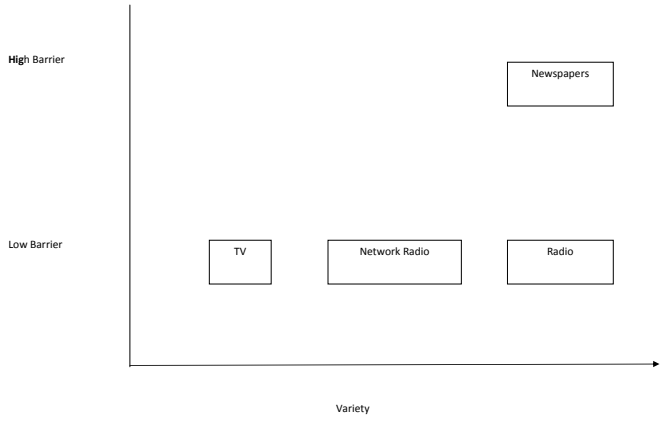



Figure 5: Media Technologies, Barriers, and Variety

on turnout. Here, for the case of TV, the prediction is more subtle. If the dominant substrate medium before TV happened to be radio, we would expect to see the variety effect in action – but not so much the composition effect. This would predict lower turnout, as lower polarization demobilized voters. On the other hand, if newspapers were dominant, one would expect to see added strength on the composition effect: newly mobilized voters turning out would counteract the former movement.

**Empirical Prediction 3: Radio reduces polarization** The introduction of radio into a substrate dominated by newspapers would represent a lowering of access barriers, and the composition effect would thus induce lower polarization. Networkization would push in the same direction, via the variety effect.

**Empirical Prediction 4: The effect of radio on turnout is ambiguous (depends on network)** As far as turnout is concerned, radio would initially increase turnout, because of the composition effect. Network radio, on the other hand, might have a negative effect as it implies a balanced decrease in variety.

### 4.3 Going to the Data: Measuring Polarization

Before taking these predictions to the data, we must first figure out a way to measure our main variable of interest, polarization. Our model ultimately refers to the behavior of politicians, which we assume to react to the preferences of constituents. One set of measures of polarization of (incumbent) politicians is the one used by McCarty et al. (2006), as exemplified above; however, since our data on media technologies are at the county level – as will be later described in greater depth – we want a measure of polarization

that also varies at that same level. This rules out those measures, which are defined at the national level. We construct such a county-level measure by resorting again to the DW Nominate scores for US House members, from Poole and Rosenthal.[42] While this is a well-established measure for ideological positions that is comparable across individuals and over time, it is available at the congressional district level, which we then need to match with the county-level information. If one district comprises more than one county (which is typically the case) we attribute the Nominate score of the district's representative to all of the counties. Due to their geographic proximity, those counties will typically be part of the same TV market (and will thus share the same date of TV introduction), but not always. In any event, we will cluster the standard errors at the level of the congressional district - by decade, since districts are redrawn based on every new Census. If one county is split over more than one district, we take the Nominate score of that county to be the simple average of all the representatives associated with it. We would like to weigh that average by the share of the county's population that belongs to each district, but we do not have that information. Because of this limitation, we will limit the sample to the set of single-district counties in our main specifications, and consider the full set of counties for robustness.[43]

Once we have the scores converted onto the county level, we need to turn them into measures of polarization. Since we only have the measure of ideological position for the incumbent, it is not possible to observe polarization *within* each county. Nevertheless, within the context of our model we can proxy for that by looking at polarization *across* counties.[44] One way to capture this is to look at a relative measure: the (absolute) difference between a county's score and the average score of all counties in that year. We call this measure "*relative polarization*". We can also think of a non-relative measure, which compares the ideological score to the standard DW Nominate benchmark of zero. We thus compute the absolute value of the county's score, and call it "*absolute polarization*". We think of this as a non-relative measure in that its benchmark does not vary over time. In that sense, it captures whether a county's preferences are moving away from the center, while the first measure captures whether they are moving away from other counties' preferences. These measures will be the main outcome variables of interest in our analysis.

In addition to these two main variables, we also consider the effect of media on the behavior of voters, which our theory suggests is the key transmission mechanism from voters' preferences to the positions

[42] We actually look at the first coordinate of DW Nominate, which is usually interpreted as a conventional left-right ideological spectrum, as distinct from the second dimension that in the US case used to capture positions with respect to racial issues. This might be relevant for the period we are looking at, which mostly precedes the Southern realignment. We have checked that our results survive when we leave the South out of the sample.

[43] Note that we have one measure per congress, i.e. two-year period.

[44] To see why this is the case, consider the influence function we have described in our model, $y = H(x, \tau)$. For simplicity of exposition, we can take the media content to be set at $\delta_m$ (which is equivalent to having a single media source). If we abuse notation to state $y = H(x; m)$ and take a 1st order Taylor expansion of $H$ around the point where $x = m$, we have $y \approx x + H'(x; x)(m - x)$. This implies $y - E[y] \approx (1 - H'(x; x))(x - E[x])$ and $y - m \approx (1 - H'(x; x)(x - m)$, and any compression of the distribution of $y$ around the local mean relative to the distribution of $x$ will be matched by a relative compression of that distribution around $m$. To the extent that $m$ is anchored by the national mean, the within-county compression is matched by an across-county compression.

taken by politicians. The voting data comes from county-level election results compiled by ICPSR (study #8611); from that we compute a measure of the "*lopsidedness*" of the election, as the (absolute) difference between Democratic and Republican shares of the vote. This can be another window onto polarization, to the extent that less polarization (in the cross-county sense) would reduce the share of Republican (resp. Democratic) vote in districts that are more Republican (resp. Democratic) than the average, thereby making elections less lopsided. Finally, we are also interested in predictions on turnout, insofar as our theory suggests that turnout and polarization are intimately related. We thus look at voter turnout (in congressional elections).[45]

### 4.4 Evidence from the Introduction of Broadcast TV

We are now ready to move on to the evidence, starting with the introduction of broadcast TV. As we have noted, the fast adoption of the new technology means that there was substantial variation over a short period of time. It was also the case that there was substantial variation across different places in terms of the timing of introduction of and the exposure to the new medium – with an additional exogenous component to this timing was generated by events that delayed introduction in markets that would have otherwise gotten TV earlier than they did.[46] Given these features, we can implement an empirical strategy along the lines of the one proposed by Gentzkow (2006) in his analysis of the effect of the introduction of TV on voter turnout.[47] In other words, we combine the use of a panel structure that controls for constant unobservable factors and controls for the level and evolution of key variables that might be related to the timing of adoption of the new technology.

For a first look at the raw data, we split the sample between counties that got access to TV relatively early (before 1951) and those that got it late. We then run a regression of the polarization variable on year-region dummies, and then calculate the mean of the residuals for each group of counties.

Figure 6 illustrates the result of the comparison for relative polarization. The key dates for the introduction of TV, 1946 (marking the end of the wartime ban on television station construction) and 1952 (the end of the FCC freeze on new television licenses), are marked as vertical lines in the plot. We see a remarkably clear decline after those periods, showing that relative polarization in those counties that got TV early dropped dramatically in comparison with the relative polarization in the latecomer counties. The downward trend starts as TV spreads in the groundbreaking counties, and picks up speed as the second group joins the fold.

