Platform merger: lessons from French digital broadcast TV*

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Abstract

This paper empirically studies the merger effects in market with two-sided network externalities. We investigate the consequences of an antitrust decision in the Franch broadcast TV industry, which approved only the merger of broadcasting services (BSs) but blocked the merger of advertising sales houses (ASHs) of TV channels. We estimate a structural model of demand and supply in advertising. The paper introduces a novel approach to model the advertisers' demand which takes into account the substitutability and/or complementarity between different channels for advertisers. Ex-post merger evaluation shows that blocking only the merger of ASHs was ineffective in limiting the increase in advertising quantities and prices. Improving broadcasting quality of the merging channel increases not only their advert prices but also their advert levels, due to the two-sided network externalities between viewers and advertisers. Counterfactual simulation further suggests that the implemented behavioral remedy - blocking the merger of ASHs - was ineffective in limiting the damage of the acquisition on TV viewers and has increased the advertisers' total cost. Yet, the remedy has benefited the competitors of the merging channels in advertising market.

JEL Classiffication: K21, L10, L40, L82, M37

Keywords: Merger, competition policy, network externalities, two-sided market, advertising, TV

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1 Introduction

Recently, competition authorities are particularly concerned by the behavior of dominant firms in two sided markets, which provide service on the one side but generate revenue on the other side, in a way that could harm the interest of consumers.[1] In the internet industry, users search on the web free of charge, but trigger adverts which generate revenues for the web browsers. Similarly, in the broadcast TV market, when viewers are watching their favorite programs for free, they receive a flow of adverts that bring revenues to the TV channels. Dominant firms in these markets often provide better services than their rivals without charging extra monetary price to their users. In such a way, the dominant firms attract more users, which in turn, increase their attractiveness in the advertising market. While consumers enjoy free service from these firms, they maybe overwhelmed by the amount of adverts. It is even more problematic when the dominant media companies get bigger by acquiring smaller competitors. On the one hand, the dominant firms could offer better service by getting bigger (resource sharing, etc.), which allow them to show more adverts (as a non-monetary price) to users. On the other hand, the acquisition increases the market power of the merging firms in the advertising market, which allow them to charge higher prices to the advertisers.

This paper studies this situation by providing an analysis on the welfare effects of an important acquisition in the French broadcast TV industry. We observe a unique situation in which the antitrust authority only allowed for the merger of broadcasting services of the purchased channels with the parent company, but blocked the merger of their advertising sales houses (ASHs) through a behavioral remedy. By such decision, the authority wishes to improve the broadcasting quality of the purchased channels without detrimental effects on the advertising market. We will exam if the decision leads to the expected outcome.

In January 2010, French Antitrust Authority cleared the acquisition of two free broadcast TV channels NT1 and TMC by a big media holding company, TF1 Group, subject to a behavioral remedy - which requires NT1 and TMC to sell their advertising time separately from the main channel of TF1 Group. In practice, the remedy blocks the possibility of merger between the ASH of channel TF1 and the ASH of channels NT1 and TMC; only broadcasting content of the three channels are managed jointly following the acquisition.

The Antitrust Authority was convinced by the positive impact of the acquisition on the broadcasting side: TF1 Group has a large catalog of programs - thanks to its partnership with numerous content providers - that channels NT1 and TMC could benefit from following the acquisition.[2] It was readily deemed that merging broadcasting side of the three channels would improve the quality of broadcasting content on NT1 and TMC without additional cost; having more channels offering high quality content could enhance the competition in audience among different TV broadcasters. However, the Authority was concerned about the eventual anti-competitive effects of merging the ASHs of the three channels, due to the dominant position of TF1 channel on TV advertising market.

Before the acquisition, the ASH of TF1 channel held a 40 percent market share, while the ASHs of channels NT1 and TMC held, respectively, two and three percent market shares. The merger could simply reinforce the position of TF1 Group in the advertising market, which would translate into an increase in either advertising quantity or prices. To avoid any detrimental effect of the acquisition on the TV advertising market, the Antitrust Authority decided to impose a behavioral

[1] See for instance the European Commission decision, in March 2019, to fine Google 1.49 billion for abusive practices in online advertising.

[2] The two purchased channels NT1 and TMC are new entrants to the market. While they are growing very fast, their catalogs of broadcasting programs are not as rich as the catalogs of the incumbent channels like TF1.

remedy - blocking the merger of ASHs of the three channels.

While the antitrust authority's examinations on both sides of the market (broadcasting side and advertising side) are straightforward, its decision has nevertheless treated the advertising market separately from the broadcasting services of TV channels, which ignored not only the implication of changes in broadcasting quality of TV channels on the pricing and quantity of their advert slots, but also the impact of two-sided network externalities between viewers and advertisers. We exploit this specific context and investigates the consequences of the cleared acquisition on the TV advertising market.

We first estimate the demand elasticities of TV viewers with respect to advertising level. We find a median audience loss of about 8.7 percent in response to a 10 percent increase in advertising time. We next estimate the demand of advertisers for viewers in order to understand how advertisers complement and/or substitute between advert slots of different TV channels. Our estimation suggests that the advertisers consider the two purchased channels NT1 and TMC as substitutes, but both as complements to channel TF1. We use post-acquisition data to evaluate the consequences of the acquisition. We find that the broadcasting quality of the two purchased channels has indeed increased, but the ASHs readjust the advert quantities (thereby prices) of TV channels according to their broadcasting quality. In particular, we show by counterfactual simulation that the negative externalities that the advertisers generate to TV viewers incentivize the ASHs to increase advert quantity following an increase in broadcasting content of TV stations.

