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THE LIMITS OF PROPAGANDA:  
EVIDENCE FROM CHAVEZ'S VENEZUELA

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### **ABSTRACT**

In this paper, we investigate viewer responses to changes in the ideological content of television programming using variation induced by cadenas, unannounced takeovers of the public television airwaves by the government in Venezuela. Using high-frequency ratings data, we find that, consistent with the predictions of our choice model, the drop-off in ratings during cadenas is concentrated among viewers of news programming on opposition private channels, as opposed to viewers of news on pro-government public channels. Also consistent with the predictions of our model, the drop-off in ratings for private channels with moderate ideology takes an intermediate value. In addition, the drop-off is stronger for viewers with access to cable channels, which are not required to air cadenas. Consistent with this result, we also show that viewership of an opposition cable channel rises during cadenas. Complementing this analysis, we then estimate the parameters of the theoretical model in a structural analysis. Using these parameter estimates, we consider counterfactual scenarios, allowing for an examination of the dynamic responses of viewers of differing ideology to cadenas and an analysis of the welfare consequences of cadenas.

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# 1 Introduction

The media is often considered essential in the functioning of democracy via the provision of information to voters. At the same time, there is a temptation for incumbent governments to use media outlets to deliver political propaganda. This propaganda can be used by the government, among other ways, to promote its policies, increase its standing with the population in advance of elections, and to criticize opposition leaders and parties. If influential, propaganda may lead to moral hazard, via poor monitoring of incumbents by voters, and the re-election of low quality politicians and parties.

Sophisticated consumers of information may respond to such propaganda in a variety of ways. One possibility involves viewers discounting biased information.<sup>1</sup> A second possibility involves viewers switching to other media outlets that are not delivering government propaganda.<sup>2</sup> With a preference for like-minded information, this second possibility is particularly relevant for consumers affiliated with the opposition. Given that the second option will only be available in media sectors that are pluralistic, a third possibility involves consumers simply “tuning out”, or consuming less information overall across all media outlets. Like the second option, tuning out may be especially relevant for the opposition.

In this paper, we focus on these two latter responses, switching to outlets with like-minded content and tuning out. By their very nature, these responses can limit the influence of propaganda. Given that, as noted above, both switching and tuning out may be especially common among the opposition, then propaganda, if influential, may lead to an increased polarization of the electorate. Likewise, we examine whether or not switching and tuning out are more common among individuals with a larger choice set. If so, and given that higher income individuals typically have larger choice sets, polarization according to income may also increase, with the poor disproportionately exposed to and influenced by propaganda.

While Durante and Knight (2012) investigate, in the Italian context, switching over several years, we investigate these issues, both switching and tuning out, using high-frequency television ratings data from the country of Venezuela, where Hugo Chavez and his successor have routinely used *cadenas*, speeches by government officials that are required to be aired live by all broadcast television channels. Thus, during a *cadena*, viewers watching television face the same programming on every broadcast channel. Importantly, these *cadenas* are not announced in advance to viewers, providing an experiment through which to examine short-run responses, in terms of changes in viewership, to government propaganda. In addition, *cadenas* were not required to be aired by cable channels during our sample period, allowing us to examine whether households with

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<sup>1</sup>See Chiang and Knight (2011).

<sup>2</sup>See Durante and Knight (2012).

larger choice sets are more likely to switch to other outlets when faced with propaganda. Finally, broadcast channels in Venezuela during our sample period cover the political spectrum and can be naturally categorized as either opposition or pro-government. This allows us to examine whether switching and tuning out are more common among opposition viewers, who, as we document using survey data, are more likely to watch opposition news programming.

To develop a set of testable hypotheses, we begin by building a simple model of consumer choice of television programming. In the model, there are two types of consumers, opposition and pro-government, both with a preference for like-minded information, two types of channels, opposition and government, and two types of programming, news and cadenas. We begin by assuming that both channels are required to air cadenas and thus initially focus on tuning out. The model predicts that, with positive switching costs and a preference for like-minded news, the drop-off in viewership when transitioning from news to cadena is more significant for the opposition channel than for the pro-government channel. This is due to the selection of opposition viewers into news programming on the opposition channel and the selection of pro-government viewers into news programming on the government channel. Introducing a third channel, which is moderate in nature, the model predicts that the drop-off in ratings when moving from news programming to cadenas should be most significant for the opposition channel, followed by the moderate channel, followed by the government channel. Finally, we consider an extension of the model to allow for switching via a cable channel, which is not required to air cadenas, and this extension provides two additional predictions. First, the model predicts that the drop-off in viewership on the private network, relative to the public network, should be more significant for households with access to cable, when compared to households without cable. Second, cable viewership, due to its role as an outside option, should be higher during the airing of cadenas on broadcast channels, relative to when cadenas are not aired on broadcast channels.

We then test these predictions using data on television ratings from Venezuela. These data cover the years 2006 and 2007 and are high-frequency in nature (i.e. day-by-day and show-by-show). Consistent with the first prediction of the model, we find that the drop-off in viewership when transitioning from news programming to cadenas is more significant for the opposition channel than for the government channel. Consistent with the second prediction of the model, we find that the drop-off in viewership for news programming on the moderate channel takes an intermediate value, between that of opposition channels and that of government channels. Next, focusing on the outside option, we find that, consistent with switching, cable viewership rises during cadenas and the drop-off in viewership is more significant for those with access to cable.

Complementing this analysis, we also estimate the underlying structural parameters of the model; these include switching costs and the value of ideological information. Using these parameter estimates, we document the dynamic viewer responses to cadenas, which lead, for example, to

a persistent reduction in viewership among opposition viewers watching opposition channels. We also use the parameter estimates to conduct a normative analysis, in which we measure the welfare costs of cadenas to opposition and pro-government viewers.

The paper proceeds as follows. Section 2 provides a discussion of the relevant literature. Section 3 provides an overview of the key institutional details. Section 4 develops our key hypotheses in the context of a simple choice model. Section 5 describes the data, and Section 6 provides our results. Section 7 provides the structural estimates and counterfactual exercises. Finally, Section 8 offers a brief conclusion.

## 2 Related Literature

This paper contributes to several literatures on media bias. Several studies have documented a preference for like-minded news. These include Gentzkow and Shapiro (2010), Durante and Knight (2012), Martin and Yurukoglu (2015), and Gentzkow et al. (2014). One difference between our study and this literature involves the frequency of responses. While these studies tend to study long-run relationships between the choice of media outlets and consumer ideology, our paper measures high-frequency, short-run changes in media consumption associated with a preference for like-minded news. Given inertia, it is possible that short-run responses are much smaller than long-run responses.

In addition, there is a literature that examines the influence of media bias on political outcomes. These include DellaVigna and Kaplan (2007), Enikolopov et al. (2011), George and Waldfogel (2003), Chiang and Knight (2011), Gentzkow et al. (2011), Gerber et al. (2009), Martin and Yurukoglu (2015), and Snyder and Stromberg (2010). See DellaVigna and Gentzkow (2010) and Prat and Stromberg (2013) for a comprehensive overview of this literature. To the extent that viewers self-select into channels with like-minded ideological content and to the extent that such ideological content is influential, then government propaganda may lead to increased polarization in the electorate, with those already inclined to support the government being disproportionately exposed to and influenced by propaganda.

There is also a related literature focused on government propaganda disseminated by mass media. DiTella et al. (2012) study the effects of government propaganda against privatization of water services after the 2006 nationalization in Argentina, finding that the effect is large and significant for households that had not experienced expansions in the water network during the period of privatization. Qian and Yanagizawa-Drott (2013) document an increase in U.S. news coverage of human rights abuses in countries not aligned with the U.S. when they rotated onto the U.N. Security Council during the Cold War, with opposite effects, a reduction in coverage, for countries aligned with the U.S. They report similar patterns for reports produced by the U.S. State

Department, suggesting an important role for government propaganda. Other literature focuses on the power of propaganda to mobilize the masses. Welch (1993) and Adena et al. (2015) document the importance of political propaganda to mobilize support for the Nazis, and Yanagizawa-Drott (2014) provides evidence on the role of propaganda broadcast on radio by the Hutu government during the Rwandan genocide. Finally, DellaVigna et al. (2014) document an instance in which propaganda had negative consequences: cross-border exposure to Serbian radio among Croats is associated with anti-Serbian sentiment and anti-Serbian behavior.

### **3 Institutional Context**

This section covers the political career of Hugo Chavez, the role of the opposition during Chavez's time in office, and the role of television in the political system of Venezuela. This section draws upon Wilpert (2007), Corrales and Penfold (2011), Nelson (2009), Republica Bolivariana de Venezuela (2012) and Dinneen (2012).

In 1998, the leftist candidate Hugo Chavez won the presidential elections in Venezuela with 56 percent of the vote. Chavez promised a "Bolivarian revolution" designed to lessen social exclusion, poverty and government corruption. Chavez was re-elected in 2000, 2006, and 2012, and he served as President until his death in 2013.

Since the beginning of Chavez's time in office, the right-wing opposition was committed to removing him from power. In April 2002, the opposition led a coup, which failed a few days after some initial successes. Later that year, during December 2002, the opposition organized a national strike in the oil industry aimed at toppling Chavez. Then, in 2004, the right-wing coalition tried to remove Chavez from power via a Presidential recall referendum, which ultimately failed, with 59 percent of voters supporting Chavez.<sup>3</sup>

During these confrontations, the private media sector tended to side with the opposition. For example, private television channels tended to cover only anti-government protests during the coup and pointed to the government as the cause of violence in the struggle between Pro-Chavez and Anti-Chavez protesters. Once Chavez returned to power, private channels stopped broadcasting news, and a Chavez speech was aired in split-screen to broadcast anti-Chavez protests in parallel with the speech by Chavez. During the strike, the media gave priority to this issue for more than two months, often suspending regular programming for more extensive coverage of the crisis. Even when the protests were significantly weakened, some private media commentators continued to call for Chavez's resignation in order to end the crisis.

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<sup>3</sup>Chang-Tai et al. (2011) document that voters who supported the Presidential recall referendum against Chavez experienced a significant reduction in earnings and employment following the public release of a list of voters who signed the recall petition.

During these events, tensions between the private media and government were at their peak, with Chavez referring to major private television channels (Venevision, RCTV, Globovision and Televen) as the "four Horsemen of the apocalypse", and, more generally, his language against the private media became very aggressive.<sup>4</sup> In 2004, before the recall referendum, Chavez met with the owner of Venevision, leading to a warming in relations between the channel and President Chavez.<sup>5</sup> Then, Televen followed the initiative to moderate their anti-Chavez tone around the same period.<sup>6</sup> However, Globovision and RCTV (Radio Caracas Television), the oldest and largest television station, remained in opposition to the government.

This partitioning of private channels into opposition (RCTV and Globovision) and moderate (Televen and Venevision) is consistent with media monitoring during the 2006 Presidential elections. In particular, EU-EOM (2006) document that RCTV and Globovision devoted a majority of their coverage to the opposition party, whereas Televen and Venevision devoted a majority of their coverage to Chavez's party. Not surprisingly, the main public channel, VTV, also devoted disproportionate coverage to Chavez's party. Similar patterns were found with respect to the tone of the coverage, with positive coverage of the opposition and negative coverage of Chavez on RCTV and Globovision. Coverage of both Chavez and the opposition by Televen and Venevision, by contrast, was largely positive in nature. Finally, coverage of Chavez on the main public channel VTV was primarily positive, with decidedly negative coverage of the opposition.