This picture suggests an effect of TV on polarization, but it it is essentially about correlations. A

[45] The impact of TV and radio on turnout was studied by Gentzkow (2006) and Stromberg (2004). We will see how our results relate to their findings.

[46] These events were World War II and an FCC-imposed freeze in new operation licenses, between 1948 and 1953, due to spectrum allocation issues.

[47] Our empirical strategy for the introduction of TV closely follows Gentzkow (2006). While there is little reason to stray from his convincing and well-established strategy, our main focus is on a different variable, polarization, and a different set of predictions. As such, we will depart accordingly.

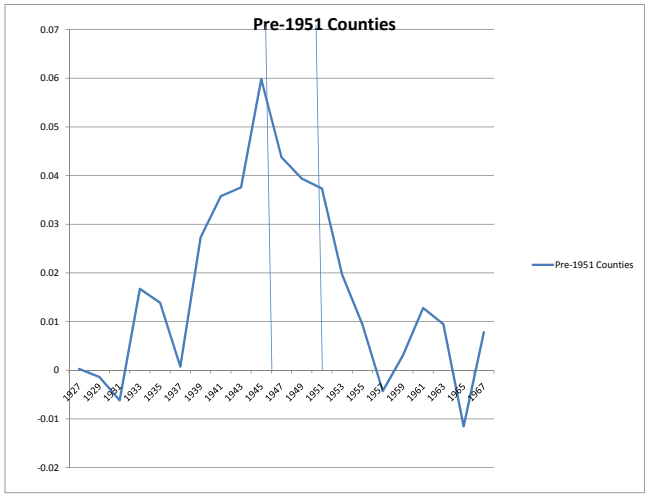



Figure 6: Polarization in Pre-1951 Counties (Relative to Post-1951 Counties)

regression analysis enables us to implement the empirical strategy we have described. This strategy translates into the following specification:

$$Y_{it} = \alpha_i + \delta_{rt} + \gamma TV_{it} + \beta X_{it} + \epsilon_{it} \tag{3}$$

where $i$ refers to county, $t$ to years and $r$ to census region. Note that we include county fixed effects and also region-year fixed effects, which let us control for unobservable time trends that we allow to vary by region. $Y_{it}$ is the outcome variable, and $X_{it}$ stands for a set of control variables. We then estimate this equation with the standard errors are all clustered at the level of congressional district.

In order to model the effect of TV, $TV_{it}$, we again follow Gentzkow (2006) in looking at the number of years since the introduction of TV in the county ("*years of TV*") – with 1946 being year zero for all counties where TV was introduced before the end of World War II, since the penetration of TV was essentially negligible until then. After all, this is the measure that encapsulates the idiosyncratic variation introduced by the exogenous freezes, and it does so less crudely than a simple dummy variable since we should expect any effect to be felt over time. Finally, we restrict our attention to the sample between 1940 and 1968, to focus on the period over which TV was being introduced.

The results in Table 1 show a negative and significant effect of TV on polarization, which is particularly strong for our measure of relative polarization. The measure is quantitatively significant: our coefficients would suggest that within the space of two decades exposure to TV would induce a decrease in relative polarization that is around one standard deviation of the relative polarization sample. Note that the even-numbered columns add a broader set of demographic controls, which include (the log of) population,

population density, percent urban, percent non-White, and percent with high-school education.[48] We obtain very similar results for relative and absolute polarization, and also for lopsidedness.[49] This is entirely consistent with our Prediction 1.

As an additional check on the robustness of the results, we can look at the full sample, including the counties that are split over more than one congressional district. This prevents us from clustering the standard errors at the level of the congressional district, and for this reason we present the results when they are clustered by county. Keeping this caveat in mind for the comparison, we can see in Table 2 that the results are essentially the same for both relative and absolute polarization. Indeed, the coefficients prove to be remarkably stable. (The results are still present, though slightly weaker, when it comes to the measure of lopsidedness.)

Having established the basic result, the next step in the strategy considers direct comparisons between counties that look alike in some observable dimension that is likely to influence the timing of introduction of TV. Similarly to a matching strategy, the idea is to check whether, say, two rural counties that just happened to differ in the timing of introduction – presumably due to exogenous reasons, for the most part – displayed different trajectories in terms of polarization. We can do so for a number of observable dimensions, splitting the sample according to terciles of those distributions; this is what Table 3 shows. In this table, each entry corresponds to the coefficient on "*years of TV*" that is obtained from running a regression such as the one in Table 1.

We can see that the signs are unfailingly negative, and generally quite significant – the few instances of non-significance are borderline (for the 10% level), with one single exception in the last line. In other words, this underscores the evidence of a negative effect of TV on polarization.[50] (The results are similar, though not as strong in terms of significance, for absolute polarization and lopsidedness.) All in all, we see robust evidence if favor of or Prediction 1.

Table 3 also lets us go a little bit further in exploring the mechanisms predicted by the theory. In particular, the differences between terciles are illuminating: the drop in polarization is quantitatively smaller in the poorer, less educated counties than in their richest, most educated counterparts. This is not what one would have expected from the composition effect, and thus seems to indicate that the drop

[48] These demographic controls are obtained from Census data, and interpolated in order to fill in for the intervening years. We have also measures of income and median age, but we do not include them because they are only available starting in the 1950s. The regressions including those yield similar results for both relative polarization and lopsidedness, but they show little effect of TV on absolute polarization. This seems to be due mostly to the drop in the sample, and not to the inclusion of the additional controls.

[49] The results for polarization are robust to excluding from the sample the period during World War II, which may be thought of as exceptional – one might argue that the war itself would have had a very strong impact on political behavior and preferences. The coefficients are slightly smaller, which is not surprising if we consider that the magnitude of the movements in polarization is considerably stronger in the 1930s and 1940s than in the 1950s and 1960s, as shown by McCarty et al (2006).

[50] Another strategy, also following Gentzkow (2006), is to control for the interaction between key demographic variables (income, the log of population) in a base year and a fourth-order polynomial in time. This lets us control flexibly for the evolution over time of variables that might have been important in determining the timing of introduction of TV. Our regression results also go through if we include these interactions, with the base year chosen to be 1960; these are available upon request.

Table 1. Effects of Years of TV on Political Outcomes, 1940-67 (Single-district counties)

| | (1) relative | (2) relative | (3) absolute | (4) absolute | (5) lopsided | (6) lopsided | (7) turnout | (8) turnout |
|---|---|---|---|---|---|---|---|---|
| Years of TV | -0.0056*** | -0.0055*** | -0.0031** | -0.0034** | -0.3336** | -0.3336* | -0.1418* | -0.0129 |
| | [0.0018] | [0.0018] | [0.0015] | [0.0014] | [0.1661] | [0.1719] | [0.0792] | [0.0796] |
| Controls | No | Yes | No | Yes | No | Yes | No | Yes |
| Observations | 27137 | 27079 | 27137 | 27079 | 26985 | 26968 | 26985 | 26968 |
| # of counties | 2909 | 2900 | 2909 | 2900 | 2955 | 2955 | 2955 | 2955 |
| R-squared | 0.072 | 0.074 | 0.068 | 0.069 | 0.137 | 0.139 | 0.615 | 0.625 |

Robust standard errors in brackets, clustered by congressional district (per decade). All regressions include county fixed effects and region-year dummies. Controls are: log population, density, percent urban, percent nonwhite, and % high school.