To gain an insight on the potential consequences of merging ASHs of the three channels, we simulate the equilibrium level of advertising quantity and prices in case where the advert slots of NT1, TMC and TF1 are chosen and sold by one common ASH. We show that merging ASHs of the three channels would only increase slight their total advert quantities, due to the small substitutional effect of advertising on the viewers side; and would have almost no impact on their advert prices, since their advert slots are complements for advertisers. Welfare analysis further suggests that blocking the merger of ASHs of the three channels did not have a significant positive effect on the surplus of TV viewers and has increased the advertisers' total advertising cost. Yet, we note that the behavioural remedy has benefited the competing ASHs of TF1 Group by avoiding an important shift of the total advert profits from the non-merging ASHs to the merging ones. Whether or not the ASHs of channels NT1, TMC and TF1 should be cleared depends on how the antitrust authority weighs the different market players.

This paper first contribute to the two-sided market literature popularized by Rochet and Tirole (2003) and Armstrong (2006). Based on this approach, theoretical papers have addressed TV advertising competition by assuming that the adverts are a nuisance to TV viewers (e.g., Anderson and Coate, 2005; Cunningham and Alexander, 2004; Nilssen and Sørgard, 2000). Very few empirical papers in practice have estimated the viewers demand elasticities with respect to advertising level. Wilbur (2008) finds TV viewers indeed dislike advertising. Similar attitude of audience towards advertising has also been found in radio and newspaper industry. (See Jezioski, 2014 and Ivaldi and Muller, 2018.) However, empirical studies have also found audiences appreciating advertising in yellow pages and magazines. (See Rysman, 2004 and Kaiser and Wright, 2006.) Identifying the sign of network externalities that the advertisers generate to viewers is crucial, as it impacts the strategic behavior of ASHs in the advertising market. If viewers dislike advertising and substitute channels during the adverts, the ASHs would restrict the quantity of adverts on TV to avoid losing audience, but adjust advertising levels of TV channels according to their broadcasting quality.[3] We estimate the disutility of advertising to TV viewers and find a statistically significant disutility of advertising to TV viewers.

[3]Viewers' demand is less elastic to advertising during better quality of content, the ASHs acknowledge this fact and therefore strategically include more adverts into better programs.

We also contribute to the literature by proposing a novel approach to model the demand of advertisers which considers the advertisers' multi-homing behavior and allows for estimating whether a channel is complementary or substitutable to another channel for advertisers from aggregated advertising data. For practical reason, cross-substitution and/or complementation of channels by advertisers has been so far assumed away in the empirical two-sided market literature. (See for instance Rysman, 2004; Argentesi and Filistrucchi, 2007; Fan, 2013; Berry, Eizenberg and Waldfogel, 2016.) We relax this assumption here as ignoring the cross-substituability and/or complementarity of viewers of different TV channels for advertisers could bias the results of merger evaluation that we carry out in this paper. We find that the two purchased channels: NT1 and TMC are substitutable for advertisers, but both are complementary with channel TF1. This demand pattern of advertisers implies that merging ASH of NT1 and TNC with the ASH of channel TF1 would not result in a significant price increase.

Finally, this paper also contributes to the literature on mergers. Ex-post merger analysis has been adopted to evaluated the effectiveness of competition policy in numerous industries, such as airline markets (Borenstein, 1990; Kim and Singal, 1993), banking (Facacelli and Panetta, 2003), petroleum (Hastings 2004; Gilbert and Hastings, 2005; Hosken, Silvia, and Taylor, 2011), and appliances (Ashenfelter, Hosken, and Weinberg, 2013); Ashenfelter and Hosken (2010) assesses mergers in five different branded goods industries; Björnerstedt and Verboven (2015) evaluates the performance of merger simulations in Swedish Analgesics Market. In line with these previous work, we ex-post evaluate the consequences of the approved acquisition - under behavioual remedy - in the TV advertising market. We find that the acquisition has significant impact on both the advert quantities and prices of the two purchased channels. These results motivate our structural analysis on the effect of the acquisition on broadcasting quality of the three merging channels, and our counterfactual simulation on the two-sided network effects.

Our structural analysis is related to another stream of merger literature quantifies the welfare effects of mergers. Examples of papers include Baker and Baresnahan (1985), Hausman *et al.* (1994), Werden and Froeb (1994) and Nevo (2000), among others. More recent literature has specially interested in the merger effects in two-sided media markets. Sweeting (2010) studied the merger effects on product positioning. Fan (2013) simulates the potential consequences of a merger blocked by the Department of Justice in US newspaper industry. She allows for a richer model of characteristics choice but assumes that the newspaper readers do not care about advertising.[4] Therefore, while she can endogenize the variety in the counterfactual, she can not comment on the implication of two-sided network externalities in competition analysis. The analysis in our paper complements Fan (2013). We find a statistically significant disutility of advertising to TV viewers. We also observe a specific context in which the antitrust authority has approved the merger of the broadcasting services of TV channels but blocked the merger on their ASHs through behavioral remedy. We show by counterfactual simulation that the negative cross-side externalities that advertisers generate to viewers incentivizes the advertising sales houses to increase advert quantity of the merging channels, as a strategic response to the increase in their broadcasting quality.