In May 2007, the broadcasting license of RCTV expired and was not renewed by the government, and RCTV was replaced overnight by TVES, a government-run channel. The government's rationale for closing RCTV had two key components: alleged violations of broadcast laws and their coverage of the coup and the strike in the oil sector. Later that year, during July 2007, RCTV re-emerged as a cable channel under the name RCTV International.<sup>7</sup>

In addition to not renewing the broadcast license of RCTV, Chavez attempted to influence the media via government channels and cadenas, speeches by government officials that must be aired live by all non-cable (i.e. broadcast) channels and which are not announced in advance to stations or viewers.<sup>8</sup> Bisbal (2009) estimates that 1,731 cadenas were broadcast between 1999 and June 2008, totaling over 1,000 hours. According to Kitzberger (2010) and Reporters Without Borders (2003), cadenas are used by Chavez to mobilize supporters, criticize and threaten adversaries, and

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<sup>4</sup>Chavez accused the private channels publicly of : "inciting rebellion and disrespect for legitimate institutions and authorities", "broadcasting false, misleading or biased news reports", "harming the reputation and good name of persons or institutions" and promoting "subversion of public and social order." See Reporters Without Borders (2003).

<sup>5</sup>New York Times (2007).

<sup>6</sup>See Besley and Prat (2006) for an analysis of government capture of the media sector.

<sup>7</sup>RCTV International was later shut down, closing in 2010.

<sup>8</sup>In addition to cadenas, Chavez also hosts a public television program titled "Alo Presidente", where he promoted the Bolivarian revolution. The show started at 11 am every Sunday and lasted about 5 hours (Kitzberger (2010)). Frajman (2014) argues that Alo Presidente was a "grand stage for Chavez to promote his position as revolutionary leader and be cheered by crowds of loyal supporters".

more generally, for political campaigning.

## 4 Theoretical Model

This section develops a simple theoretical model to provide a set of hypotheses for the empirical analysis of ratings data. In addition, the model provides a framework for the structural analysis to follow. We begin with the simple case of only two types of viewers (opposition and pro-government), two channels (opposition and government), and two types of programming (news and cadenas). In extensions of the model, we then introduce a third channel, which is moderate in nature, and then separately consider how the results differ with the presence of a cable channel that is not required to air cadenas.

### 4.1 Baseline case

Viewers, indexed by  $v$ , are of two types: pro-government ( $g$ ) and opposition ( $o$ ). Let the fraction of each type in the population be given by  $\pi_g$  and  $\pi_o = 1 - \pi_g$ , respectively.

News stations, indexed by  $i$ , are also of two types: government ( $g$ ) or opposition ( $o$ ). Each outlet offers news programming ( $p = n$ ), and both outlets are also required to carry cadenas ( $p = c$ ).

Viewers differ in the degree to which they value news programming. For pro-government types, the value of government news is  $\theta_s$  and the value of opposition news is  $\theta_d$ , where we assume that viewers prefer same-ideology news over different-ideology news (i.e.,  $\theta_d < \theta_s$ ). For opposition types, by contrast, the value of government news is  $\theta_d$  and the value of opposition news is  $\theta_s$ . Cadenas are assumed to have pro-government content and thus provide payoffs of  $\theta_d$  to opposition types and  $\theta_s$  to pro-government types. Then, letting  $u_{vip} \in \{\theta_d, \theta_s\}$  represent these systematic payoffs, viewer  $v$  receives the following overall payoff from watching programming  $p$  on station  $i$ :

$$U_{vip} = u_{vip} + \varepsilon_{vip}$$

where  $\varepsilon_{vip}$  is assumed to be distributed type-1 extreme value.

We next consider a scenario in which both stations are airing news and viewers have three options: 1) watching the government station, 2) watching the opposition station, and 3) watching neither (which yields a systematic payoff of zero). Then, letting  $\sigma_{in}$  be the market share on channel  $i$  when both channels are airing news programming, we have the following market shares:

$$\sigma_{gn} = \pi_g \frac{\exp(\theta_s)}{1 + \exp(\theta_s) + \exp(\theta_d)} + \pi_o \frac{\exp(\theta_d)}{1 + \exp(\theta_s) + \exp(\theta_d)}$$

$$\sigma_{on} = \pi_g \frac{\exp(\theta_d)}{1 + \exp(\theta_s) + \exp(\theta_d)} + \pi_o \frac{\exp(\theta_s)}{1 + \exp(\theta_s) + \exp(\theta_d)}$$

Now, suppose that the government airs a cadena and that this is not anticipated by viewers (that is, viewers do not account for the cadena when choosing whether or not to watch news). For simplicity, assume that viewers who are not watching news (the third option described above) do not come back to watch the cadena on either of the two channels. Also, assume a switching cost of  $\eta > 0$  so that viewers will not change the channel when the cadena comes on the air. That is, with a positive switching cost and identical programming, no viewers will switch between channels. Instead the only margin involves whether or not to watch the cadena. Then, let the fraction of pro-government viewers who choose to watch the cadena, conditional on watching the news on that channel, be given by  $p_g = \exp(\theta_s)[1 + \exp(\theta_s)]^{-1}$  and the analogous fraction for opposition viewers is given by  $p_o = \exp(\theta_d)[1 + \exp(\theta_d)]^{-1}$ , where  $p_o < p_d$  since  $\theta_d < \theta_s$ .

Then, we have that market shares for cadenas on the two stations are given by:

$$\sigma_{gc} = \pi_g \frac{\exp(\theta_s)}{1 + \exp(\theta_s) + \exp(\theta_d)} p_g + \pi_o \frac{\exp(\theta_d)}{1 + \exp(\theta_s) + \exp(\theta_d)} p_o$$

$$\sigma_{oc} = \pi_g \frac{\exp(\theta_d)}{1 + \exp(\theta_s) + \exp(\theta_d)} p_g + \pi_o \frac{\exp(\theta_s)}{1 + \exp(\theta_s) + \exp(\theta_d)} p_o$$

Then, define the drop-off in viewership moving from news to cadena, for government and opposition channels, respectively, as  $\Delta^o = \ln \left[ \frac{\sigma_{oc}}{\sigma_{on}} \right]$  and  $\Delta^g = \ln \left[ \frac{\sigma_{gc}}{\sigma_{gn}} \right]$ . Given the log transformation, these measures can be interpreted as the percentage reduction in viewership on a given channel when moving from news programming to cadenas.

We first compare the drop-off in viewership on opposition and government channels in the following proposition:

**Proposition 1:** *With positive switching costs ( $\eta > 0$ ) and a preference for like-minded news ( $\theta_d < \theta_s$ ), the drop-off in viewership moving from news to cadena is more significant for the opposition channel than for the government channel. That is,  $\Delta^o < \Delta^g$ .*

We provide proofs of all Propositions in the Appendix. The intuition for this proposition is simply that opposition viewers, relative to pro-government viewers, are more likely to watch opposition news, relative to government news. Moreover, these opposition viewers also have a distaste for the content of the cadena, relative to pro-government viewers. Given all of this, viewers of opposition news are more likely to tune out when a cadena comes on the air.

## 4.2 Moderate Channel Extension

We next extend the model to allow for a third channel, which is assumed to air moderate news. For simplicity, assume that both opposition and pro-government voters get a payoff of  $\theta_m$  from watching news programming on this channel, with  $\theta_d < \theta_m < \theta_s$ . Then, again comparing the drop-off in viewership across the channels, we have the following proposition:

**Proposition 2:** *With positive switching costs ( $\eta > 0$ ) and a preference for like-minded news ( $\theta_d < \theta_m < \theta_s$ ), we have that drop-off in viewership for the moderate channel lies in between the opposition and the government channel. That is,  $\Delta^o < \Delta^m < \Delta^g$ .*

The intuition for this proposition is simply that the moderate channel attracts a less polarized audience for its news programming, whereas the opposition channel disproportionately attracts opposition viewers and the government channel disproportionately attracts pro-government viewers. Thus, the drop-off in viewership for the moderate channel takes an intermediate value, when compared to the government and opposition channels.

## 4.3 Cable Extension

To investigate the possibility of switching to other outlets in a pluralistic media environment, we next allow for a cable channel, which is assumed to be linked to the opposition and is not required to air cadenas. In the context of this extension, we investigate two questions. First, due to the presence of this new opposition channel, is the drop-off in viewership, when moving from opposition news to cadena, more significant for those viewers with cable than for those viewers without cable? Second, consistent with switching, does cable viewership increase during cadenas?

Given the empirical application to the cable channel RCTV International, we assume here that cable also has opposition news, yielding a payoff of  $\theta_d$  to pro-government viewers and  $\theta_s$  to opposition types. Now, suppose that the government unexpectedly decides to air a cadena. As above, assume that viewers who are not watching do not come back to watch the cadena. Also, as above, assume a switching cost of  $\eta > 0$  so that viewers will not change the channel when the cadena airs. Finally, for simplicity, we assume that viewers do not switch from cable to either the opposition or the government channel when the cadena comes on the air. They can switch from one of the broadcast stations to cable but must incur the switching cost. Then, we have the following result with respect to the drop-off measures considered above:

**Proposition 3:** *With positive switching costs ( $\eta > 0$ ) and a preference for like-minded news ( $\theta_d < \theta_s$ ), the drop-off in viewership on the opposition channel, relative to the government channel, for viewers with cable is larger than for viewers without cable. That is,  $\Delta^o - \Delta^g$  falls when cable is introduced.*

The intuition for Proposition 3 is that, in addition to turning off the television, opposition view-

ers with access to cable now have another attractive outside option, switching to watch opposition news on cable during the cadena. Given this, even fewer viewers of opposition news will watch the cadena.

Finally, we consider how viewership of cable changes when a cadena comes on broadcast television, and we have the following result.

**Proposition 4:** *With positive switching costs ( $\eta > 0$ ), a preference for like-minded news ( $\theta_d < \theta_s$ ), and a cable option, viewership of cable rises during the cadena.*

The logic behind Proposition 4 is straightforward. Since opposition viewers value cable as an outside option, viewership of cable programs rises during cadenas.

To summarize, the theoretical model makes four predictions. First, the drop-off in viewership when moving from news to cadenas should be more significant on private channels, when compared to the government channel. Second, the drop-off in viewership on moderate channels should take an intermediate value, between the opposition channel and the government channel. Third, the drop-off in viewership for the opposition channel, relative to the government channel, should be more significant for those with access to cable. Fourth, cable viewership should rise during cadenas.

## 5 Data

Our data on television ratings were purchased from AGB Nielsen Media Research Venezuela and include broadcast ratings of each television show aired on each channel, from January 1, 2006 to December 31, 2007, separately for the four largest metropolitan areas (Caracas, Barquisimeto, Maracaibo and Valencia). Our analysis considers the most significant channels, those discussed in Section 2. In particular, and as shown in Table 1, we focus on four private broadcast channels, one of which is news only (Globovision) and three of which mix news and entertainment (Televen, RCTV, and Venevision), one public channel, Venezolana de Television (VTV), and one cable channel, RCTV International.<sup>9</sup> In addition to analyzing aggregate ratings for each show, channel, and metropolitan area, we also test Proposition 3 by employing measures of ratings separately for those with and without cable subscriptions. Likewise, our structural analysis uses gender-specific ratings. In constructing our measure of ratings for each show we use the Average Minute Rating (AMR) measure, and, given their very low ratings, ignore shows aired between midnight and 6am. Finally, we also group show types into three categories: news, entertainment and cadenas.<sup>10</sup>

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<sup>9</sup>This information is consistent with EU-EOM (2006), which shows that VTV and Globovision devoted greater time to political information during 2006 elections and the private channels RCTV, Venevision, and Televen devoted far less time to political information.

<sup>10</sup>In particular, news programs includes the categories “Information/Opinion” and “Documentaries”. Entertainment includes “Sports”, “Entertainment”, “Children”, “Games”, “Micro-series”, “Miniseries” “Movies” “Series” and “Soap

As described in Section 2, television in Venezuela during the sample period is considered to be highly polarized. This political polarization allows us to create three categories for the channels based upon their ideology, as discussed above. While the main public channel (VTV) is assumed to be pro-government, private channels are split into opposition (RCTV and Globovision) and moderate (Venevision and Televen). During the part of the analysis focused on ratings of broadcast channels, we focus on data from the period prior to the closing of RCTV in May 2007 in order to have a consistent set of channels. During 2006 and 2007, a total of 229 cadenas were aired on broadcast television.