*** p<.01, ** p<.05, * p<.1

Table 2. Effects of Years of TV on Political Outcomes, 1940-67 (All counties)

| | (1) relative | (2) relative | (3) absolute | (4) absolute | (5) lopsided | (6) lopsided | (7) turnout | (8) turnout |
|---|---|---|---|---|---|---|---|---|
| Years of TV | -0.0055*** | -0.0052*** | -0.0023** | -0.0028*** | -0.1580 | -0.1915* | -0.2441*** | -0.0728 |
| | [0.0011] | [0.0012] | [0.0011] | [0.0010] | [0.1025] | [0.1081] | [0.0564] | [0.0587] |
| Controls | No | Yes | No | Yes | No | Yes | No | Yes |
| Observations | 29597 | 29431 | 29597 | 29431 | 29331 | 29314 | 29331 | 29314 |
| # of counties | 2966 | 2947 | 2966 | 2947 | 3002 | 3002 | 3002 | 3002 |
| R-squared | 0.064 | 0.066 | 0.065 | 0.068 | 0.112 | 0.114 | 0.622 | 0.632 |

Robust standard errors in brackets, clustered by county. All regressions include county fixed effects and region-year dummies. Controls are: log population, density, percent urban, percent nonwhite, and % high school.

*** p<.01, ** p<.05, * p<.1

Table 3. Effect of Years of TV on Relative Polarization, by Terciles

| | Lowest | Middle | Highest |
|---|---|---|---|
| *Counties partitioned by*: | | | |
| Population | -.0081*** | -.0031* | -.0044*** |
| | [.0031] | [.0017] | [.0017] |
| Population density | -.0104** | -.0037** | -.0018 |
| | [.0042] | [.0017] | [.0017] |
| Percent urban | -.0061*** | -.0039** | -.0048** |
| | [.0023] | [.0016] | [.0020] |
| Family income | -.0021 | -.0051** | -.0118*** |
| | [.0017] | [.0023] | [.0030] |
| % high school | -.0029* | -.0002 | -.0150*** |
| | [.0015] | [.0021] | [.0034] |

Table 4. Effect of Years of TV on Turnout, by Terciles

| | Lowest | Middle | Highest |
|---|---|---|---|
| *Counties partitioned by:* | | | |
| Population | -.3515*** | -.0420 | -.1500* |
| | [.1124] | [.1008] | [.0893] |
| Population density | -.2444** | -.0427 | -.0838 |
| | [.1229] | [.1025] | [.0887] |
| Percent urban | -.2359** | .0216 | -.2450*** |
| | [.1040] | [.1127] | [.0850] |
| Family income | .1916** | -.1193 | -.5880*** |
| | [.0925] | [.1037] | [.0868] |
| % high school | -.0115 | -.1001 | -.5700*** |
| | [.0968] | [.1002] | [.0937] |

in polarization might have been mostly due to the variety effect.

We can also look at the auxiliary prediction on turnout, as summarized by Prediction 2. We can look at Columns (7)-(8) of Tables 1 and 2 to see that there is evidence of a negative effect, consistent with what was found by Gentzkow (2006).[51] Our Prediction 2, however, suggests that there is something more to the effect of TV on turnout, depending on the substrate. Some of this subtlety can be seen in Table 4, which repeats for turnout the exercise that was run in Table 3 for polarization. Most interesting here is the variation across terciles. In the poorest, least educated terciles, the effect of introducing TV is much less negative than in their wealthier, more educated counterparts – in fact, there is a significant positive impact of TV on turnout in the poorest counties.[52] This is evidently consistent with the composition effect: either the drop in turnout is much smaller (and insignificant) or the impact is even positive in the least educated or poorest counties, where the impact of TV on political learning should be stronger.

However, we can test the mechanism underlying Prediction 2 more directly, by taking on the importance of the media substrate that our theory highlights. The "quasi-matching" strategy that we have used above can be directly adapted to disentangle that issue. As we have mentioned, our theory suggests that, in places where radio did not have a large presence, the effect of TV as a low-barrier medium in increasing political knowledge would have been stronger. This would actually lead to a positive effect on turnout, as more people are exposed to at least some political knowledge, or at least less negative, as these "new" participants compensate for the "old" ones whom our theory suggests might tune off because of a decrease in stakes driven by lower polarization within county.[53]

With that in mind, we run the regressions separately by quintiles of the distribution of radio penetration (measured by the share of dwellings with radio in 1940, from the Census).[54] The results for turnout (with 95% confidence intervals) are depicted in Figure 7. We see a clearly negative pattern, whereby there is a significantly positive effect of TV on turnout in the counties that had been least exposed to radio, as well as a significantly negative effect in those counties that had been most exposed. This is exactly what our theory would predict, as per Prediction 2.

We can use the same procedure for relative polarization, which is depicted in Figure 8. We do not see the same clearly monotonic profile, although there is some evidence that the effect might be more pronounced in counties with high levels of radio penetration. Since the level of variety afforded by TV is even smaller than for radio, we would expect it to trigger the variety effect everywhere. The composition effect, however, should be stronger for the counties with relatively low radio penetration. We might thus take this as yet some more evidence that the variety effect is somewhat more important than the

[51] Note that our specification is different from Gentzkow's, mainly because we do not include lopsidedness as a control variable – since we are interested in polarization as our main outcome of interest, we are led to think of it as a dependent variable. In fact, including it increases the coefficient in the turnout regressions.

[52] Gentzkow (2006) also finds that the negative effect he detects is substantially smaller in magnitude in the first tercile.

[53] These old participants might also drop out due to lower consumption of local news, as suggested by Gentzkow (2006). Our interpretation is certainly complementary to that.

[54] The quintiles are: 0-47, 47-68, 68-81, 81-88, 88-98.

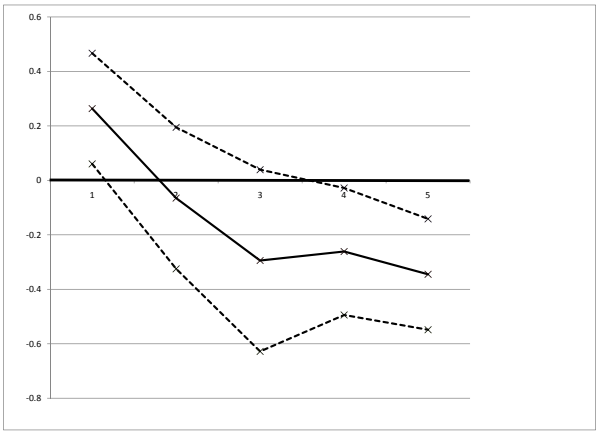



Figure 7: Effect of TV on Turnout, by Radio Penetration Quintile

composition effect, when it comes to driving the fall in polarization.

In sum, the evidence from the introduction of TV in the US points, quite robustly, at a causal effect leading to lower polarization, which is statistically significant and quantitatively important. In other words, we find support for Prediction 1. The evidence also seems to suggest that the variety effect was prominent in driving that reduction in polarization – the reduction in polarization seems weaker in the poorer, less educated counties where the composition effect would presumably be at its strongest. At the same time, there is evidence that the logic behind the composition effect is also present, as the poorer, less educated counties seem to have experienced an increase in turnout, in contrast with their richer, more educated counterparts. Finally, we also find evidence in favor of Prediction 2, as turnout increases in those places where TV represented a lowering of barriers, and decreased where it would have been mostly a decrease in variety.