Jeziorski (2014) expost evaluates the welfare effects of merger in the US Radio market. In particular, he discomposes the consumer surplus changes into product repositioning effects and advertising quantity readjustment effects. He shows that the product repositioning effect of merger improves listeners surplus but the resulting advertising readjustment reduces listeners surplus. We also observe post-acquisition data but under a behavioral remedy blocking the merger on the advertising side. We find that the observed acquisition - which merged only the broadcasting services of three TV stations - has caused a reallocation of high quality programs from the main

[4]Fan (2013) note that the newspaper readers are estimated to be slightly adverse to advertising in her paper.

channel to the two purchased ones. Besides, the advertising quantity and prices of the three channels have increased accordingly. The overall effect of the acquisition is a decrease in surplus of TV viewers. We show further by counterfactual simulation that the implemented behaviroual remedy was ineffective in limiting the damage of the acquisition on TV viewers and has increased the advertisers' total cost; yet, it has prevented a shift of the total advertising profits from the non-merging channels to the merging ones.

The remainder of this paper is structured as follows. In Section 2, we present the French TV market. In Section 3, we model the demand of TV viewers and of advertisers. The demand estimates are reported in Section 4. We carry out the merger evaluation in Section 5 and conclude in Section 6.

2 The French broadcast TV market

2.1 Data

The French audiovisual regulator - the Conseil supérieur de l'audiovisuel (CSA herein) - has put at our disposal monthly data of audience and advertising (gross advertising revenues and advert quantities) of 12 major broadcast TV stations in France from March 2008 to December 2013. The sample is representative of the French TV market: total audience share of the 12 stations exceeds 95 percent in the free-broadcast TV market and exceed 79 percent in the whole TV market including pay TVs; advertising revenue shares of the 12 stations exceed 90 percent in the free-broadcast TV market and 81 percent in the whole TV market. A list of the 12 TV stations is provided in Table 1 below. All the 12 TV stations are generalist, broadcasting a wide range of programs. The incumbent channels broadcast since the post-1950, while the new entrants entered the market in 2005. The three channels involved in the acquisition are highlighted in bold.

Table 1: List of TV channels and their ownership since 2010

	Channels	Nature	Media Group membership
Incumbents	**TF1**	**private**	**TF1 Group**
	M6	private	M6 Group
	FR2	public	FTV Group
	FR3	public	FTV Group
	FR5	public	FTV Group
New channels	**NT1**	**private**	**TF1 Group**
	TMC	**private**	**TF1 Group**
	W9	private	M6 Group
	FR4	public	FTV Group
	D17	private	Canal plus Group
	D8	private	Canal plus Group
	Gulli	private	Lagardère Group

The audience data come originally from Médiamétrie, which provides a measurement on the television audience, based on a panel of households equipped with one or more TV sets in their main residence.[5] Médiamétrie surveys the panel household every second. Our monthly data are

[5]This panel has been built to account for both the socio-demographic characteristics of households in metropolitan France and the structure of the television supply. It is made up of nearly 4,300 households, which corresponds to

the weighted average of viewers per second in a month.[6]

The advertising data - more precisely, gross advertising revenues and number of advertising seconds - come from Kantar Media. Using this information, we estimate the monthly average advertising price per second by dividing each channel's gross advert revenues by the number of advert seconds in the month. This is the price that the advertising sales houses charge to advertisers in our model.

Table 2 presents summary statistics of the main variables in our analysis: The total number of TV viewers per channel per second is on average equal to 3.84 thousands; a TV channel broadcasts on average 56 hours (i.e., 0.2 million seconds) of advertising per month; the average advertising price is 5.96 euros per second. All the three main variables are measured at the monthly level for each channel.

Table 2: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.
Number of TV viewers (in thousands)	3.84	4.14	2.86	16.03
Number of advert seconds (in million)	0.20	0.09	0.03	0.44
Advert price per second (in thousands)	5.96	8.01	0.42	35.95

Note: The total number of observations is 840, which amounts to 70 monthly observations per TV channel. Source: Médiamétrie & Kantar Media.

In addition to above data provided by the CSA, Médiamétrie made available to us complementary information on the broadcasting content of the 12 TV stations in our sample. In detail, we observe the monthly broadcasting hours of six major genres of TV shows per channel during the period of study (i.e., 2008-2013). Summary statistics on the broadcasting of the six program genres are provided in Table 3. Fiction, Culture/science and Entertainment are the most broadcast programs, which occupy more than 70 percent of broadcasting time of each TV station. The broadcasting of News vary importantly across channel; the new entrants such as TMC, Guilli and D17 do not show any News. Sports and Cartoon occupy relatively small shares of the total broadcasting time of the 12 generalist TV stations in our sample; specially, FR5 and TMC do not show Sports, while D8 and W9 do not show Cartoon.

2.2 Market structure

TV stations could be considered as two-sided market platforms connecting viewers to advertisers. They indeed provide two services: TV shows to viewers on the one side, and advertising slots to advertisers on the other side. While viewers enjoy the news and entertainment content on TV, they receive the flow of advertising. When TV viewers see the adverts, they generate audience for the advertisers. TV viewers may, however, be sensitive to the advertising level, in which case, the advertisers generate negative externalities to the TV viewers. Advertisers value TV advertising

approximately 10,500 individuals aged 4 and over. In each home, Médiamétrie installs one or more audimeters (depending on how many pieces of equipment they have) fitted with a remote control with individual keys, which constantly record all uses of the television set(s) in the household and all the viewing habits of each member of the household and their guests. (See http://www.mediametrie.fr.)

[6] In practice, the number of viewers of channel j in month t, y_{jt} used in the model later, is defined as the following. Médiamétrie measures the number of viewers of channel j at every second s. Assuming there is 30 days in month t (so in total 2592000 seconds in the month), the monthly average number of viewers of channel j, y_{jt}, is equal to $\frac{\sum_s^{2592000} y_{js}}{2592000}$, where y_{js} denotes the total number of viewers of channel j in second s. In other words, y_{jt} measures the average number of viewers per second on channel j in month t.