Table 1: Channels Analyzed

<b>Name</b>	<b>Programming</b>	<b>Ideology</b>	<b>Coverage</b>	<b>Period</b>
RCTV	News & Entertainment	Opposition	National	Until May 27, 2007
VENEVISION	News & Entertainment	Moderate	National	Whole period
TELEVEN	News & Entertainment	Moderate	National	Whole period
GLOBOVISION	News Only	Opposition	Caracas & Valencia	Whole period
VTV	News & Entertainment	Government	National	Whole period
RCTV International	News & Entertainment	Opposition	Cable	Starting July 16, 2007

Key to our identification strategy is the assumption that viewers are not aware of cadenas in advance. The law does not require the government to pre-announce cadenas, and our understanding is that cadenas are not pre-announced in practice. Nonetheless, it is still possible that viewers can predict the airing of cadenas to the extent that they follow regular patterns. We investigate this issue by analyzing the distribution of cadenas across days, their starting time, and their duration. As shown in Figure 1, while cadenas are most commonly aired on Wednesdays, followed by Tuesdays, Thursdays, and Fridays, cadenas may appear on any day of the week, and there is not a noticeable spike on any particular day. Likewise, as shown in Figure 2, while cadenas are most commonly aired during prime time (i.e. between 7pm and 10pm), cadenas can occur at nearly any hour. In addition, as shown in Figure 3, while many cadenas start at the top of the hour, they can also begin at any minute within the hour. Finally, the duration of cadenas is difficult to predict. As shown in Figure 4, cadenas can be either very short in duration, less than 30 minutes, or very long in duration, in excess of four or even five hours. To summarize, there is not a specific pattern in terms of the timing of cadenas, and there is thus an important element of surprise for the viewer, who can

Operas”; Finally, we leave the category “cadenas” as is.

be exposed to these interruptions by the government at any time, without anticipating the day, the hour, the minute, or the length of the interruption.

Figure 1: Day of the week of cadenas

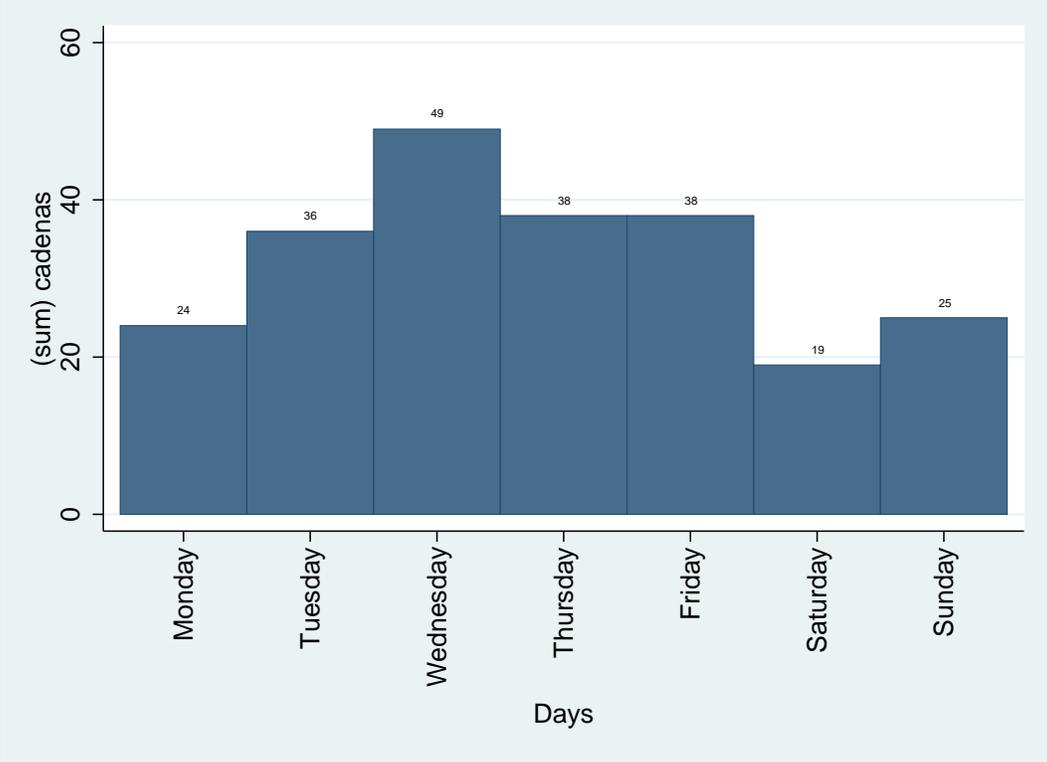


Figure 2: Starting hour of cadenas

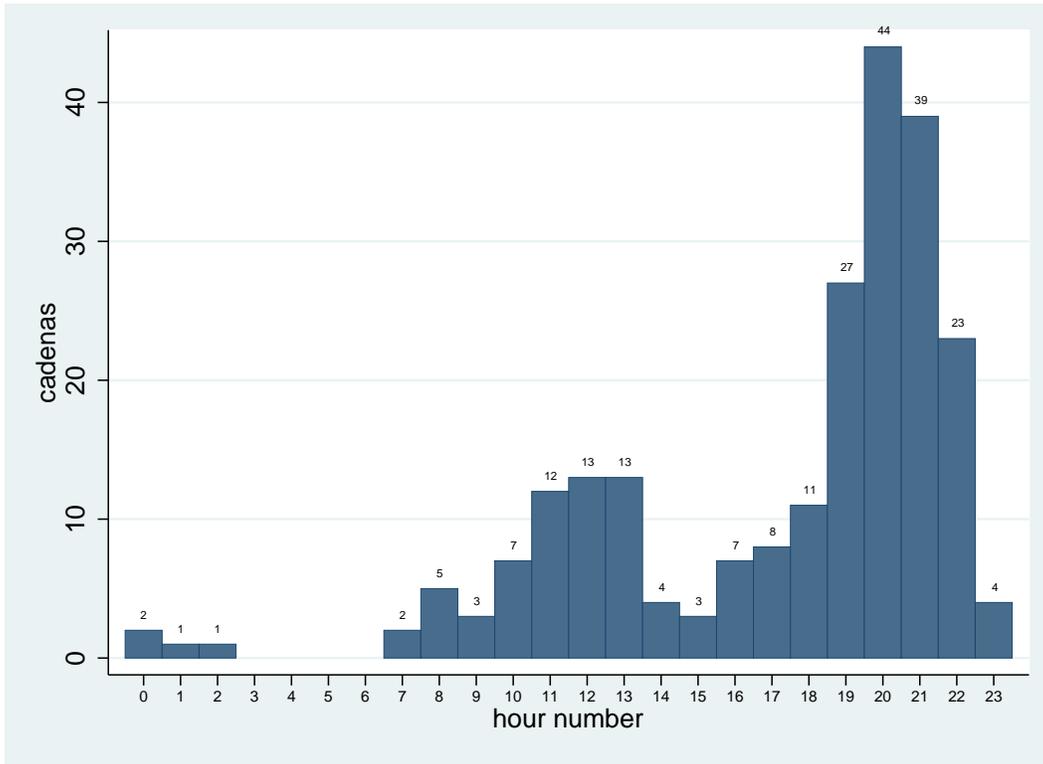


Figure 3: Starting Minute of cadenas

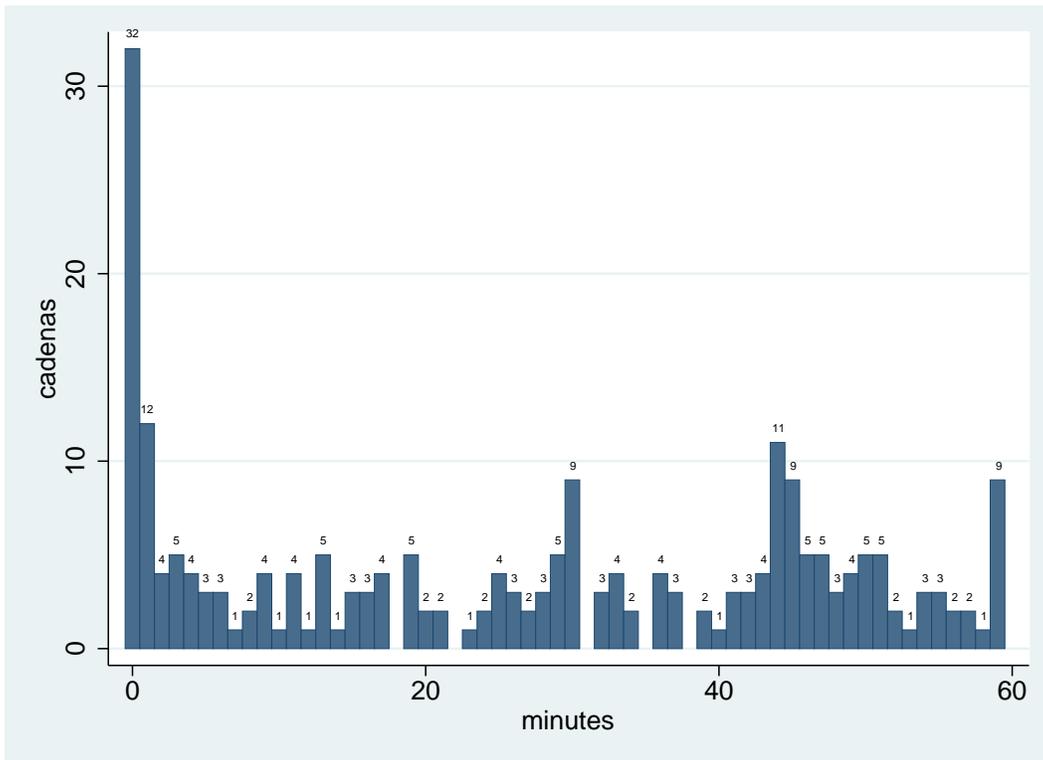
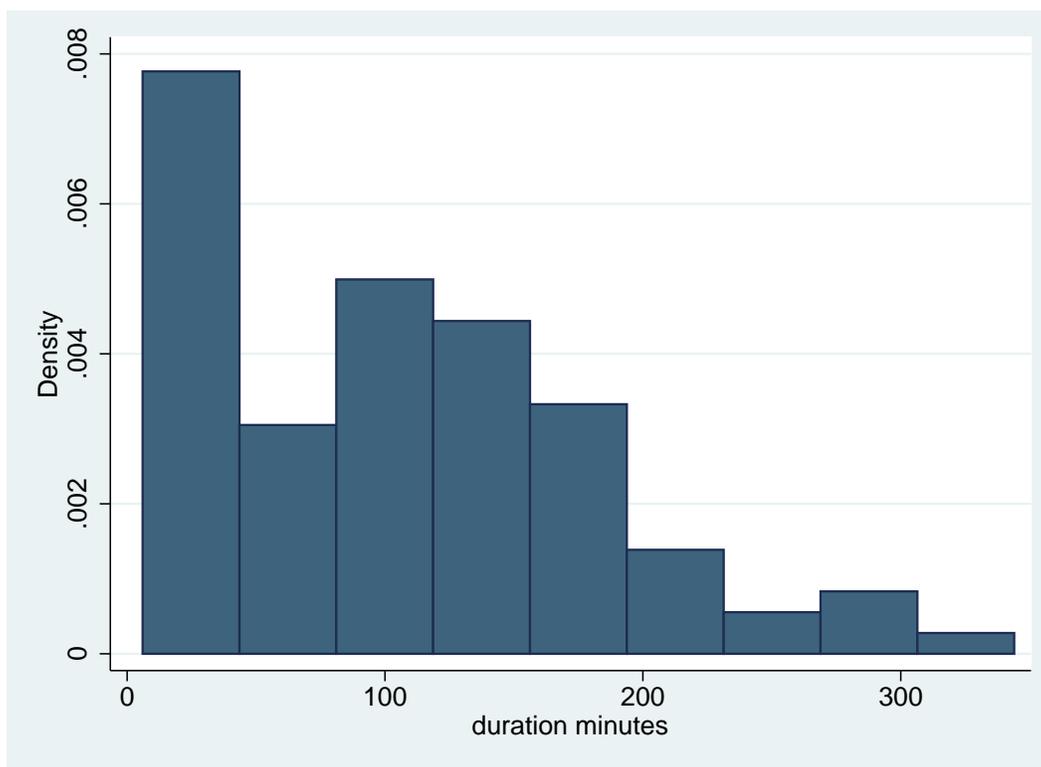