### 4.5 Evidence from the Rise of Network Radio

Moving on to the radio predictions: how can we assess these in the data? What we do is collect from primary sources [*include the sources*] the location and network affiliation of all radio stations in the US, which enables us to know the number of radio stations in each county as well as the subset of those that were indeed affiliated. Data limitations restrict us to the period after 1932, since our sources did not include network affiliation before then, and we limit our attention to the period before the entry of the US into World War II, which substantially affected the radio industry across the country to an extent that makes comparisons over time difficult.[55] We also collect data on the transmission power of every

[55]In February 1942 the FCC imposed a freeze on new stations due to the wartime rationing, which lasted until August 1945. Most importantly from our perspective, the war also substantially affected content, by unleashing "programming

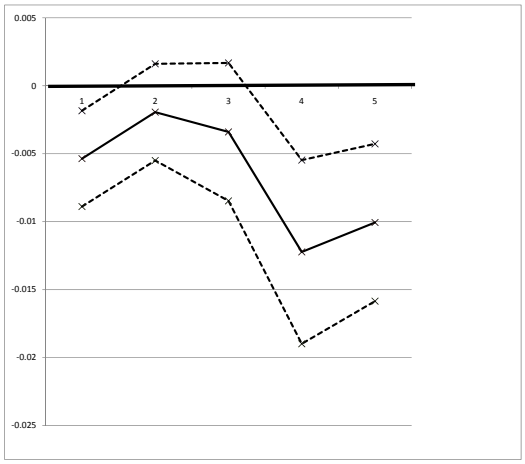



Figure 8: Effect of TV on Relative Polarization, by Radio Penetration Quintile

radio station, since their reach would vary a lot depending on that power.[56] We then weigh each station by the square root of its power – because distance reached varies with that square root. We thus end up with the power-weighted number of radio stations that are located in each county, which we term "*radio exposure*", and its network component, ("*network exposure*"). This will give us an idea of the degree of exposure to radio, and of the variety embedded in that exposure, that each county would have – albeit an imperfect one, since radio signals evidently do not stop at county lines.

While the data do not afford us the kind of identification that the introduction of TV did, it is nevertheless interesting to look at the correlations and what they say about Predictions 3 and 4. Starting with the former, Table 5 shows a negative and significant correlation between radio exposure and relative polarization, in Column (1).[57] This is entirely consistent with Prediction 3: the introduction of a low-barrier medium such as radio would be expected to be associated with lower polarization. Column (2) lets us go in greater depth into the prediction, as it shows that this correlation operates only through the exposure to network stations, both in terms of significance and size of the coefficients. Once again, this suggests a predominance of the variety effect, as was the case with the TV evidence: the composition effect should not lead to much of a difference between network and non-network radio. Note also that the

patriotism" (Sterling and Kittross 2002), which substantially blurred the distinction between network and non-network stations in terms of uniformity. Consistent with this point, including the war period does confound the empirical results.

[56]The importance of this weighting is evident from the fact that network stations were typically much more powerful, by an order of magnitude, than their unaffiliated counterparts. For instance, in 1935 the average American city would have just over 3,000 watts of power coming from its average network station, and a mere 500W coming from its average unaffiliated station.

[57]Note that we adopt the specification with all counties, as opposed to those with a single congressional district. This is because a lot of the interesting variation, when it comes to differences in network penetration, comes from large cities, which are disproportionately left out when focusing on single-district counties. On the other hand, this underscores the caveat that the variation in network exposure is far from exogenous.

Table 5. Effects of Radio Exposure on Political Outcomes, 1932-41 (All counties)

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | relative | relative | absolute | absolute | lopsided | lopsided | turnout | turnout |
| Radio Exposure | -0.00014** | | -0.00010** | | -0.0061 | | 0.0055* | |
| | [0.00006] | | [0.00005] | | [0.0040] | | [0.0030] | |
| Network | | -0.00019*** | | -0.00013*** | | -0.0015 | | 0.0055* |
| | | [0.00006] | | [0.00005] | | [0.0031] | | [0.0032] |
| Non-Network | | -0.00001 | | -0.00003 | | -0.0201 | | 0.0059 |
| | | [0.00016] | | [0.00015] | | [0.0127] | | [0.0051] |
| Observations | 10623 | 10623 | 10623 | 10623 | 10665 | 10665 | 10665 | 10665 |
| # of counties | 2521 | 2521 | 2521 | 2521 | 2574 | 2574 | 2574 | 2574 |
| R-squared | 0.22 | 0.22 | 0.23 | 0.23 | 0.08 | 0.08 | 0.48 | 0.48 |

Robust standard errors in brackets, clustered by county. All regressions include county fixed effects and region-year dummies. Controls are: log population, density, percent urban, percent nonwhite.

*** p<.01, ** p<.05, * p<.1

same pattern is true when it comes to absolute polarization, as shown in Columns (3) and (4), although the results are undistinguished when it comes to the measure of lopsidedness of elections.

When it comes to Prediction 4, on turnout, the results are less clear. Columns (7) and (8) show some evidence of a positive correlation between exposure to radio and turnout, in line with the results in Stromberg (2004). In this case, it seems that there is no particular distinction between affiliated and unaffiliated stations. The information / motivation impact of the introduction of the new medium seems to have dominated any possible negative impact on turnout that lower polarization might have induced.

In sum, and with the caveat that no causality claim is warranted from this evidence, the results are consistent with the idea that (network) radio had a similar depolarizing effect to that which TV would also have later on. Also in line with the TV results, there is also evidence that such depolarizing effect would have been attributable, to a substantial extent, to the variety effect predicted by the theory.

Broadly speaking, we have good reason to believe that the evolution of media technologies between the 1930s and 1950s had a significant role in the drop in polarization observed over that period.

# 5 Concluding Remarks

This paper has developed a framework that allows us to understand the impact of changes in media technology on the distribution of political preferences, and thus on equilibrium levels of polarization. Building on a simple model of how media exposure affects individual ideological positions, married to a model of how these affect politicians' behavior through electoral competition, we identify two different channels through which that impact takes place: the composition effect and the variety effect. The former stems from the fact that exposure to media affects the levels of information and political motivation, and hence turnout decisions. Because those levels, in turn, are generally different for ideologically moderate individuals than for those who are ideologically extreme, this affects equilibrium polarization. The latter effect arises from the influence that media technologies exert over individuals' ideological views. As a result, changes in the scope of ideological variety supplied by the media will also affect the distribution of those views, and hence polarization.

In addition to that, we provide empirical evidence, gauged from the episodes of introduction of TV and network radio in the US, that supports the prediction that these new technologies – since they implied substantial decreases in variety and increases in accessibility – would engender reductions in polarization. This suggests that the substantial reduction in polarization that occurred in the US around the mid-20th century was helped by the changes in media environment, as had been suggested for instance by Prior (2007). The evidence also enables us to try to disentangle the two effects predicted by the theory: it seems that the variety effect, namely the direct impact of the media on individuals' ideological views, was at the heart of the changes.