Table 3: Monthly broadcasting hours of different show genres

Genre	Unit	Level	Mean	Std.Dev.	Min.	Max.
Fiction	hours	channel/month	283.85	157.30	16.78	696.00
Culture/science	hours	channel/month	153.23	156.77	2.70	711.45
News	hours	channel/month	52.31	53.66	0	214.47
Entertainment	hours	channel/month	123.41	137.39	0	692.67
Sport	hours	channel/month	14.31	19.45	0	166.80
Cartoon	hours	channel/month	1.30	2.35	0	21.13

Source: Médiamétrie

for its ability to inform and/or persuade viewers on the merits of products or services they have to commercialize. Therefore, a priori, the more popular a TV channel is for TV viewers, the more demanding it is by advertisers. Our empirical analysis below will provide evidence on the sign and the magnitude of these externalities between the two sides of TV stations.

Advertisers buy the advert slots of TV channels from the advertising sales houses (ASHs), whose job is to handle and sell the advertising time made available by different TV stations. The ASHs charge advertisers a price per second of advertising for the scheduling and broadcasting services. The advertisers' objective is then to minimize their total advertising costs by combining the advert slots on several TV channels in order to achieve a certain overall reach in audience. In other terms, the advertisers practice multi-homing strategies.

The programming of TV shows is decided by the TV channels several months in advance. Based on the respective broadcasting content provided by the TV channels, each ASH determines their optimal supply of advertising slots. The advertising quantities of broadcast TV stations are, however, subject to double regulation caps enforced by the French law at the hourly and daily average level.[7] According to Table 11 in the Appendix, where we compared the effective advert quantities to the maximum minutes of adverts per month allowed for each TV station (calculated based on the daily average level of regulation caps), we note that the observed advertising time of different TV channels are far from hitting the regulatory ceilings.[8][9] Given these regulatory constraints are not binding, ASHs behave as Cournot-type firms because they adjust the length of the advertising slots according to the content of the programs and the level of reactivity of viewers to advertising. In other words, each ASH's objective is to determine the amount of advertising time maximizing the profit of channels under its management.

Contrary to pay TV channels which charge subscription fees to TV viewers, free-broadcast TV stations only require their viewers to bear the advertising. While the pay TVs play important role in the U.S. TV market, they are much less common in France. Although there are between 184 and 207 pay TV channels available in French TV market during the observation period, neither their

[7]The average time per hour per day devoted to advertising must not exceed 6 minutes for public TV channels, 9 minutes for the incumbent private channels, and 12 minutes during the first 7 years of broadcasting for the new channels launched in 2005 and 2012. Moreover, the advertising time cannot exceed 12 minutes within any given clock hour for the private TV broadcasters and 8 minutes for the public TV broadcasters.

[8]As we use monthly data in this paper, we computed the maximum minutes of adverts per month allowed for each TV station from its daily average level of regulation cap imposed by the regulator: The maximum minutes of adverts allowed for channel j in month t is equal to the maximum minutes of adverts per day allowed for channel j in month $t \times$ the number of days in month t.

[9]Regulatory constraints at hourly level can be binding during prime time, though our monthly aggregate data do not allow for exploring its impact. Crawford *et al.* (2017) and Zhang (2018) have studied this issue in detail.

total audience share nor their total advertising revenue share exceeds 10 percent.[10] In addition, most of the pay TV channels are specialized on one theme and target a specific audience group (children, young ladies, etc.), while the 12 major free-broadcast TV stations used in our study are generalist TV channels which aim to serve a wide audience. We group all the pay TV channels into an outside option of our model because statistics on the audience share of individual pay TV channel are not available, due to their negligible level.

2.3 Evidence of two-sided externalities

Two elements, which could support the view that the broadcast TV market is a two-sided market, are the relationship between the advertising quantity and the number of viewers, as well as the relationship between the TV viewership and the advertising price. Indeed, an industrial organization as two-sided market is meaningful only if the cross-side externalities could be identified between the two sides of consumers, which are here, the viewers and the advertisers.

As the cross-side externalities between viewers and advertisers could play a crucial role in the evaluation of the antitrust decision that we investigate in this paper, we perform here some descriptive analysis to gain insight on the existence and the sign of those externalitites, and also to show that there is variation in our data to identify the structural parameters that we will estimate later in the paper.

Relationship between advertising quantity and TV viewership

To understand if the advertising quantity impacts significantly the viewership of TV channels and what's the direction of such effect, we regress the *number of viewers* on the *number of advertising minutes* controlling for channel-, month- and year-fixed effects, as well as the broadcasting hours of different program genres. OLS results, reported in the second colon of Table 4, indicate that higher viewership is associated with higher advertising quantity, which is counterintuitive.

The number of advertising minute is likely to be endogenous, however, because the error term contains unobserved channel-time-genre specific program quality, which is correlated with the advertising quantity. We therefore re-estimate the same equation using BLP IVs, namely, the sum of broadcasting hours of news and entertainment programs of the competing channels during the same months. In contrast to the OLS results, we now find a negative correlation between advertising quantity and the viewership of TV stations, as is shown in the third colon of Table 4.

Relationship between TV viewership and advertising price

Another important element which characterizes the broadcast TV market as two-sided market platform is the network externalities that the viewers generate to advertisers. Intuitively, the advertisers' willingness to pay should be higher for the advertising slots of a channel which attracts more viewers.

To visualize this, we produce binned scatterplot of the relationship between number of viewers and advertising prices, controlling for channel-, month- and year-fixed effects. The result is reported in Figure 1. We notice that higher viewership is indeed associated with higher advertising spending, suggesting that the TV viewers generate positive network externalities to the advertisers.