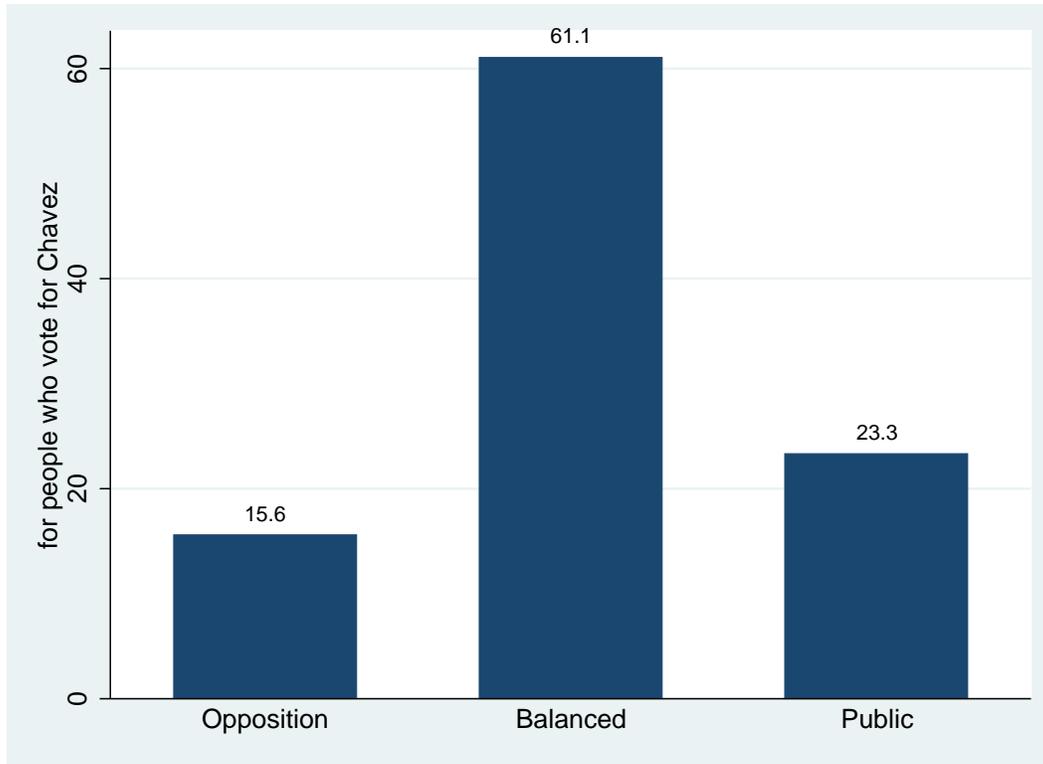
Figure 4: Duration in Minutes of cadenas



A key mechanism in our model is a preference for like-minded news, implying that opposition viewers are more likely to watch opposition news and that pro-government viewers are more likely to watch news on public channels. Unfortunately, our ratings data do not have any measures of viewer ideology. Instead, to examine this issue, we have analyzed data from the Latin American Public Opinion Project (LAPOP) Survey, conducted during 2007 for Venezuela. The survey includes questions about political preferences and media consumption for a total of 1,510 Venezuelan citizens. In particular, LAPOP asks respondents which candidate they voted for in the last election and the channel they watch most often for news. For the purposes of this analysis, we group the channels into opposition (RCTV and Globovision), moderate (TVES and Venevision), and public (VTV). As shown in Figure 5, respondents who voted for Chavez have a greater propensity to choose public and moderate channels and are unlikely to watch opposition channels RCTV and Globovision. For respondents who voted for the opposition, by contrast, the patterns are reversed. In particular, and, as shown in Figure 6, these respondents have a very low propensity of watching the public channel, and a majority report watching news on either RCTV or Globovision. To summarize, Chavez supporters are roughly 10 times more likely than opposition supporters to watch VTV, and opposition supporters are roughly three times more likely than Chavez supporters to watch opposition channels. This provides support for our maintained assumption of a preference

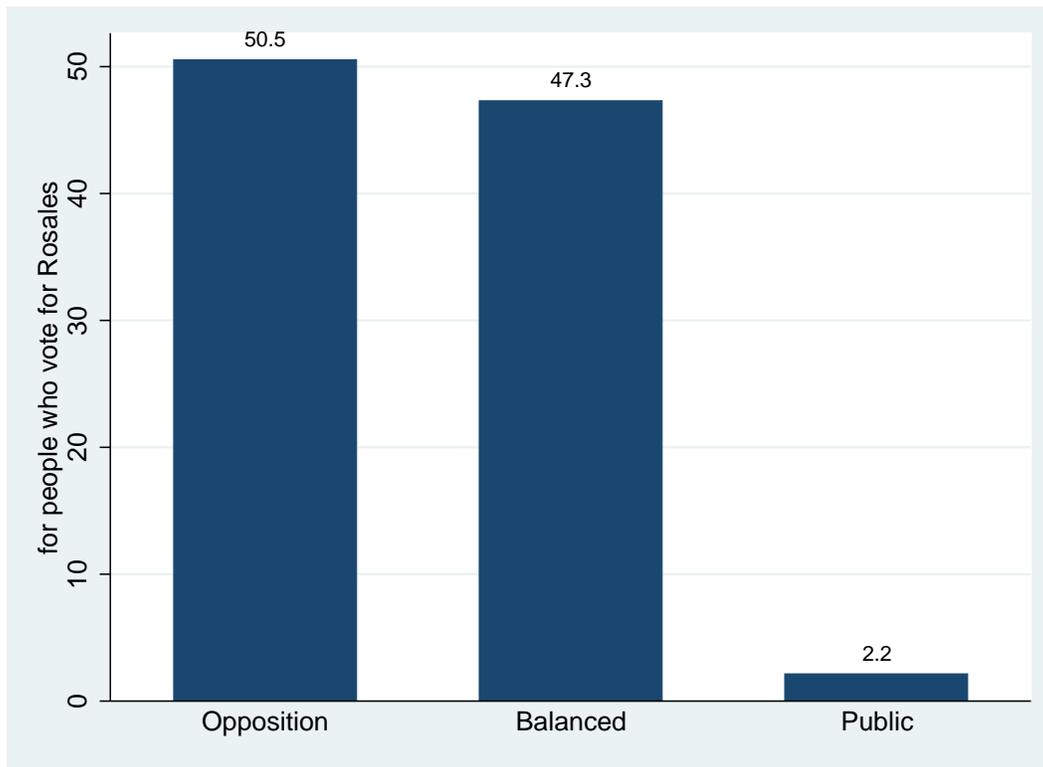
for like-minded news.<sup>11</sup>

Figure 5: Favorite News Channels for Chavez Supporters



<sup>11</sup>Likewise, using other measures of political preferences, not reported here, we find that people who watch news on public channels report higher levels of trust in Chavez than people who watch private channels.

Figure 6: Favorite News Channels for the Opposition



## 6 Analysis of Ratings data

In this section, we test the key hypotheses of the theoretical model in an investigation of viewer responses to political propaganda via cadenas in Venezuela during 2006 and 2007, a key period during Chavez's time in office.

### 6.1 Drop-off: News to Cadena

Our econometric analysis begins with an investigation of how ratings change when a cadena interrupts news programming depending upon the political orientation of the station, under the assumption that viewers prefer to watch like-minded news. Given, as shown above, that opposition viewers have a higher probability of watching opposition news channels and under the assumption that opposition viewers dislike cadenas, we expect viewers of opposition news to be more likely to tune out when cadenas are aired on television, relative to viewers of pro-government news.

As argued above, we hypothesize that viewers watching the opposition news program will respond more strongly to cadenas when compared to viewers watching news programming on government channels. To test this hypothesis, we estimate the following econometric model of

viewer responses to cadenas:

$$\Delta^i = \ln \left[ \frac{s_{ic}}{s_{in}} \right] = \beta_i + \varepsilon_i \quad (1)$$

where  $s_{ic}$  represents the measured rating for a cadena aired on channel  $i$  and  $s_{in}$  is the ratings for the previous news program aired on channel  $i$ . That is, consistent with the theoretical predictions, the drop-off in viewership is measured as the log difference in the rating between cadenas and the previous news program for each cadena aired between January 2006 and May 2007.<sup>12</sup> On the right-hand side,  $\beta_i$  is a channel-specific constant. To test Proposition 1, we use a dummy variable that takes the value of 1 for a private channel and the value of 0 for a public channel. To test the second Proposition, we employ a set of dummy variables based on political ideology of the station (i.e. opposition, moderate and public). Then, we estimate a more flexible specification that uses a separate dummy variable for each channel. Finally,  $\varepsilon_i$  represents the unobserved determinants of the drop-off in ratings on channel  $i$ .

We begin with a simple comparison of private and public channels, where public channels are the omitted category. Thus, the results are interpreted as reflecting drop-off for the private channel relative to the public channel. As shown in the first column of Table 2, the coefficient on private channels is negative and statistically significant, documenting that airing cadenas after news programming on private channels, relative to the public channel, generates a decrease of around 45 percent in viewership. This provides support for Proposition 1, which predicted that the drop-off in viewership should be more significant for private channels than for public government channels.

Next, in the second column, we use three categories for the channels based upon their ideology: opposition, moderate, and public, where the latter is the omitted category. The coefficients are also large in magnitude and statistically significant for the two categories, opposition and moderate, relative to the public channel. The coefficients in the second column demonstrate that viewers of news on the opposition and moderate channels, relative to viewers of the public channel, are more likely to turn off the television when a cadena is aired. That is, consistent with Hypothesis 2, which predicted that the drop-off for moderate channels should take an intermediate value, the change in viewership for moderate channels is 19 percentage points higher than the public channel but is 35 percentage points lower than the opposition channels. Finally, in the third column of Table 2, we present the results separately for each channel, where the effects should again be considered relative to the public channel VTV. As shown, and for all channels, we find a statistically significant reduction of viewership, relative to the change in viewership of VTV, when a cadena is aired. Consistent with the results in the second column, the effect of switching to an outside option is most significant for Globovision and RCTV, the most extreme channels in terms of the their

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<sup>12</sup>For this analysis we drop cases where the gap between the end time of the news and the start time of the cadena exceeds 10 minutes.

opposition to the government.

Overall, these results are consistent with Propositions 1 and 2, which predict that viewers of news on private channels are more likely to turn off the television during cadenas and that the drop-off on the moderate channels during cadenas lies between the opposition channels and the public channel. This behavioral response of shifting to an outside option associated with unanticipated exposure to ideological content that is not like-minded in nature suggests that the impact of political propaganda may be limited. The results are in line with theories of television program choice, which predict that people select television content in order to satisfy their preferences (Youn (1994), Durante and Knight (2012) and Yao et al. (2014)), while, at the same time, suggesting that inertia in television viewership is incomplete (see Moshkin and Shachar (2002), Goettler and Shachar (2001) and Perretti and Esteves-Sorenson (2012)).