An important advantage of our theoretical framework is that it can be broadly applied, presumably to any changes in media technology, which we codify simply according to accessibility and variety. For instance, one could use it to think about the effects of recent changes, such as the diffusion of cable TV or the internet or even talk radio, which have all been accused of increasing polarization (Prior 2007, Bishop 2008, Sunstein 2009). In particular, our evidence that the variety effect was more important than the composition effect in explaining the effects of media technologies on polarization, for the case of radio and broadcast TV in the US, does not imply that this would be the case in other contexts. Our theory also suggests, and the data support, that the same technology could have very different effects depending on the media substrate into which it is introduced. This could be especially interesting in the context of comparing different countries: the introduction of the internet could have a very different impact when it takes place in a context dominated by a high-variety medium (say, cable TV), as is probably a good description for the US, than when the backdrop is state-owned broadcast TV. Such

cross-country comparisons are also particularly interesting in that our theory suggests that differences in political institutions will affect the effects of media – it would be worthwhile to empirically check for the predictions under a proportional representation system. We believe these are all exciting topics for future research.

By the same token, future research may also focus on exploring the implications of our model of how media affects preferences, and vice-versa. We have proposed a theory of the individuals' demand for ideological variety, and it seems natural to extend the analysis to incorporate the supply side and the equilibrium provision of variety. In the context of our model, this would involve endogenizing market variety ($M$) and the "budget" allocated to media consumption – which would include the extensive margin of choosing not to consume at all. This would connect naturally with the literature on media slant, as in Mullainathan and Shleifer (2005), towards a dynamic theory of how ideology evolves, tied to issues such as technological features and regulation (switching costs, different sources of revenue such as subscription vs advertising, etc.). These are some of the avenues that we intend to pursue.

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# A Proofs

## A.1 Variety and Ideology

**Proof of Proposition 1.**

The demand $\tau^*(z, \phi, M)$ for varieties of a consumer with ex-ante ideology $z \in X$ in a market with variety $M$ solves

$$\max_{\tau \in \Delta(M)} \quad W(z, \tau) \equiv \lambda(|z - H(z, \tau)|) - \phi(\tau).$$

The result is established by characterizing the solution to this problem.

If $z \notin \Sigma(M)$ then, regardless of $\phi(\tau)$, the optimal choice is $\tau^*(z, \phi, M) = \delta_{m^*(z)}$. Indeed, this choice achieves the smallest possible dissonance $|z - H(z, \tau)|$ across consumption plans $\tau \in \Delta(M)$ and $\phi(\tau) \geq \phi(\delta_{m^*(z)}) = 0$.

If $z \in \Sigma(M)$ there are two cases. Either the optimal consumption involves switching or not. In the first case, assumption (A1) ensures that $\tau^*(z, \phi, M)$ can be chosen so that $H(z, \tau^*(z, \phi, M)) = z$, i.e., zero dissonance. Without loss of generality, let $\lambda(0) = 0$. In general, unless $z = m$ for $m \in M$, the value of a plan that leaves a consumer's ideology unchanged is $\lambda(0) - \phi = -\phi$ (if $z = m$ no switching is required to achieve zero dissonance). The best plan without switching is $\delta_{m^*(z)}$. It follows that the optimal plan is switching iff

$$\phi \leq \lambda(|z - H(z, \delta_{m^*(z)})|) \tag{4}$$

Since $|z - H(z, \delta_{m^*(z)})|$ is an increasing function of $|z - m^*(z)|$, from (4) it follows that there exists $K(\cdot)$ is an increasing function, such that if $\phi \leq K(|z - m^*(z)|)$ then $\tau^*(z, \phi, M)$ can be chosen so that $H(z, \tau^*(z, \phi, M)) = z$. Instead, if $\phi \geq K(|z - m^*(z)|)$ then $\tau^*(z, \phi, M) = \delta_{m^*(z)}$. This, combined with our observation for $z \notin \Sigma(M)$ establishes (i) and (ii).

To show (iii), let $\Sigma(M) = [\sigma_-, \sigma_+]$. Suppose that $z \leq \sigma_-$ so that $m^*(z) = \sigma_-$. From (ii), the ex-post ideology is given by $x(z) = H(z, \delta_{\sigma_-})$ and, by assumption (A1), $H(\cdot, \cdot)$ is increasing in its first argument from which $x(z)$ is increasing for all $z \leq \sigma_-$. The case $z \geq \sigma_+$ is analogous. If $M = \Sigma(M) = \{m\}$ so that $\sigma_- = \sigma_+$, we are done. Suppose instead that $\sigma_- < \sigma_+$ and consider $z \in \Sigma(M)$. Recall that $M = \{m_1, ..., m_n\}$ with $\sigma_- = m_1$ and $\sigma_+ = m_n$, and $\Sigma(M)$ can be partitioned into subintervals of the form $\Sigma_i = [m_i, m_{i+1}]$, where each of the extremes correspond to adjacent varieties offered in the market. Note that if $z = m_i$ then $\tau^*(z, \phi, M) = m_i$ and $H(z, \tau^*(z, \phi, M)) = z$. To conclude the proof it suffices to show that $H(z, \tau^*(z, \phi, M))$ is increasing in $z$ within each $\Sigma_i$. Observe that the largest distance between a point in the interval and one of the extremes is the midpoint $z_i^{mid} = (m_i + m_{i+1})/2$ and the distance to either $m_i$ or $m_{i+1}$ is $(m_{i+1} - m_i)/2$. From (i) and (ii), we conclude that there exist $m_i^-, m_i^+ \in \Sigma(M)$ with $m_i^- < z_i^{mid} < m_i^+$ such that (i) if $z \in [m_i, m_i^-) \cup (m_i, m_i^+]$ then $\phi > K\left(|z - H(z, \delta_{m^*(z)})|\right)$, $\tau^*(z, \phi, M) = \delta_{m_i}$ for $z \in [m_i, m_i^-)$ and $\tau^*(z, \phi, M) = \delta_{m_{i+1}}$ for $z \in (m_i, m_i^+]$; (ii) if $z \in [m_i^-, m_i^+]$ then $\phi \leq K\left(|z - H(z, \delta_{m_i})|\right)$ and $\tau^*(z, \phi, M)$ is such that $H(z, \tau^*(z, \phi, M)) = z$. Clearly, $H(z, \tau^*(z, \phi, M))$ is strictly increasing in each of the intervals $[m_i, m_i^-)$, $[m_i^-, m_i^+]$, and $(m_i, m_i^+]$. Furthermore, $H(m_i^-, \delta_{m_i}) < m_i^-$ and $H(m_i^+, \delta_{m_i+1}) < m_i^+$. It follows that $H(z, \tau^*(z, \phi, M))$ is increasing on $\Sigma_i$, and thus, on $\Sigma$ as desired. ■

**Proof of Proposition 2.**

Suppose that $\phi = 0$. For each balanced market variety $M \subset X$ and $\Sigma(M) = [\sigma_-, \sigma_+]$ is the variety span. If $M$ is balanced then $\sigma_- + k = \sigma_+ - k = \widehat{x}$. Given $z \in X$ let $R_M(z) \equiv H(z, \tau^*(z, \phi, M))$ be the corresponding ex-post ideology and recall that $G_M(x) = G_0(R_M(x))$. Invoking Proposition 1(i),

$$R_M(x) = \begin{cases} H(x, \delta_{\sigma_-}) & \text{if} \quad x < \sigma_- \\ x & \text{if} \quad x \in [\sigma_-, \sigma_+] \\ H(x, \delta_{\sigma_+}) & \text{if} \quad x > \sigma_+. \end{cases}$$

To establish the result we consider an infinitesimal increase in $\sigma_-$ and one in $\sigma_+$. (Recall that for $\phi = 0$ a balanced decrease in variety amount to increasing $\sigma_-$ and decreasing $\sigma_+$ by the same amount. Assumption (A1)(H3) implies that $H(x, \delta_\sigma) < H(x, \delta_{\sigma'})$ if $\sigma' > \sigma$. It follows that $\frac{\partial H(x, \delta_\sigma)}{\partial \sigma} > 0$, from which $\frac{\partial G_M(x)}{\partial \sigma^-} = g_0(R_M(x)) \frac{\partial H(x, \delta_\sigma)}{\partial \sigma} > 0$. ■

We conclude with an intuitive lemma that follows from proposition 1 and is used in the proof of proposition 3. The proof is omitted.