[10] See for instance the annual report of Médiamétrie: https://izart.fr/wp-content/uploads/2014/02/2014-01-06$_M$%C3%A9diamat – Annuel – 2013 – 1.pdfandofCSA : file : ///C : /Users/u0118597/Downloads/Bilan%20financier%20des%20cha%C3%AEnes%20payantes%202013.pdf.

Table 4: TV viewers' demand coefficient estimates

	Number of viewers (y_{jt})	
	OLS	IV
Advertising quantity	0.138***	−0.269*
	(0.027)	(0.140)
Fiction	−0.006	0.004
	(0.006)	(0.009)
Culture/Science	−0.006	−0.003
	(0.008)	(0.011)
News	0.016	0.169***
	(0.016)	(0.034)
Entertainment	−0.055***	−0.027*
	(0.009)	(0.014)
Sport	0.100***	0.138***
	(0.020)	(0.026)
Cartoon	0.311	1.393***
	(0.230)	(0.324)
Channel FE	Yes	Yes
Month FE	Yes	Yes
Year FE	Yes	Yes
No. observations	840	840
Cragg-Donald Wald F statistic		10.36
Hansen J statistic (p-value)		0.298

Standard errors are in parentheses: ***p<0.01, **p<0.05,***p<0.1

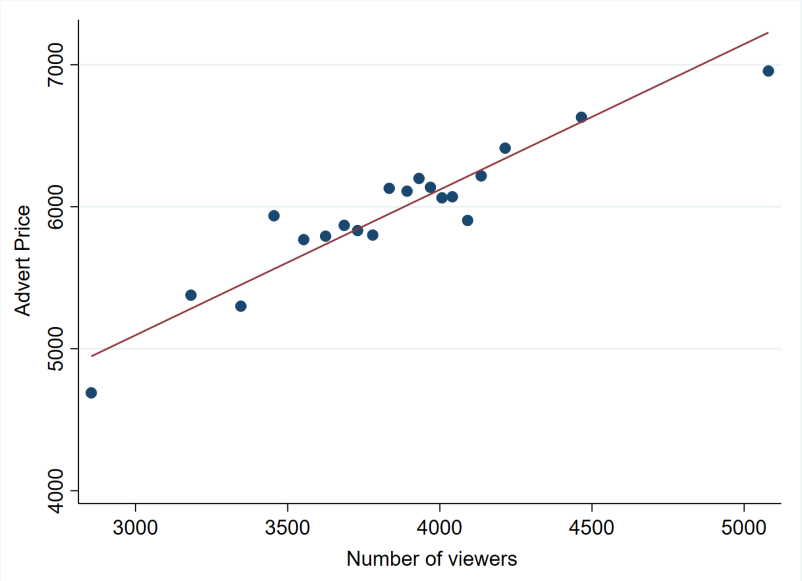

Figure 1: Relationship between number of viewers and advertising price
(Binned scatterplot controlling for channel-, month- and year- fixed effect)

3 Structural model of demand

We now present our structural models of demand of TV viewers and of advertisers. We first explain the motivation behind the choice of our specification. Then, in next section, we discuss

the estimation results of these models.

3.1 Viewers demand

We specify the viewers demand using a nested-logit model, which classifies the choices of TV viewers into g groups (or nests) and an additional group for an outside good. As it is well known, one of the main properties of this model is that choices within the same group are closer substitutes than choices from different groups (see Berry, 1994). We motivate the categorization of groups as follows.

Our sample includes 12 major broadcast TV stations: five incumbent channels and seven new entrants. We categorize the incumbent channels and the new entrants into two different groups to account for their different brand awareness, content type and quality. Indeed, the seven new entrants do not enjoy the same market position as the five incumbent channels do: audience share of the new channels are remarkably lower than the audience share of the incumbents. (See Table 12 in Appendix for detailed statistics.)

Three elements explain their difference. First, the incumbent channels and new entrants do not have the same brand awareness, simply because they entered the market at different times. The incumbent channels broadcast since the post-1950, while the seven new channels entered the market in 2005. The new entrants also requires a new reception technology, which was only adopted gradually by the French households between 2005 and 2013.

Second, the broadcasting content on incumbent channels and on the new channels have different focus and quality. Although all of the 12 TV stations in our sample show a wide range of program genres, the incumbent channels devote relatively more time on news and culture/science, while the new channels show more fictions.[11] The incumbent channels offer better quality of sport events and entertainment programs than the new entrants - only the incumbent channels can afford the cost of broadcasting popular sport events such as Champions League, Olympic Games and the expensive live shows such as The Voice.

Last, a French law requires the free-broadcast TV stations to show at least 40 percent of French audiovisual programs per day. The incumbent channels must fulfill this obligation in the evening, from 18:00 to 23:00, while the new entrants have the whole day to carry out the same obligation.

Instead of choosing one of the channels in our sample, the viewers can select the outside option (corresponding to group 0) which consists of either watching one of the remaining free or pay TV channels (for which we have no individual data due to their very small audience) or engaging in other activities than watching TV.

The nested logit model allows for the incumbent TV channels to be considered as closer substitutes for each other than for the new channels. It also allows for the probability that a representative viewer to choose an incumbent channel to be higher than the probability of choosing a new channel, which is consistent with their respective audience shares and with the higher reputation and quality of incumbent channels compared to the new channels.