Table 2: Drop-off in Ratings: News to cadena

Variable	Change in Ratings	Change in Ratings	Change in Ratings
<i>Private</i>	-0.4456*** (0.0672)		
<i>Opposition</i>		-0.5403*** (0.0732)	
<i>Moderate</i>		-0.1858*** (0.0898)	
<i>Globovision</i>			-0.5902*** (0.0807)
<i>RCTV</i>			-0.3598*** (0.101)
<i>Televen</i>			-0.2701*** (0.1253)
<i>Venevision</i>			-0.1125*** (0.1083)
<i>Constant</i>	0.195*** 0.0504	0.195*** (0.0504)	0.195*** (0.0505)
Observations	807	807	807

Public Channel VTV is the base outcome for all columns. Robust standard errors in brackets; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

## 6.2 Other transitions

For comparison purposes, we next extend the analysis to investigate the effect of the reverse experiment: transitioning from cadenas to news programs. While the formal model did not consider this possibility, it is natural to conjecture that the results should go in the opposite direction, with

viewership of news rising on private, relative to public, following a cadena. As shown in Table 3, the coefficient in the first column is positive and statistically significant, documenting that private channels do experience an increase in viewership of 23 percent, relative to the public channel, when cadenas are followed by a news program. As shown in columns 2 and 3, the effect is driven by opposition channels, especially Globovision, which is the only channel that has a statistically significant coefficient, re-enforcing the idea that viewers of the opposition channel search for ideological content similar to their own ideology. Overall, these results are consistent with notion that viewers have preferences for watching like-minded political content.

Table 3: cadena to News

Variable	Change in Ratings	Change in Ratings	Change in Ratings
<i>Private</i>	0.2283*** (0.0695)		
<i>Opposition</i>		0.3029*** (0.0721)	
<i>Moderate</i>		-0.0889 (0.1531)	
<i>Globovision</i>			0.3606*** (0.0751)
<i>RCTV</i>			-0.0691 (0.1678)
<i>Televen</i>			-0.0008 (0.2989)
<i>Venevision</i>			-0.1431 (0.1588)
<i>Constant</i>	-0.1495*** (0.0404)	-0.1495*** (0.0405)	-0.1495*** (0.0405)
Observations	1014	1014	1014

Public Channel VTV is the base outcome for all columns. Robust standard errors in brackets; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

For comparison purposes, we also analyze the change in viewership when moving from news to an entertainment program.<sup>13</sup> As shown in Table 4, we find that private channels, relative to the public channel, generate a statistically significant 45 percent increase in ratings when moving

<sup>13</sup>News audiences are typically smaller than those of entertainment (Webster (1984) and Webster and Newton (1988)), and Prior (2005) documents that many people abandon news for entertainment because they prefer entertainment programming.

from a news program to an entertainment program. This is similar in magnitude to the result for the drop-off when moving from news to cadenas, suggesting that our results may be about viewership of news on different channels per se rather than political ideology. On the other hand, it is not clear that entertainment programming on public channels is comparable to entertainment programming on private channels, which is very popular in Venezuela. Moreover, as shown in column 2 and 3, the effects are similar for opposition and moderate channels. The similarity of these results for entertainment across these private channels of differing ideology suggests that our baseline results are driven, at least in part, by channel ideology, rather than other characteristics of news programming on different channels.

Table 4: News to Entertainment

<b>Variable</b>	<b>Change in Ratings</b>	<b>Change in Ratings</b>	<b>Change in Ratings</b>
<i>Private</i>	0.4519*** (0.0228)		
<i>Opposition</i>		0.4148*** (0.0244)	
<i>Moderate</i>		0.4713*** (0.0237)	
<i>Globovision</i>			0.1208*** (0.0345)
<i>RCTV</i>			0.5238*** (0.0246)
<i>Televen</i>			0.4055*** (0.0289)
<i>Venevision</i>			0.5207*** (0.0238)
<i>Constant</i>	-0.2390*** (0.0214)	-0.2390*** (0.0214)	-0.2390*** (0.0214)
<b>Observations</b>	<b>17721</b>	<b>17721</b>	<b>17721</b>

Public Channel VTV is the base outcome for all columns. Robust standard errors in brackets; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Finally, in Table 5, we examine the drop-off in rating when entertainment programs are interrupted by a cadena. We again find similar results to those in the analysis of a change in content from news to cadenas. Nevertheless, as shown in column 2, the results are again similar for opposition and moderate channels, and, as shown in column 3, the results are economically significant for all

four private channels. Taken together, the results for Table 4 and Table 5 suggest that our baseline results relating to channel ideology are not driven by other channel-specific characteristics.

Table 5: Entertainment to cadena

Variable	Change in Ratings	Change in Ratings	Change in Ratings
<i>Private</i>	-0.4371*** (0.1604)		
<i>Opposition</i>		-0.4160*** (0.1615)	
<i>Moderate</i>		-0.4479*** (0.1609)	
<i>Globovision</i>			-0.5953 (0.5371)
<i>RCTV</i>			-0.4131** (0.1614)
<i>Televen</i>			-0.4760*** (0.1632)
<i>Venevision</i>			-0.4200*** (0.1612)
<i>Constant</i>	0.3853** (0.1596)	0.3853** (0.1597)	0.3853** (0.1598)
Observations	1505	1505	1505

Public Channel VTV is the base outcome for all columns. Robust standard errors in brackets; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

### 6.3 Cable Television

We next consider Propositions 3 and 4 in the context of cable channels, which were not required to broadcast cadenas. Given this, Proposition 3 predicts that the disproportionate drop-off in viewership on the private channel, relative to the public channel, should be more significant for households with cable subscriptions, relative to households without cable subscriptions. Likewise, Proposition 4 predicts that viewership of cable should rise during cadenas, and we test this prediction using data from RCTV International, which began as a cable channel during July 2007.

In terms of Proposition 3, we begin by estimating the following regression:

$$\Delta^i(cable) - \Delta^i(nocable) = \beta_i + \varepsilon_i \quad (2)$$

where the drop-off in viewership is now measured separately for cable and non-cable households, and, according to Hypothesis 3, the coefficient for private channels, relative to public channels, should be negative.

Table 6: drop-off for Cable versus no Cable

<b>Variable</b>	<b>Difference between cable and no cable</b>	<b>Difference between cable and no cable</b>	<b>Difference between cable and no cable</b>
<i>Private</i>	-0.2001* (0.1099)		
<i>Opposition</i>		-0.1385 (0.1191)	
<i>Moderate</i>		-0.3811** (0.1708)	
<i>Globovision</i>			-0.1974 (0.1345)
<i>RCTV</i>			0.0409 (0.1660)
<i>Televen</i>			-0.4493* (0.2357)
<i>Venevision</i>			-0.3280 (0.2221)
<i>Constant</i>	-0.1218 (0.0775)	-0.1218 (0.0776)	-0.1218 (0.0777)
<b>Observations</b>	<b>632</b>	<b>632</b>	<b>632</b>

Public Channel VTV is the base outcome for all columns. Robust standard errors in brackets; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

As shown in Table 6, and consistent with Proposition 3, the drop-off in ratings for those with cable, relative to households without cable, is indeed more significant for private channels, relative to public channels. In columns 2 and 3, we break out this effect by type of channel, finding that the effect is somewhat larger and only statistically significant for moderate channels and is driven in large part by Televen. Taken together, these results demonstrate that the opposition may be exposed to political propaganda to an even lesser degree when a source of opposition programming remains available during cadenas. This implies that viewers who are not able to afford cable, especially those already inclined to support the government, are disproportionately exposed to propaganda. Moreover, to the extent that cable subscribers are of higher income, this finding suggests that political polarization may also increase according to income.

Using ratings data from RCTV International, a cable channel created following the closing of RCTV on broadcast television, we next test Proposition 4, which predicts that RCTV cable ratings should rise during cadenas as viewers use this channel as a source of opposition programming. In particular, we estimate the following regression specification:

$$\Delta^{RCTV} = \beta_1 \text{Change in cadena Overlap} + \varepsilon \quad (3)$$

where the left-hand side variable ( $\Delta^{RCTV}$ ) is the percentage change in ratings for a program airing on RCTV International, when compared to the previous program aired on RCTV International. To compute the key right-hand-side variable, we first compute cadena overlap for each RCTV cable show. Cadena overlap is defined as the fraction of minutes for which the RCTV cable show overlapped with a cadena. Thus, cadena overlap varies between zero and one, where the former value is attained if there is no cadena aired at any point of the show, and the latter value is attained if the show overlaps entirely with a cadena. Taking first differences of cadena overlap, we then compute the change in cadena overlap, which ranges in value from negative one to plus one. For this analysis, we use the sample from July 2007 to December 2007, the period in which RCTV is aired on cable.

As shown in Table 7, and consistent with Proposition 4, we do find that RCTV cable ratings rise during cadenas, and the effect is positive and statistically significant. In particular, considering moving from no overlap to complete overlap (i.e. change in cadena overlap equal to one), we have that ratings on RCTV cable rise by an economically significant 69 percent. In the second column, we investigate whether these results differ according to the type of programming on RCTV cable. As shown, the results are larger for news programming on RCTV cable, when compared to other types of programming on RCTV cable. More concretely, viewership of RCTV cable news programming increases by 171 percent when a cadena comes on broadcast television, whereas viewership of non-news programming increases by only 61 percent. These results provide further support for our hypothesis of viewer choice of like-minded ideological content.

Table 7: Cable Channel RCTV International

Variable	Change in Ratings	Change in Ratings
<i>Change in cadena overlap</i>	0.6882*** (0.0945)	0.6087*** (0.0986)
<i>News</i>		-0.0126 (0.0211)
<i>News * Change in cadena overlap</i>		1.1047*** (0.3188)
<i>Constant</i>	0.0206** (0.0105)	0.0259* (0.0137)
Observations	9404	9404

All columns show the results for the cable channel RCTV International when a cadena is aired on the broadcast channels. Robust standard errors in brackets; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

## 6.4 Content of cadenas

We next use more detailed information about individual cadenas, as provided by Nielsen in the form of short descriptions of the content of each cadena. Using this description and supplementing this with information found online, we create five categories of cadena content, and these are described below:

1. Foreign Relations: coverage of foreign policy accomplishments, such as visits of presidents, multilateral agreements, and international travel by Chavez.
2. Delivery: coverage of events involving government promises of the provision of public goods, services, etc.
3. Elections: broadcasts focusing on elections, especially coverage of the 2006 Presidential elections and the 2007 constitutional referendum.
4. Celebrations: coverage of public events, such as the birth of Simon Bolivar, marches, etc.
5. Information: summary of the progress of the country in several areas, such as economic and political

For cadenas that do not meet one of these definitions, we create a sixth category, other.

Table 8 examines the drop-off in rating, separately, for each of these categories on the private channels, compared to the same categories in the public channels, when transitioning from news

to cadena. This specification is consistent with the baseline analysis in column 1 of Table 2. The regression also controls for main effects of these categories, not reported in the Table. Comparing the magnitude of the coefficients on the interactions, we have that the largest drop-off on private, relative to public, occurs for the categories delivery and elections. The large drop-off for delivery cadenas aired on private television may reflect the fact that many of these broadcasts involve Chavez himself delivering promises of public goods and services to his core voters. Given the targeting of these goods and services, there may be a particular distaste among opposition viewers for these cadenas. Likewise, cadenas about elections are, by their very nature, politically oriented and may have created polarized responses in terms of viewership. Finally, the smaller coefficient on the information category may reflect the fact that both opposition and pro-government viewers find these transmissions to be truly informative about the state of the economy or along other dimensions.

Table 8: Cadenas Content

<b>Variables</b>	<b>Change in Ratings</b>
<i>Foreign*Private</i>	-0.465*** (0.139)
<i>Delivery*Private</i>	-1.056*** (0.261)
<i>Elections*Private</i>	-0.758*** (0.265)
<i>Celebrations*Private</i>	-0.544*** (0.163)
<i>Information*Private</i>	-0.264** (0.111)
<i>Others*Private</i>	-0.482 (0.473)
Observations	807

Robust standard errors in parentheses; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## 6.5 Summary

To summarize, the results of the empirical analysis are consistent with the four key predictions of the model. First, the drop-off in ratings is more substantial for private channels, when compared to the public channel. Second, this effect is concentrated among opposition channels, and results for the moderate channels take an intermediate value. Third, the drop-off in viewership for the

private channel is more significant for households with a cable subscription. Fourth, we show that viewership of RCTV International, an opposition cable channel opened during 2007, rises significantly during cadenas. Finally, we examine heterogeneity according to the content of cadenas, with the largest drop-off of viewership on private channels for cadenas associated with the delivery of public goods and services and for cadenas related to elections.