**Lemma 6** *Suppose that $\phi = 0$ and fix a market with variety $M$. If $M'$ is a balanced decrease in variety with respect to $M$ then $g_{M'}(\widehat{x}) \geq g_M(\widehat{x})$ with strict inequality if $M' = \{\widehat{x}\}$.*

In words, since a reduction in variety leads to a compression of the distribution, it cannot reduce the mass of voters with the median ideology.

## A.2 Political Equilibrium: Analysis

We introduce some notation and terminology used in the proofs. Write $\epsilon$ for the set of parameters of the model. Let

$$y(z, \epsilon) = \widehat{x} - \frac{c}{2z}$$

and

$$Q(z, \epsilon) = pg(\widehat{x}) + (1-p)g(y(z, \epsilon)) - \frac{1}{2}\rho(x_{0R} - x_{0L} - z)$$

We say $x^*$ is an *interior* equilibrium of the electoral game if $x_{L0} < x_L^* < x_R^* < x_{0R}$.

**Lemma 7** *If $x^*$ is an interior equilibrium of the electoral game then $\Delta x^* = x_R^* - x_L^*$ solves $Q(\Delta x^*, \epsilon) = 0$.*

**Proof.** Each candidate's policy must satisfy a first order condition (FOC). For $L$ the FOC is

$$\frac{\partial W_L}{\partial x_L}(x_L^*, x_R^*) - \rho(x_L^* - x_{L0}) = 0.$$

Observe that under assumption (A4), $\frac{\partial W_L}{\partial x_L} = \frac{\partial V_L}{\partial x_L} - \frac{\partial V_R}{\partial x_L}$, where

$$\frac{\partial V_L}{\partial x_L} = \frac{1}{2}pg(x_{1/2}) + (1-p)g(y_L)\frac{\partial y_L}{\partial x_L} \quad \text{and} \quad \frac{\partial V_R}{\partial x_L} = -\frac{1}{2}\left[pg(x_{1/2}) + (1-p)g(y_R)\frac{\partial y_R}{\partial x_L}\right].$$

If $G$ has unbounded support, $y_L(\mathbf{x}) = x_{1/2} - \frac{c}{2(x_R - x_L)}$ and $y_R(\mathbf{x}) = x_{1/2} + \frac{c}{2(x_R - x_L)}$, from which $\frac{\partial y_L}{\partial x_L} = \frac{1}{2}\left(1 - \frac{c}{2(x_R - x_L)^2}\right)$ and $\frac{\partial y_L}{\partial x_L} = \frac{1}{2}\left(1 + \frac{c}{2(x_R - x_L)^2}\right)$. Now, for a symmetric equilibrium, we have that $x_{1/2}^* = \widehat{x}$, $x_L^* - x_{L0} = \frac{1}{2}(x_{0R} - x_{0L} - \Delta x^*)$ and, since $g$ is symmetric with respect to $\widehat{x}$, $g(y_R(\mathbf{x}^*)) = g(y_R(\mathbf{x}^*))$. Combining the previous, the FOC at an equilibrium point is

$$pg(\widehat{x}) + (1-p)g(y(\Delta x^*, \epsilon)) - \frac{1}{2}\rho(x_{0R} - x_{0L} - \Delta x^*) = 0, \tag{5}$$

or $Q(\Delta x^*, \epsilon) = 0$. ■

**Lemma 8** *$Q(\Delta x^*, \epsilon) = 0$ has a solution $0 < \Delta x^* < x_{R0} - x_{L0}$. Furthermore, the largest and smallest solutions of $Q(\Delta x^*; \epsilon) = 0$ in $[0, x_{R0} - x_{L0}]$ satisfy $\frac{\partial Q}{\partial z}(\Delta x^*, \epsilon) > 0$. These two solutions are equilibria of the electoral competition game.*

**Proof.** Observe that $Q(x_{0R} - x_{0L}, \epsilon) = pg(\widehat{x}) + (1-p)g(y(\Delta x^*, \epsilon)) \geq pg(\widehat{x}) > 0$ for all $\epsilon$. On the other hand, $y(0, \epsilon) = -\infty$, so that $g(y(\Delta x^*, \epsilon)) = 0$. It follows that $Q(0, \epsilon) = pg(\widehat{x}) - \frac{1}{2}\rho(x_{0R} - x_{0L} - \Delta x^*)$. From assumption (P6), $Q(0, \epsilon) < 0$. Since $Q(0, \epsilon) < 0$, $Q(x_{0R} - x_{0L}, \epsilon) > 0$, and $Q$ is continuous in its first argument, we conclude by the intermediate value theorem that $Q(z^*; \epsilon) = 0$ for some $z^* \in (0, x_{R0} - x_{L0})$.

Since $Q(0, \epsilon) < 0$, for the smallest solution $Q(z^*; \epsilon)$ crosses the zero from below. Similarly, since $Q(x_{0R} - x_{0L}, \epsilon) > 0$, the same is true for the largest solution. It follows that $\frac{\partial Q}{\partial z}(\Delta x^*, \epsilon) > 0$ where $\Delta x^*$ is either the largest or smallest solution of $Q(\Delta x^*, \epsilon) = 0$.

Finally, observe that $Q(\Delta x^*, \epsilon) = 0$ follows from the candidates' necessary FOC. For the case of the smallest and largest solution it can be shown that this FOC is associated with the unique best response for each candidate. ■

**Lemma 9** *Given the c.d.f. $G$ and the corresponding p.d.f.g let $r_G(x,y) = \frac{g(x)-g(y)}{G(x)-G(y)}$. If $g$ is log-concave then $r_G(x,y) \leq \frac{g'(y)}{g(y)}$ for all $y \leq x$.*

**Proof.** $r_G(x,y) \leq \frac{g'(y)}{g(y)}$ for all $y \leq x \Leftrightarrow S(x,y) \equiv (G(x)-G(y))\, g'(y) - g(y)\,(g(x)-g(y)) \geq 0$ for all $y \leq x$. Note that $S(y,y) = 0$. Differentiating $S(x,y)$ with respect to $x$ we get $S_x(x,y) = g(x)g'(y) - g(y)g'(x)$. This is strictly positive for $x \geq y$ as long as $g$ is log-concave. ■