Formally, in each period t, the indirect utility of consumer i from watching channel j, belonging to the group g (incumbent, entrant or outside good), is given by

$$U^i_{jgt} = \delta_{jt} + \zeta^i_{jgt}, \tag{1}$$

where δ_{jt} represents the mean utility level of TV viewers from watching channel j or choosing the outside good at time t and ζ^i_{jgt} captures the departure of consumer i's preference from the common

[11] See Figure 2 in Appendix for the distribution of different program genres on incumbent channels versus the new entrants.

utility level.[12] We define

$$\delta_{jt} = q_{jt} + \alpha A_{jt}, \tag{2}$$

where q_{jt} measures the perceived quality of channel j in period t and A_{jt} denotes the quantity of advertising. We model the quality as $q_{jt} = X_{jt}\beta + \xi_{jt}$, where ξ_{jt} is a random term capturing the unobserved quality of channel j in period t, and X_{jt} is a matrix of variables including observed content characteristics, channel-fixed effects, month- and year-fixed effects. The observed content characteristics are broadcasting hours of fiction, entertainment, news, culture/science, sport and cartoon, capturing the observable channel-time specific broadcasting quality. Channel dummies capture the brand awareness of each individual TV station; year dummies capture the potential changes in policy, fluctuations of the economic climate and the generalization of the digital TV technology; month dummies capture the seasonality of TV viewing.

We also specify the error term ζ^i_{jgt} in Equation (1), which reflects individual deviations from the mean valuation, as a weighted sum of two unobserved variables ε^i_{gt} and ε^i_{jt}

$$\zeta^i_{jgt} = \varepsilon^i_{gt} + (1-\sigma)\varepsilon^i_{jt}, \tag{3}$$

where the term ε^i_{gt} affects the individual i's preferences common to all channels belonging to group g, and the term $(1-\sigma)\varepsilon^i_{jt}$, impacts the individual i's preferences specific to product j. The two terms ε^i_{gt} and ε^i_{jt} are distributed in such a way that the individual preferences have an extreme value distribution and are allowed to be correlated across channels j. (See MacFadden *et al.*, 1978 and Williams, 1977.)

The parameters of interest to be estimated are α and σ. The parameter α measures the mean preference of TV viewers for advertising: A positive (negative) value of α suggests that viewers value (disvalue, respectively) adverts. We let the data decide the sign of α at the estimation stage. Moreover, a statistically significant α would confirm the two-sided nature of TV market and is hence a crucial element of our structural estimation.

The parameter $\sigma \in [0, 1)$ measures the substitutability of TV channels belonging to the same group. As σ approaches one, the TV viewers substitute significantly between channels within the same group g; as σ decreases, the correlation of preferences for channels within a same group decreases. Typically, $\sigma = 0$ signifies that the TV viewers are equally likely to switch between channels in different categories as between channels in the same group.

Following Berry (1994), the mean utility level for the outside good is normalized to 0, i.e., $\delta_0 = 0$, and the demand of viewers is specified as

$$ln(\mathfrak{s}_{jt}) = X_{jt}\beta + \alpha A_{jt} + \sigma ln(\bar{\mathfrak{s}}_{jt/g}) + ln(\mathfrak{s}_{0t}) + \xi_{jt}, \tag{4}$$

where $\mathfrak{s}_{jt}$ ($\mathfrak{s}_{0t}$, respectively) is the probability that an individual chooses to watch channel j (to take the outside option) at time t. The probability $\mathfrak{s}_{jt}$ is decomposed as the product of two probabilities: the probability $\bar{\mathfrak{s}}_{jt/g}$ of watching channel j given that channel j belongs to group g and the probability $\bar{\mathfrak{s}}_{gt}$ that an individual chooses to watch channels of group g. The difference in brand awareness between incumbents and new entrants imply that the probability of choosing an incumbent channel is greater than the probability of choosing a new entrant. As we think over a representative TV viewer, the choice probabilities $\mathfrak{s}_{jt}$, $\bar{\mathfrak{s}}_{jt/g}$, $\mathfrak{s}_{0t}$ coincide at the aggregate level with the market share of channel j s_{jt}, the market share of channel j within its group $\bar{s}_{jt/g}$ and the market shares of the outside goods s_{0t}, respectively.

[12] Note that we observe monthly average number of viewers per channel per second, computed from the per second measurement by Médiamétrie. (See footnote 5.) We assume that a viewer chooses one channel to watch in a given second and that the number of viewers per second is constant for a channel j within a month t.

If, at time t, T_t is the market size and if y_{jt} is the number of TV viewers watching TV j, the audience share of channel j and its audience share within its group are measured as $s_{jt} = y_{jt}/T_t$ and $\bar{s}_{jt|g} = s_{jt} \Big/ \sum_{j \in C_g} s_{jt}$, respectively, while the audience share of the outside good is obtained as $s_{0t} = 1 - \sum_j s_{jt}$.[13]

From Equation (4), we define the number of viewers as $y_{jt} = s_{jt} T_t \equiv y_{jt}(\mathbf{A}_t)$, where $\mathbf{A}_t = \{A_{1t}, \ldots, A_{jt}, \ldots, A_{Jt}\}$ is the vector of advertising quantities of all channels. Finally, the TV viewers' demand function to be estimated is given by

$$\ln s_{jt} - \ln s_{0t} = \alpha A_{jt} + \sigma \ln \bar{s}_{jt/g} + X_{jt}\beta + \xi_{jt}. \tag{5}$$

Identification

Equation (5) entails two identification problems. The first one concerns the parameter σ. Conceptually, observing the viewers' switch between channels within the same group (i.e., incumbent, entrant, or outside channels) over time should allow for identification of σ, as it involves changes in the conditional probabilities of choosing the same group. These variations can be either the result of changes in channels' characteristics or the result of changes in the number of channels operating on the market. There is, however, a potential endogeneity problem if viewers switch from a channel because of some unobserved changes in the characteristics of the TV channel. Indeed, in Equation (5), when ξ_{jt} is high, the market share s_{jt} is high, but the conditional market share, $\bar{s}_{jt/g}$, is also high, not only because of the viewers' switch from channels of its own group but also because of some viewers that have switched from channels of other categories. For instance, when an incumbent TV channel j increases the quality of its broadcasting content during period t, it attracts additional viewers both from other incumbent channels and from the new channels. We do not observe this change in the quality of channel j, which is captured by ξ_{jt}; however, we observe an increase in its market share s_{jt} and its conditional market share $\bar{s}_{jt/g}$. As a consequence, the estimate of σ could be biased upwards unless $\bar{s}_{jt/g}$ is properly instrumented for.