## 7 Structural Estimation

Building upon this evidence, we next provide estimates of a structural version of the model. We begin by extending the model and the notation to allow for non-news programming and gender-specific preferences over this programming. We then detail several issues in the empirical implementation and describe identification. After presenting the parameter estimates, we use the model to conduct no-cadena counterfactual experiments. These experiments will allow us to quantify the dynamic responses of viewership to cadenas and also to quantify the welfare consequences of cadenas.

### 7.1 Approach

As in the first extension of the model, we consider three types of stations: government ( $i = g$ ), moderate ( $i = m$ ), and opposition ( $i = o$ ). As before let  $v \in \{o, g\}$  index viewer ideology, opposition and pro-government. Then, viewers receive payoffs equal to  $\theta_s$  from same-type programming (cadenas and government news for pro-government viewers and opposition news for opposition viewers) and payoffs equal to  $\theta_d$  from different-type programming (cadenas and government news for opposition viewers and opposition news for pro-government viewers). Both opposition and pro-government viewers receive payoffs of  $\theta_m$  from moderate news.

To estimate switching costs, we also consider the following additional types of non-news programming: soap operas (telenovas), sports, and other. Following Esteves-Sorenson and Perretti (2012), we measure switching costs via gender-specific preferences over soaps and sports. In particular, let  $k \in \{m, f\}$  index viewer gender, and let  $u_{vkip}$  represent gender-specific systematic payoffs for a viewer with ideology  $v$  watching programming  $p$  on station  $i$ .

Table 9 summarizes these payoffs:

Table 9: Summary of payoff structure

	$v = o, k = \text{male}$	$v = o, k = \text{female}$	$v = g, k = \text{male}$	$v = g, k = \text{female}$
$p = n, i = g$	$\theta_d$	$\theta_d$	$\theta_s$	$\theta_s$
$p = n, i = m$	$\theta_m$	$\theta_m$	$\theta_m$	$\theta_m$
$p = n, i = o$	$\theta_s$	$\theta_s$	$\theta_d$	$\theta_d$
$p = c$	$\theta_d$	$\theta_d$	$\theta_s$	$\theta_s$
$p = \text{sports}$	$\text{sports}_m$	$\text{sports}_f$	$\text{sports}_m$	$\text{sports}_f$
$p = \text{soaps}$	$\text{soaps}_m$	$\text{soaps}_f$	$\text{soaps}_m$	$\text{soaps}_f$
$p = \text{other}$	$\text{other}_m$	$\text{other}_f$	$\text{other}_m$	$\text{other}_f$

As shown, payoffs from news programming and cadenas differ across viewer ideology but not gender, and payoffs from non-news programming, such as sports and soaps, differ across gender but not ideology. Likewise, while preferences for news programming vary across stations, a simplifying assumption is that preferences for sports, soaps, and other programming vary across viewer types but not across stations.

In the context of this model, we next derive market shares, separately for viewers of ideology  $v$  and gender  $k$ . We sequence shows within a day according to the time aired ( $t = 1, 2, 3, \dots$ ). Then, with positive switching costs ( $\eta > 0$ ), market shares for a viewer with ideology  $v$  and gender  $k$  watching programming  $p$  on station  $i$  at time  $t$  ( $\sigma_{vkip}^t$ ), as a function of market shares during the previous time slot ( $\sigma_{vkip}^{t-1}$ ), are given by:

$$\sigma_{vkip}^t = \sigma_{vkip}^{t-1} \frac{\exp(u_{vkip}^t)}{\exp(u_{vkip}^t) + \sum_{j \neq i} (u_{vkjp}^t - \eta)} + \sum_{l \neq i} \sigma_{vklp}^{t-1} \frac{\exp(u_{vkip}^t - \eta)}{\exp(u_{vklp}^t) + \sum_{j \neq l} \exp(u_{vkjp}^t - \eta)}$$

The first term represents the likelihood that a viewer is both watching channel  $i$  during the previous time slot ( $t - 1$ ) and does not switch to another channel at time  $t$ . The second term represents the likelihood that a viewer is both watching a different channel ( $l \neq i$ ) during the previous time slot and switches to channel  $i$  at time  $t$ , incurring switching costs equal to  $\eta$ . This is then summed across all other options. This includes the outside option of not watching television, which, as above, is normalized to provide a systematic payoff of zero.

To illustrate the intuition behind these market shares, consider two special cases. First, with high switching costs ( $\eta \rightarrow \infty$ ), market shares do not change between time  $t - 1$  and time  $t$ ; that is,  $\sigma_{vkip}^t = \sigma_{vkip}^{t-1}$ . In this case, inertia is complete, and viewership does not respond to the airing of cadenas. Second, in the absence of switching costs ( $\eta = 0$ ), market shares at time  $t$  are independent

of market shares at time  $t - 1$  and collapse to the standard multinomial logit form:

$$\sigma_{vkip}^t = \frac{\exp(u_{vkip}^t)}{\exp(u_{vkip}^t) + \sum_{j \neq i} (u_{vkjp}^t)}$$

In this case, there is no inertia. While viewership does respond to the airing of cadenas, the impact lasts for only one period, with viewership during future periods unchanged. In intermediate cases, with moderate switching costs, inertia exists but is incomplete. In particular, a positive shock to viewership of channel  $i$  at time  $t - 1$  leads to higher viewership of that channel at time  $t$ . For example, if females have a stronger preference for soaps than males, then a soap airing at time  $t - 1$  will, all else equal, tend to increase viewership of that channel for females, relative to males, at time  $t$ . This is due to the presence of switching costs, resulting in inertia in viewership.

Since our data distinguish between male and female viewers but not between pro-government and opposition viewers, we next aggregate market shares across opposition and pro-government. Recalling that  $\pi_g$  represents the fraction of pro-government viewers, we have that market shares among gender  $k$  for station  $i$  airing programming  $p$  equal:

$$\sigma_{kip}^t = \pi_g \sigma_{gkip}^t + (1 - \pi_g) \sigma_{okip}^t$$

For the purposes of estimation, these model-based market shares ( $\sigma_{kip}^t$ ) are then linked to observed market ( $s_{kip}^t$ ) shares via the following log-odds formulation:

$$\ln\left(\frac{s_{kip}^t}{1 - s_{kip}^t}\right) = \ln\left(\frac{\sigma_{kip}^t}{1 - \sigma_{kip}^t}\right) + \varepsilon_{kip}^t$$

where  $\varepsilon_{kip}^t$  is assumed to be normally distributed. Then, the parameters of the model (e.g.  $\theta_d, \theta_m, \theta_s, \eta$ ) can be estimated via maximum likelihood.

## 7.2 Empirical Implementation and Identification

Before presenting estimates of the parameters of this model, we first address three issues regarding empirical implementation. We then provide an intuitive overview of identification.

First, while the above formulation assumed that the sequence of programming ( $t = 1, 2, 3, \dots$ ) was identical across channels, programming schedules differ across channels within a day. For example, RCTV may air a program from 6pm to 6:30pm, whereas Globovision may air a program from 5:30pm to 6:20pm and then another show from 6:20pm to 7pm. In this case, for a given program, it is unclear how to define the set of competing shows, those aired on other channels. To do so, we define, for each show, the set of competing shows on other channels as those with

the maximal time overlap with the focal program. In the above example, a show airing from 6pm to 6:30pm on RCTV would compete for viewership with the show airing from 5:30pm to 6:20pm on Globovision, which shares 20 minutes of programming, and not a show airing from 6:20pm to 7pm, which shares only 10 minutes of programming.

Second, given the recursive formulation above, in which viewership at time  $t$  depends upon viewership at time  $t - 1$ , one must define initial conditions for market shares. To do so, we assume zero viewership before 6am, when most of the population is sleeping, and ratings are consequently extremely low. That is, we assume that the entire market is consuming the outside option of no television, which provides a systematic payoff of zero, prior to  $t = 1$ . This allows us to write viewership during the first time slot ( $t = 1$ ) as follows:

$$\sigma_{vkip}^1 = \frac{\exp(u_{vkip}^1 - \eta)}{1 + \sum_{j \neq 0} \exp(u_{vkjp}^1 - \eta)}$$

where  $u_{vkip}^1 - \eta$  is the payoff from switching from the outside option to channel  $i$  airing programming  $p$  at  $t = 1$  and  $j = 0$  refers to the outside option. In addition to closing the model, this assumption implies no dynamic linkages in viewership between midnight and 6am, allowing us to treat each date as an independent observation.

Third, since we do not observe market shares separately for opposition and government viewers, we must aggregate across these groups, as outlined above. Given this, one must thus measure the fraction of pro-government viewers ( $\pi_g$ ) in each municipality. To do so, we measure these via municipality-specific vote shares for the opposition party and Chavez, respectively, in the 2006 Presidential election.

The intuition for identification is explained in several steps. First, gender-specific preferences over sports and soap operas are identified simply by comparing ratings for these types of programming across male and female viewers. Then, with these estimates of gender-specific programming, switching costs can be identified by examining gender-specific ratings for shows aired on the same channel but after these sports and soaps programs. Finally, with estimates of these switching costs, one can identify ideology-specific preferences over news and cadenas by examining, similarly to the reduced form evidence presented above, changes in ratings during cadenas that interrupt news programming across different types of stations (opposition, moderate, and pro-government). This identifies preferences over ideological content, as given by  $\theta_d$ ,  $\theta_m$ , and  $\theta_s$ .

Note that this intuition is incomplete, as the model also implies linkages between switching costs and preferences over ideological content via the ideological mechanism. That is, in order to observe a disproportionate drop-off in viewership when a cadena is aired on private channels, it must be the case that switching costs are positive. Otherwise, as noted above, viewership of cadenas is independent of previous programming, which includes the ideological content of news.

Thus, switching costs are identified via both gender-specific preferences over programming and channel-specific changes in viewership when cadenas are aired.

### **7.3 Parameter Estimates**

Our parameter estimates are provided in Table 10. Note that these coefficients should be considered relative to programming other than news, cadenas, sports, and soaps. This includes categories such as movies and game shows, which receive payoffs equal to the constant term, and the payoff from not watching television is normalized to zero.

Following the identification logic from above, we begin by discussing gender-specific preferences over news programming. As seen, and consistent with prior evidence (Esteves-Sorenson and Perretti (2012)), we find overall high viewership for soaps but especially so among female viewers. Likewise, we find slightly lower viewership for sports but especially so among female viewers. These two gender-specific coefficients are both economically and statistically significant, with females, relative to males, having 56 percent higher viewership for soaps and 18 percent lower viewership for sports. In addition, females have 18 percent higher viewership across all categories.

Table 10: Structural estimates

<b>Variable</b>	
<i>Information</i>	-0.4812*** (0.0072)
<i>Information</i> × <i>same</i>	0.2409*** (0.0078)
<i>Information</i> × <i>different</i>	-1.6717*** (0.0078)
<i>Female</i>	0.1759*** (0.0046)
<i>Soaps</i>	1.4439*** (0.0091)
<i>Sports</i>	-0.2854*** (0.0194)
<i>Female</i> × <i>soaps</i>	0.5584*** (0.0122)
<i>Female</i> × <i>sports</i>	-0.1839*** (0.0268)
<i>Switching cost</i>	3.8089*** (0.0100)
<i>Constant</i>	-2.5179*** (0.0059)
<b>Observations</b>	<b>31081</b>

Standard errors in brackets; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

As noted above, by comparing gender-specific ratings on shows immediately following sports and soaps, we can identify switching costs. As shown, these estimated switching costs are also statistically significant, and evidence on their economic significance will be documented in a counterfactual analysis to follow, in which we trace out the dynamic response to cadenas for viewers and channels of differing ideology.