**Proof of Proposition 3**
(i) From lemma 7, an interior equilibrium satisfies $Q(\Delta x^*, \epsilon) = 0$. It follows that $\frac{\partial \Delta x^*}{\partial p} = -\frac{\partial Q}{\partial p} / \frac{\partial Q}{\partial z}$. For the highest and lowest equilibrium $\frac{\partial Q}{\partial z} > 0$ (Lemma 8) Hence, if $\frac{\partial Q}{\partial p} < 0$. then $\frac{\partial \Delta x^*}{\partial p} > 0$. Now,

$$\frac{\partial Q}{\partial p} = g(\widehat{x}) - g(y(\Delta x^*, \epsilon)) > 0.$$

Similarly,

$$\frac{\partial Q}{\partial c} = -(1-p)g'(y(\Delta x^*, \epsilon))\frac{1}{\Delta x^{*2}},$$

which is less than zero if $g$ is increasing at $y(\Delta x^*, \epsilon)$.
(ii) As argued in the main text, letting $\Delta G = G(y_R(\mathbf{x}^*)) - G(y_L(\mathbf{x}^*))$ and $y' = \frac{\partial y(\Delta x^*, \epsilon)}{\partial z} = \frac{c}{2\Delta x^{*2}} > 0$ for short,

$$\frac{\partial V^*}{\partial p} = \Delta G + 2(1-p)g(y(\Delta x^*, \epsilon))y' \frac{\partial \Delta x^*}{\partial p}$$

and, from (i), letting $\Delta g = g(\widehat{x}) - g(y(\Delta x^*, \epsilon))$,

$$\frac{\partial \Delta x^*}{\partial p} = -\frac{\partial Q}{\partial p} / \frac{\partial Q}{\partial z} = -\frac{\Delta g}{(1-p)g'(y(\Delta x^*, \epsilon))y' + \frac{1}{2}\rho}.$$

Thus, $\frac{\partial V^*}{\partial p} > 0$ iff

$$\begin{aligned}
&\Leftrightarrow \quad \left((1-p)g'(y(\Delta x^*, \epsilon))y' + \frac{1}{2}\rho\right)\Delta G - 2(1-p)g(y(\Delta x^*, \epsilon))y'\Delta g \geq 0 \\
&\Leftrightarrow \quad (1-p)y'\left[\frac{g'(y(\Delta x^*, \epsilon))}{g(y(\Delta x^*, \epsilon))} - 2\frac{\Delta g}{\Delta G}\right] + \frac{1}{2}\rho \geq 0 \\
&\Leftrightarrow \quad (1-p)y'\left[\frac{g'(y(\Delta x^*, \epsilon))}{g(y(\Delta x^*, \epsilon))} - r_G(\widehat{x}, y(\Delta x^*, \epsilon))\right] + \frac{1}{2}\rho \geq 0
\end{aligned}$$

where $r_G(x,y) = \frac{g(x)-g(y)}{G(x)-G(y)}$ and we used $G(y_R(\mathbf{x}^*)) - G(y_L(\mathbf{x}^*)) = 2\,(G(\widehat{x}) - G(y))$. The latter follows from symmetry. By Lemma 9, $\frac{g'(y)}{g(y)} - r_G(x,y) \geq 0$ and the expression above is positive as desired. ■

**Proof of Proposition 4.**
Let $M$ be the market's ideological variety and $G_M$ be the associated distribution of citizens' ideologies. If $M$ is balanced with respect to $\widehat{x}$, the market variety span can be expressed as $\Sigma(M) = [\widehat{x}-k, \widehat{x}+k]$ for some $k > 0$. The variety span is entirely determined by $k$, with larger $k$ associated with more variety, we write $M = M_k$. If $M_{k'}$ is a balanced decrease in variety with respect to $M_k$ then $k' < k$. To establish (i) we show that an decrease in $k$ is associated with an decrease of the equilibrium polarization level $\Delta x^*(k)$ for the (smallest and largest equilibrium) or, equivalently, $\Delta x^*(k)$ is increasing in $k$.
(i) From Lemma 7 we have that the equilibrium level of polarization $\Delta x^*(k)$ satisfies $Q(\Delta x^*(k), \epsilon) = 0$, where

$$Q(z, \epsilon) = pg_{M_k}(\widehat{x}) + (1-p)g_{M_k}(y(z, \epsilon)) - \frac{1}{2}\rho(x_{0R} - x_{0L} - z)$$

Since $\frac{\partial Q}{\partial z} > 0$ for the smallest and largest equilibrium, $\Delta x^*(k)$ increases with $k$ if $Q(z,\epsilon)$ deceases with $k$. From Lemma 6 $g_{M_k}(\widehat{x}) \leq g_{M_{k'}}(\widehat{x})$ if $k' < k$. The corresponding change in $g_{M_k}(y(z,\epsilon))$ has an ambiguous sign. However, for $p$ large enough the conclusion follows.
(ii) As illustrated in the main text the direct effect of the compression induced by the decrease in market variety is to reduce turnout as, all else equal, those who do not turnout are precisely the moderates with low motivation. The indirect effect derives from the change in turnout associated to the change in platforms. From (i), this movement promotes moderation by the candidates which, in turn, is associated with lower turnout by moderate citizens with low motivation. ■

### A.2.1 Proportional Representation

Under Assumption (A4') we can introduce definitions similar to the ones used for the analysis of electoral competition under Assumption (A4) to obtain the comparative statics we are interested in. As before let $\epsilon$ be the parameters of the model and define $\gamma = \frac{g(\widehat{x})}{|x_{0R}-x_{0L}|\rho}$. The analogues of $y(\cdot,\cdot)$ and $Q(\cdot,\cdot)$ defined above are given by

$$\begin{aligned} y(z,\epsilon) &= \widehat{x} - \frac{c}{2|x_{0R}-x_{0L}|}\frac{1}{z} \text{ and} \\ \Gamma(z;\epsilon) &= \gamma\left[1+\tfrac{1-p}{p}\frac{g(y(z,\epsilon))}{g(\widehat{x})}\right] - (1-z)\left[1+\tfrac{1-p}{p}\frac{G(y(z,\epsilon))}{G(\widehat{x})}\right]. \end{aligned}$$

The proofs of the following two Lemmas parallel those of Lemmas 7 and 8, and are thus omitted. They are available upon request.

**Lemma 10** *If $x^*$ is an interior equilibrium of the electoral game then $\Delta^* = \frac{x_R^*-x_L^*}{x_{R0}-x_{L0}}$ solves $\Gamma(\Delta^*;\epsilon) = 0$.*

**Lemma 11** *$\Gamma(\Delta^*;\epsilon) = 0$ has a solution $\Delta^* \in (0,1)$. Furthermore, the largest and smallest solution of $\Gamma(\Delta^*;\epsilon) = 0$ satisfy $\frac{\partial\Gamma}{\partial z}(\Delta^*;\epsilon) > 0$. These two solutions correspond to equilibria of the electoral competition game.*

**Proof of Proposition 5.**
(i) From lemma 10, an interior equilibrium satisfies $\Gamma(\Delta^*;\epsilon) = 0$. It follows that $\frac{\partial\Delta^*}{\partial p} = -\frac{\partial\Gamma}{\partial p}/\frac{\partial\Gamma}{\partial z}$. For the highest and lowest equilibrium $\frac{\partial\Gamma}{\partial z} > 0$ (Lemma 11.) Hence, if $\frac{\partial\Gamma}{\partial p} < 0$. then $\frac{\partial\Delta^*}{\partial p} > 0$. Now,

$$\frac{\partial\Gamma}{\partial p} = \frac{1}{p^2}\left(-\gamma\frac{g(y(\Delta^*,\epsilon))}{g(\widehat{x})} + (1-\Delta^*)\frac{G(y(\Delta^*,\epsilon))}{G(\widehat{x})}\right).$$