The second issue of identification comes from the fact that the market shares of TV channels s_{jt} and the advertising quantities A_{jt} are determined simultaneously. The random term ξ_{jt} includes characteristics of channel j during period t that are unobserved by econometricians but are likely to be observed by the TV stations. The equilibrium level of advertising A_{jt} should be high (or low) if the TV operator anticipates that its viewership s_{jt} will be high (or low). Hence, without controlling for the advertising quantity A_{jt}, the estimate of α would be biased upward (or downward, respectively).

We use the following BLP-style instrumental variables to address the endogeneity issue: monthly broadcasting hours of news and entertainment of all competing channels, as well as monthly broadcasting hours of news and entertainment of all competing channels in a group (incumbent or entrant). Note that the channels which share common-ownership with the instrumented channel are not considered as competing channels in our IV construction. The validity of above instruments relies on the decision timing of broadcasting content and of advertising quantity. According to experts of the industry, the broadcast TV content are decided at least three months before the broadcasting time. Since the content are chosen simultaneously on different TV channels, the choice of a channel cannot depend on the content quality of a competing channel during the same period. In other words, the instrumental variables - broadcasting hours of news and entertainment of competing channels within the same month - is independent of the error term, namely, unobserved show quality of the instrumented TV channel in Equation (5). TV stations communicate their broadcasting content to public about three months prior to their actual broadcasting time.

[13] In the empirical part, the market size is measured as the total French population.

The advertising sales houses collect such information, and determine the optimal advertising quantity of each channel according to the attractiveness of its content with respect to the content of its competitors. Therefore, the instrumental variables - the broadcasting hours of different TV shows of competing channels - is correlated with the endogenous variable, namely, the advertising quantity of the instrumented channel A_{jt}. The TV shows of competing channels in a group (incumbent or entrant) can explain the conditional market shares of each channel in its respective group $\bar{s}_{jt/g}$, meaning that this set of instruments - broadcasting hours of different TV shows of competing channels in a group - is correlated with the endogenous variable, namely, the conditional market shares of each channel in its respective group $\bar{s}_{jt/g}$.

3.2 Advertisers demand

[TO BE COMPLETED]

4 Estimation results

4.1 Viewers demand

The estimation results for Equation (5) are reported in Table 5. Both the coefficient associated with the advertising quantity, $\hat{\alpha}$, and the one associated with the within-nest shares, $\hat{\sigma}$, are significant at the one percent level. Since $\hat{\alpha} < 0$, an increase in the advertising quantity induces a decrease in viewership of TV channels. This result suggests that, on average, TV viewers are adversely sensitive to advertising level. The estimated $\hat{\sigma}$ is significantly smaller than 1, indicating that there exists competition between the incumbents and new channels; the value of $\hat{\sigma}$, however, suggests that there is significant segmentation between the two groups of channels (incumbents and entrants).

Note that news and cartoon have statistically significant mean positive effect on the size of audience, but entertainment has a statistically significant mean negative effect on the size of audience. In fact, the genre "entertainment" includes many unpopular programs that the TV channels use to fill the broadcasting slots during working hours and sleeping time; several high quality shows belonging to this category are exclusively broadcast by the incumbent channels - whose impact on audience size is capture by the nest parameter and channel fixed effect. We could not identify any statistically significant effect of Fiction neither Culture/Science on the audience size, because the total broadcasting hours of both genres do not vary from one month to another, although their offer (in terms of broadcasting hours) are very channel specific. In other words, the effects of Fiction and Culture/Science programs on the audience size of TV channels are absorbed by the channel-fixed effect in the monthly data. We do have identified a positive effect of sports on the audience size, though the parameter is insignificant at conventional significance level. This is because there is an important heterogeneity among different sport events, this genre includes the broadcasting of Champions League, Roland Garros tennis tournament, Olympic Games but also many small sport events that are scheduled daily between 00:00 and 06:00. We note here that monthly data are not the best to study the genre effects on the audience size. TV channels do have a strategy to schedule different genres at different time of a day, but the offer of many genres (in terms of broadcasting hours) does not vary importantly from one month to another. We note however that the goal of this paper is not to comment on the different genre effects on the audience size, the broadcasting hours of different program genres are covariates that we control for in the viewers demand model to better identity the disutility of advertising (measured by $\hat{\alpha}$) and the segmentation between the incumbent channels and the new entrants (measured by $\hat{\sigma}$).[14]

[14] Zhang (2019) provides more detailed comments and more precise estimation about the different genre effects

Table 5: Estimates of viewers demand

	$\ln s_{jt} - \ln s_{0t}$	
	coef.	(s.e.)
Advertising quantity (α)	-0.111***	(0.031)
Within-nest share (σ)	0.636***	(0.192)
Fiction	0.003	(0.003)
Culture/Science	0.001	(0.004)
News	0.068***	(0.009)
Entertainment	-0.255***	(0.078)
Sport	0.011	(0.009)
Cartoon	0.461**	(0.111)
Channel FE	Yes	
Month FE	Yes	
Year FE	Yes	
No. observations	840	
Cragg-Donald Wald F statistic	14.665	
Hansen J statistic (p-value)	0.440	

Standard errors are in parentheses: ***p<0.01, **p<0.05,*p<0.1

To validate our choice of instruments, we conduct statistical tests for weak instruments and overidentification of the IV estimations of equation (5). The results are reported in the bottom of Table 5. The Stock-Yogo weak instrument test suggests the instruments are strong, while the Hansen J statistic does not reject the null hypothesis that the instruments are valid at the 10% levels.