Finally, using these estimates of switching costs to identify preferences over ideological content, we have that payoffs from information are associated with lower viewership overall. This is the payoff for both pro-government and opposition viewers from consuming moderate news. As shown, this negative effect is partially offset for same-type information, cadenas and news on government channels for pro-government viewers and news on opposition channels for opposition

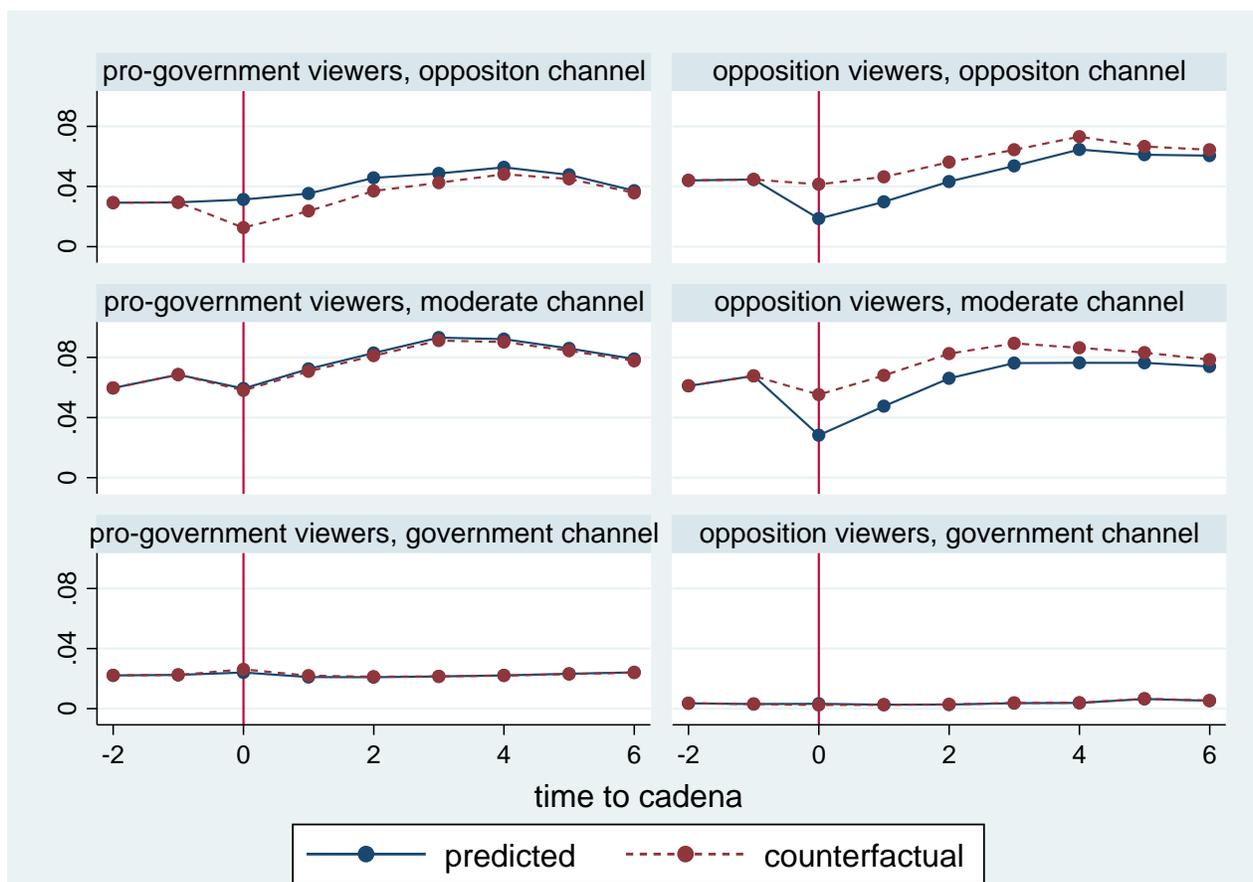
viewers. Conversely, payoffs are substantially lower for different-type information, cadenas and news on government channels for opposition viewers and news on opposition channels for pro-government viewers. Note also the asymmetry between same-type and different-type ideology, with the benefits associated with same-type information (0.2409) smaller than the costs associated with different-type information (1.6717). Taken together, these estimates thus provide additional support for the hypothesis of preferences for like-minded information.

## **7.4 Counterfactuals and Welfare Analysis**

Using these parameter estimates, we then conduct a counterfactual scenario in which cadenas are replaced with news programming. That is, propaganda is replaced by opposition content on opposition channels and moderate content on moderate channels, with no change in content on government channels. We then examine the dynamic responses to viewership and also consider the welfare consequences of propaganda for opposition and pro-government viewers.

This analysis proceeds in the following three steps. First, we focus on the set of days on which a single cadena was broadcast. This allows us to measure the dynamic response to a single change in ideological content. Second, using this sample of days and normalizing the time slot of the cadena to equal zero, we use the estimated model to predict viewership of shows aired throughout the day. For simplicity, we focus on viewership among females and in cities with the full set of available channels (i.e., Caracas and Valencia). Third, we use the model to predict how viewership would have evolved during and after the airing of a cadena were it replaced by news programming, with ideological content depending upon the channel under consideration. Only programming in the focal time slot ( $t = 0$ ) is altered, and programming during the other time slots is unchanged under the counterfactual.

Figure 7: Counterfactual Viewership



The results from this exercise are provided in Figure 7, in which we plot viewership during the two shows aired before the cadena, the cadena, and the six shows aired after the cadena. The x-axis is time to cadena and is normalized to equal zero during the cadena time slot. The y-axis is the viewership market share, separately by channel and viewer ideology. The upper panel provides results for ratings on the opposition channel, with pro-government viewers on the left and opposition viewers on the right. The middle and bottom panels provide corresponding results for moderate and government channels. Finally, we consider both predicted market shares, as given the solid line, and market shares under the no-cadena counterfactual, as given by the dashed line.

As shown by the solid line, and consistent with the evidence provided above, there is a sharp drop in viewership for opposition viewers when the cadena is broadcast on opposition channels. This drop is not apparent under the counterfactual, in which the cadena is replaced by opposition news. For pro-government viewers, by contrast, the pattern is reversed, with a slight increase in viewership of opposition channels when a cadena is aired and a sharp decrease in viewership when the cadena is replaced by opposition news.

These results also shed light on the magnitude of the estimated switching costs and the associ-

ated dynamic responses to the airing of cadenas. As shown, due to the presence of these switching costs, differences in viewership, depending upon whether the previous show is a cadena or opposition news, are also apparent during the subsequent time slots (i.e.,  $t = 1$ ), with the counterfactual path of viewership then converging back to the predicted path of viewership several time slots following the cadena. Thus, cadenas have a persistent effect on viewership of opposition channels, with a sustained increase in viewership by pro-government viewers and a sustained decrease in viewership by opposition viewers.

The middle panel presents results for ratings on the moderate channel. As shown, for opposition viewers, there is again a sharp drop in viewership when the cadena airs, and this drop largely disappears under the counterfactual scenario, when the cadena is replaced by moderate news. For pro-government viewers, by contrast, there are essentially no differences between predicted and counterfactual viewership. The difference in the response between pro-government and opposition viewers reflects the fact, as documented above, that the estimated cost of being exposed to different news is larger than the estimated benefit of being exposed to same-type news (i.e.,  $1.6717 > 0.2409$ ).

Finally, as shown in the bottom panel, there are essentially no differences in viewership between the predicted path and the counterfactual path for the government channel. This simply reflects the fact that the ideological content of news programming on the government channel is assumed to be the same as the ideological content of cadenas. The paths are not identical, however, as ideological content changes on other stations when a cadena is aired, making the government channel one of several options for pro-government viewers. Due to inertia and switching costs, however, viewers disproportionately “stick” to the channel that they watched during the prior time slot, leading to only small changes in viewership on public channels.

Turning to the normative analysis of the counterfactual, we next measure the overall welfare of opposition and pro-government viewers, respectively, when cadenas come on the air, relative to the counterfactual in which each channel airs news programming. Welfare is measured using the inclusive value, the standard measure in discrete choice models. This is calculated by taking the expected value of the maximal utility over the choice set. Abstracting from gender and taking viewership probabilities at time slot  $t - 1$  as given, the welfare of a viewer with ideology  $v$  at time  $t$  is given by:

$$W_v^t = \sum_l \sigma_{vlp}^{t-1} \ln[\exp(u_{vlp}^t) + \sum_{j \neq l} \exp(u_{vjp}^t - \eta)]$$

Within the summation, the term  $\ln[\exp(u_{vlp}^t) + \sum_{j \neq l} \exp(u_{vjp}^t - \eta)]$  represents the value to viewers with ideology  $v$  watching channel  $l$  at time  $t - 1$ , where  $u_{vlp}^t$  is the payoff from continuing to watch channel  $l$  at time  $t$  and  $u_{vjp}^t - \eta$  is the payoff associated with switching at time  $t$  from channel  $l$  to a different channel  $j \neq l$ . These values associated with watching a given channel at time  $t - 1$  are

then aggregated across channels, weighting by viewership at time  $t - 1$ .

The results from this welfare analysis are presented in Table 11. As shown, welfare for pro-government viewers falls under the counterfactual, in which cadenas are replaced with news programming. This simply reflects the fact that overall ideological content is more opposition-oriented under the counterfactual, relative to under the scenario in which pro-government cadenas are aired. For opposition viewers, by contrast, the pattern is reversed, with an increase in welfare under the counterfactual, again reflecting the fact that overall ideological content is more opposition-oriented under the counterfactual.

Table 11: Welfare Analysis

	Predicted welfare	Counterfactual welfare	Difference
Pro-government	-0.1841	-0.2218	-0.0377
Opposition	-0.2645	-0.1937	0.0717
Aggregate	-0.2206	-0.2092	0.0114

Using the share of pro-government viewers from Caracas, which equals 55.1 percent in the 2006 election, we have that aggregate welfare rises under the counterfactual, despite the fact that opposition viewers comprise a minority. This simply reflects the fact that the welfare losses from cadenas to the opposition exceeds the welfare gains to pro-government viewers.

To better understand why these losses to the opposition exceed the gains to pro-government viewers, consider the following simple example. Suppose there are only two stations, one pro-government and one opposition, and an equal number of opposition and pro-government viewers (i.e.  $\pi_g = 0.5$ ). Then, welfare for each group is given by  $\ln[\exp(\theta_s) + \exp(\theta_d)]$ . Consider next a government takeover of the opposition channel, leading to a market with two pro-government channels and no opposition channels. Welfare for opposition viewers is now  $\ln[2\exp(\theta_d)]$  and welfare for pro-government viewers is now  $\ln[2\exp(\theta_s)]$ . One can then show that aggregate welfare falls under this intervention due to a preference for like-minded information ( $\theta_d < \theta_s$ ). This simply reflects the fact that the gain to pro-government types from a second like-minded station is less than the loss to opposition viewers from losing their only like-minded station.

## 8 Conclusion

Consistent with a preference for like-minded ideological content, we find that viewers respond to high frequency variation in the ideological slant of television programming. These responses

are stronger for private channels, when compared to public channels, and for the most ideological channels. The responses are stronger for viewers with larger choice sets, as proxied via cable. Consistent with this result, we also show that viewership of cable increases during cadenas. The results are also stronger for the most polarizing cadenas, those involving the delivery of goods and services and those related to elections. Building upon this evidence, we structurally estimate the model, documenting dynamic responses to viewership following cadenas. We also conduct a normative analysis, documenting welfare losses associated with cadenas.