From $\Gamma(\Delta^*;\epsilon) = 0$ we have that $\frac{\gamma}{1-\Delta^*} = \frac{1+\frac{1-p}{p}\frac{G(y(\Delta^*,\epsilon))}{G(\widehat{x})}}{1+\frac{1-p}{p}\frac{g(y(\Delta^*,\epsilon))}{g(\widehat{x})}}$ so the above expression becomes

$$\frac{\partial\Gamma}{\partial p} = \frac{(1-\Delta^*)\left(1+\frac{1-p}{p}\frac{G(y(\Delta^*,\epsilon))}{G(\widehat{x})}\right)}{p^2}\left(-r\left(\frac{g(y(\Delta^*,\epsilon))}{g(\widehat{x})}\right) + r\left(\frac{G(y(\Delta^*,\epsilon))}{G(\widehat{x})}\right)\right)$$

where $r(z) \equiv \frac{z}{1+\frac{1-p}{p}z}$. Our hypothesis that on the log-concavity of $G$ implies that $\frac{g}{G}$ is decreasing. Since $y(\Delta^*,\epsilon) < \widehat{x}$, we have that $\frac{g(y(\Delta^*,\epsilon))}{g(\widehat{x})} > \frac{G(y(\Delta^*,\epsilon))}{G(\widehat{x})}$. Since $r(\cdot)$ is increasing we conclude that $\frac{\partial\Gamma}{\partial p} < 0$.
(ii) As argued in the main text, the direct effect of an increase in $p$ on turnout is positive. In addition, from (i) we have that the indirect effect on turnout (which arises from the change in platforms) as an increase in polarization $\Delta^*$ without changing $x_{1/2} = \widehat{x}$ leads to higher turnout from citizens with low political motivation. ■

# B Switching costs and ideological compression

Let us explore in greater depth the model of media and ideology in Section 2.3, for a general level of switching costs, $\phi$. Note first that, regardless of $\phi$, if $M = X$ then $G_{M,\phi} = G_0$, as a result of proposition 1. In other words, if all ideologies are available, the distribution will not be affected by the media, as individuals can always find a perfect match for their initial view. (If $\phi \equiv 0$ this equality remains if the much weaker condition $\Sigma(M) = X$ holds, as in this case individuals can always combine existing media to construct an exact match.) By the same token, if there is minimal variety ($M = \{m\}$), then $G_{M,\phi}$ is independent of $\phi$ as well. Furthermore, if $m = \widehat{x}$ where $\widehat{x}$ is the median of $G_0$ then $G_{M,\phi}$ is a compression of $G_0$. We can thus see that, in going from one extreme of complete variety to the other of minimal variety, our intuition is confirmed regardless of $\phi$. However, the following example illustrates how monotonicity is not guaranteed in general, as depending on $\phi$ a relatively low supply of ideological variety can either compress or disperse the ideologies of citizens.

**Example 2** *Suppose that $X = [-1, 1]$ and assume the market has two ideological varieties, $m_1 = -1/2$ and $m_2 = 1/2$, i.e., $M = \{-1/2, 1/2\}$. This implies that $\Sigma(M) = [-1/2, 1/2]$. The distribution of prior ideologies $G_0$ is a symmetric triangle distribution with support $X$, it's median is $\widehat{x} = 0$. For concreteness we consider the linear influence function given by (1).*

*For $\phi = 0$, from proposition 1 (i) and (1), we have that the support of the new distribution becomes $\left[-\frac{1}{2} - a\frac{1}{2}, \frac{1}{2} + a\frac{1}{2}\right]$ and*

$$R_{M,\phi}(x) = \begin{cases} \frac{x-(1-a)(-\frac{1}{2})}{a} & \text{if} \quad x \in \left[-\frac{1}{2} - a\frac{1}{2}, -\frac{1}{2}\right) \\ x & \text{if} \quad x \in [-1/2, 1/2] \\ \frac{x-(1-a)(\frac{1}{2})}{a} & \text{if} \quad x \in \left(\frac{1}{2}, \frac{1}{2} + a\frac{1}{2}\right]. \end{cases}$$

*Using this and (2) it's easy to verify that the distribution $G_{M,\phi}$ is a compression of $G_0$.*

*Assuming $\phi$ is large enough so that 1(ii) holds for all ideologies, we have that the support of the new distribution is the union of the intervals $\left[-\frac{1}{2} - a\frac{1}{2}, -(1-a)\frac{1}{2}\right]$ and $\left[(1-a)\frac{1}{2}, \frac{1}{2} + a\frac{1}{2}\right]$, and*

$$R_{M,\phi}(x) = \begin{cases} \frac{x-(1-a)(-\frac{1}{2})}{a} & \text{if} \quad x \in \left[-\frac{1}{2} - a\frac{1}{2}, -(1-a)\frac{1}{2}\right] \\ \frac{x-(1-a)(\frac{1}{2})}{a} & \text{if} \quad x \in \left[(1-a)\frac{1}{2}, \frac{1}{2} + a\frac{1}{2}\right]. \end{cases}$$

*In contrast to the case $\phi = 0$, $G_{M,\phi}$ is a dispersion of $G_0$.*

The example suggests that if a society or group of consumers is initially deprived from media access and then gains access to a relatively low-variety media environment, their preferences may become more or less concentrated, depending on the cost $\phi$. For instance, the introduction of a duopoly of newspapers with different editorial lines could be associated with a dispersion if conscientious readers are a negligible fraction (say, due to subscription pricing or spatial segregation in the distribution), or with a compression if the opposite holds. Note also that the example suggests that, with negligible switching costs, the model does exhibit the monotonicity property, which does not apply to the model with high costs.

Table A1. Effect of Ideological Extremism on Likelihood of Watching Both Fox News and MSNBC

| | (1) | (2) | (3) |
|---|---|---|---|
| Extremism | -0.1112 | -0.1402* | -0.1534* |
| | [0.0803] | [0.0813] | [0.0859] |
| Demographic Controls | | Yes | Yes |
| State FEs | | | Yes |
| Observations | 617 | 616 | 603 |
| R-Squared | 0.003 | 0.043 | 0.095 |

Probit regressions, robust standard errors in brackets. All regressions include as controls the response to the question on attention to hard news (*hardnews*) and individual ideology (*ideo*). The measure of extremism is defined as the absolute value of (*ideo* – 2), since 2 is the value that corresponds to "moderate". Demographic controls are: sex, marital status and race dummies, age, education, income. The sample includes only individuals who answered "Regularly" or "Sometimes" to the question of how often she watches Fox News or CNN or MSNBC, and excludes individuals who did not answer one of the demographic questions.
*** p<.01, ** p<.05, * p<.1
Source: Pew Research Center for the People and the Press, *April 2008 Media Survey: Audience Segments in a Changing News Environment: Key News Audiences Now Blend Online and Traditional Sources* (Aug 17, 2008).