This analysis has several implications. First, to the extent that discounting of biased information by viewers is incomplete and propaganda is thus influential, our results suggest that viewer responses, as documented in this paper, may lead to increased political polarization. This polarization may increase according to ideology, with pro-government viewers disproportionately exposed to propaganda, and according to income due to the fact that high-income viewers are more likely to have access to cable, which were not required to air cadenas. Second, government propaganda may lead to welfare losses due to the reduction in media pluralism. This follows from the fact that the welfare losses to opposition viewers may exceed the welfare gains to pro-government viewers.

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## A Appendix

**Proof of Proposition 1:** Note that the ratios  $\frac{\sigma_{oc}}{\sigma_{on}}$  and  $\frac{\sigma_{gc}}{\sigma_{gn}}$  can be re-written as follows:

$$\begin{aligned}\frac{\sigma_{oc}}{\sigma_{on}} &= \frac{\pi_g \exp(\theta_d) p_g + \pi_o \exp(\theta_s) p_o}{\pi_g \exp(\theta_d) + \pi_o \exp(\theta_s)} \\ \frac{\sigma_{gc}}{\sigma_{gn}} &= \frac{\pi_g \exp(\theta_s) p_g + \pi_o \exp(\theta_d) p_o}{\pi_g \exp(\theta_s) + \pi_o \exp(\theta_d)}\end{aligned}$$

We require that:

$$\frac{\sigma_{oc}}{\sigma_{on}} < \frac{\sigma_{gc}}{\sigma_{gn}}$$

Inserting the above expressions, cross-multiplying, and dividing through by  $\pi_g \pi_o$ , we require that:

$$\exp(\theta_s)^2 p_o + \exp(\theta_d)^2 p_g < \exp(\theta_s)^2 p_g + \exp(\theta_d)^2 p_o$$

Re-arranging, we require that:

$$\exp(\theta_d)^2 (p_g - p_o) < \exp(\theta_s)^2 (p_g - p_o)$$

Since  $(p_g - p_o) > 0$ , we simply require that  $\theta_d < \theta_s$ , which is satisfied by assumption.

**Proof of Proposition 2.** With three channels, note that market shares for news and cadenas are given by:

$$\sigma_{gn} = \pi_g \frac{\exp(\theta_s)}{1 + \exp(\theta_s) + \exp(\theta_d) + \exp(\theta_m)} + \pi_o \frac{\exp(\theta_d)}{1 + \exp(\theta_s) + \exp(\theta_d) + \exp(\theta_m)}$$

$$\sigma_{on} = \pi_g \frac{\exp(\theta_d)}{1 + \exp(\theta_s) + \exp(\theta_d) + \exp(\theta_m)} + \pi_o \frac{\exp(\theta_s)}{1 + \exp(\theta_s) + \exp(\theta_d) + \exp(\theta_m)}$$

$$\sigma_{mn} = \pi_g \frac{\exp(\theta_m)}{1 + \exp(\theta_s) + \exp(\theta_d) + \exp(\theta_m)} + \pi_o \frac{\exp(\theta_m)}{1 + \exp(\theta_s) + \exp(\theta_d) + \exp(\theta_m)}$$

$$\sigma_{gc} = \pi_g \frac{\exp(\theta_s)}{1 + \exp(\theta_s) + \exp(\theta_d) + \exp(\theta_m)} p_g + \pi_o \frac{\exp(\theta_d)}{1 + \exp(\theta_s) + \exp(\theta_d) + \exp(\theta_m)} p_o$$

$$\sigma_{oc} = \pi_g \frac{\exp(\theta_d)}{1 + \exp(\theta_s) + \exp(\theta_d) + \exp(\theta_m)} p_g + \pi_o \frac{\exp(\theta_s)}{1 + \exp(\theta_s) + \exp(\theta_d) + \exp(\theta_m)} p_o$$

$$\sigma_{mc} = \pi_g \frac{\exp(\theta_m)}{1 + \exp(\theta_s) + \exp(\theta_d) + \exp(\theta_m)} p_g + \pi_o \frac{\exp(\theta_m)}{1 + \exp(\theta_s) + \exp(\theta_d) + \exp(\theta_m)} p_o$$

Note further that  $\frac{\sigma_{oc}}{\sigma_{on}}$  and  $\frac{\sigma_{gc}}{\sigma_{gn}}$  are unchanged from the baseline case and that the relevant expression for the moderate channel is given by:

$$\frac{\sigma_{mc}}{\sigma_{mn}} = \frac{\pi_g p_g + \pi_o p_o}{\pi_g + \pi_o}$$

Thus, the first inequality requires that:

$$\frac{\pi_g \exp(\theta_d) p_g + \pi_o \exp(\theta_s) p_o}{\pi_g \exp(\theta_d) + \pi_o \exp(\theta_s)} < \frac{\pi_g p_g + \pi_o p_o}{\pi_g + \pi_o}$$

Cross-multiplying and dividing through by  $\pi_g \pi_o$  yields:

$$\exp(\theta_d) p_g + \exp(\theta_s) p_o < p_g \exp(\theta_s) + p_o \exp(\theta_d)$$

Re-arranging, we have that:

$$\exp(\theta_d)(p_g - p_o) < \exp(\theta_s)(p_g - p_o)$$

Since  $(p_g - p_o) > 0$ , we require that  $\theta_d < \theta_s$ , which is satisfied by assumption.

The second inequality requires that:

$$\frac{\pi_g p_g + \pi_o p_o}{\pi_g + \pi_o} < \frac{\pi_g \exp(\theta_s) p_g + \pi_o \exp(\theta_d) p_o}{\pi_g \exp(\theta_s) + \pi_o \exp(\theta_d)}$$

Cross-multiplying and dividing through by  $\pi_g \pi_o$  yields:

$$\exp(\theta_d) p_g + \exp(\theta_s) p_o < \exp(\theta_s) p_g + \exp(\theta_d) p_o$$

Re-arranging, we have that:

$$\exp(\theta_d)(p_g - p_o) < \exp(\theta_s)(p_g - p_o)$$

Since  $(p_g - p_o) > 0$ , we require that  $\theta_d < \theta_s$ , which is satisfied by assumption.

**Proof of Proposition 3:** Then, we have the following market shares for news and for cadenas on the three channels:

$$\begin{aligned}\sigma_{gn} &= \pi_g \frac{\exp(\theta_s)}{1 + \exp(\theta_s) + 2\exp(\theta_d)} + \pi_o \frac{\exp(\theta_d)}{1 + 2\exp(\theta_s) + \exp(\theta_d)} \\ \sigma_{on} &= \pi_g \frac{\exp(\theta_d)}{1 + \exp(\theta_s) + 2\exp(\theta_d)} + \pi_o \frac{\exp(\theta_s)}{1 + 2\exp(\theta_s) + \exp(\theta_d)} \\ \sigma_{cn} &= \pi_g \frac{\exp(\theta_d)}{1 + \exp(\theta_s) + 2\exp(\theta_d)} + \pi_o \frac{\exp(\theta_s)}{1 + 2\exp(\theta_s) + \exp(\theta_d)}\end{aligned}$$

$$\begin{aligned}\sigma_{gc} &= \pi_g \frac{\exp(\theta_s)}{1 + \exp(\theta_s) + 2\exp(\theta_d)} p'_g + \pi_o \frac{\exp(\theta_d)}{1 + 2\exp(\theta_s) + \exp(\theta_d)} p'_o \\ \sigma_{oc} &= \pi_g \frac{\exp(\theta_d)}{1 + \exp(\theta_s) + 2\exp(\theta_d)} p'_g + \pi_o \frac{\exp(\theta_s)}{1 + 2\exp(\theta_s) + \exp(\theta_d)} p'_o \\ \sigma_{cc} &= \pi_g \frac{\exp(\theta_d)}{1 + \exp(\theta_s) + 2\exp(\theta_d)} + \pi_o \frac{\exp(\theta_s)}{1 + 2\exp(\theta_s) + \exp(\theta_d)} \\ &\quad + \pi_g \frac{\exp(\theta_s)}{1 + \exp(\theta_s) + 2\exp(\theta_d)} \frac{\exp(\theta_d - \eta)}{1 + \exp(\theta_s) + \exp(\theta_d - \eta)} \\ &\quad + \pi_o \frac{\exp(\theta_d)}{1 + 2\exp(\theta_s) + \exp(\theta_d)} \frac{\exp(\theta_s - \eta)}{1 + \exp(\theta_d) + \exp(\theta_s - \eta)} \\ &\quad + \pi_g \frac{\exp(\theta_d)}{1 + \exp(\theta_s) + 2\exp(\theta_d)} \frac{\exp(\theta_d - \eta)}{1 + \exp(\theta_s) + \exp(\theta_d - \eta)} \\ &\quad + \pi_o \frac{\exp(\theta_s)}{1 + 2\exp(\theta_s) + \exp(\theta_d)} \frac{\exp(\theta_s - \eta)}{1 + \exp(\theta_d) + \exp(\theta_s - \eta)}\end{aligned}$$

where  $p'_g = \exp(\theta_s)[1 + \exp(\theta_s) + \exp(\theta_d - \eta)]^{-1}$  and  $p'_o = \exp(\theta_d)[1 + \exp(\theta_d) + \exp(\theta_s - \eta)]^{-1}$ .

For cable viewership, the second and third lines represent the viewers that switch from the government channel to cable during the cadena, and the fourth and fifth lines represent the viewers that switch from the opposition channel to cable during the cadena.

Then, with cable, we have that:

$$\begin{aligned}\frac{\sigma_{oc}}{\sigma_{on}} &= \frac{\pi_g \exp(\theta_d) p'_g + \pi_o \exp(\theta_s) p'_o}{\pi_g \exp(\theta_d) + \pi_o \exp(\theta_s)} \\ \frac{\sigma_{gc}}{\sigma_{gn}} &= \frac{\pi_g \exp(\theta_s) p'_g + \pi_o \exp(\theta_d) p'_o}{\pi_g \exp(\theta_s) + \pi_o \exp(\theta_d)}\end{aligned}$$

Then, comparing this expression to the one in the Proof of Proposition 1, we require that:

$$\frac{\pi_g \exp(\theta_d) p'_g + \pi_o \exp(\theta_s) p'_o}{\pi_g \exp(\theta_s) p'_g + \pi_o \exp(\theta_d) p'_o} < \frac{\pi_g \exp(\theta_d) p_g + \pi_o \exp(\theta_s) p_o}{\pi_g \exp(\theta_s) p_g + \pi_o \exp(\theta_d) p_o}$$

Cross-multiplying and dividing through by  $\pi_g \pi_o$  yields:

$$\exp(\theta_d)^2 p'_g p_o + \exp(\theta_s)^2 p'_o p_g < \exp(\theta_d)^2 p_g p'_o + \exp(\theta_s)^2 p_o p'_g$$

Re-arranging, we require that:

$$[\exp(\theta_s)^2 - \exp(\theta_d)^2](p'_o p_g - p_o p'_g) < 0$$

Since the first term is positive, we require that  $p'_o p_g < p_o p'_g$ .

Substituting in the definitions for  $p'_o, p_g, p_o,$  and  $p'_g,$  we require that:

$$\frac{1}{1 + \exp(\theta_d) + \exp(\theta_s - \eta)} \frac{1}{1 + \exp(\theta_s)} < \frac{1}{1 + \exp(\theta_d)} \frac{1}{1 + \exp(\theta_s) + \exp(\theta_d - \eta)}$$

Cross multiplying, we require that:

$$[1 + \exp(\theta_d)][1 + \exp(\theta_s) + \exp(\theta_d - \eta)] < [1 + \exp(\theta_s)][1 + \exp(\theta_d) + \exp(\theta_s - \eta)]$$

Canceling like terms, we require that:

$$[1 + \exp(\theta_d)] \exp(\theta_d - \eta) < [1 + \exp(\theta_s)] \exp(\theta_s - \eta)$$

This is satisfied since  $\theta_d < \theta_s$ .

**Proof of Proposition 4:** Direct inspection of the two market shares  $\sigma_{cn}$  and  $\sigma_{cc}$  in the previous proof provides a proof.