The first stage regressions are reported in Table 13 in Appendix 1. Total broadcasting hours of news and entertainment of all the competing channels can explain advertising quantity of the instrumented channel. News have mean positive effect on audience, while the entertainment programs have mean negative effect on the size of audience (see Tables 5). Accordingly, the advertising quantity of competing channels are higher during the news programs, but are lower during the entertainment programs. The advertising quantity of the instrumented channel is higher when it anticipates higher advertising levels among its rivals, due to more news scheduled by its rivals, and/or due to less entertainment programs scheduled by its rivals. The sum of broadcasting hours of news and entertainment programs of the competing channels in a group (incumbent, entrant) explain significantly the logarithm of the conditional market share, $\ln(\bar{s}_{jt/g})$. The conditional market share of a channel decreases with the quantity of news broadcast by its close competitors (competing channels in the same group), but increases with the amount of entertainment programs broadcast by its close competitors. We have also tested if the estimates in Tables 5 are robust to the choice of instruments by including additional instrumental variables in the estimation. Such manipulation does not change significantly the value of estimates but decreases the associated Cragg-Donald Wald F statistics. (See Table 15 in Appendix for details.)

on the audience size of TV channels using hourly data.

To determine whether the instruments used in the estimation are helpful in fixing the endogeneity bias, we compare the results from the IV estimation with those from OLS in Table 14 in Appendix. We observe that the parameter estimates associated with the advertising quantity and the within-nest share in the viewers' demand function strongly differ under the two types of estimation. Without controlling for the endogeneity bias, the quantity of advertising reflects the quality of TV channel and is estimated to have a positive effect on the audience of the channel. The disutility effect of advertising can be isolated from the quality of the TV channel only if the endogeneity bias is properly controlled for. Moreover, with the nested-logit model specification, the value of $\hat{\sigma}$ should be between 0 and 1. This constraint is not satisfied with OLS.

The own- and cross- elasticities of viewers' demand with respect to advertising quantity ($E^V_{jj,t}$, $E^V_{ji,t}$) follow the classical formula in nested-logit model (see for instance Verboven, 1996). Their estimates, averaged by channel over the sample periods, are reported in Table 6. Our results suggest a median audience loss of about 8.7 percent in response to a 10 percent increase in advertising time.[15] All the estimates of own-demand elasticities are significant at 10 percent significance level. The estimated cross-demand elasticities are very small - suggesting that the viewers substitute between channels to a very limited degree. Nevertheless, it is important to note that viewers do switch to other channels following an increase in advertising quantity, although the estimated substitution effects are very small. This is true in particular for channels TF1, NT1 and TMC, which suggests that these three channels do have an incentive to merge their advertising sales houses (ASHs) in order to internalize the competition in audience among them. However, given the week substitution effects of advertising, we should not expect an important change in advertising level following the merger of their ASHs.

4.2 Advertisers demand

[TO BE COMPLETED]

5 Merger evaluation

In January 2010, the French antitrust authority - the Autorité de la concurrence - cleared the acquisition of channels NT1 and TMC by the TF1 Group, subject to a behavioral remedy requiring that channels NT1 and TMC sell their advertising time separately from TF1 channel. In practice, the decision blocks the merger between the ASH of channel TF1 and the ASH of channels NT1 and TMC; only broadcasting content of the three channels are allowed to be managed jointly following the acquisition.

The antitrust authority has concluded that the acquisition would have positive impacts on the broadcasting side, since channels NT1 and TMC could benefit from the large catalog of programs of channel TF1 - thanks to its partnership with numerous content.[16] It was readily deemed that approving the merger of broadcasting services of the three TV channels could improve the broadcasting quality of NT1 and TMC without additional cost.

[15] We find relatively small own-demand elasticities, comparing to previous papers using US data. Wilbur (2008) finds a 10 percent rise in advertising time causes a median 25 percent audience loss on highly-rated TV networks, and larger percentage audience losses for low-rated networks. Using improved audience measurement, Wilbur, Goeree and Ridder (2009) finds a median audience loss of about 15 percent in response to a 10 percent increase in advertising time. The difference between our estimates and the finding in WGR (2009) should be explained by the much more intensive TV advertising in the US.

[16] The two purchased channels NT1 and TMC are new entrants to the market. While they are growing very fast, their catalogs of broadcasting programs are not as rich as the catalogs of the incumbent channels like TF1.

Table 6: Own-elasticities of viewers' demand wrt adverting quantity

		E^V_{jj}	E^V_{ji}_SG	E^V_{ji}_DG
Incumbents	TF1	−0.120	0.003	0.001
		(0.074)	(0.002)	(0.002)
	FR2	−0.062	0.001	0.0002
		(0.038)	(0.001)	(0.000)
	FR3	−0.054	0.001	0.000
		(0.033)	(0.000)	(0.000)
	M6	−0.108	0.001	0.0003
		(0.066)	(0.001)	(0.000)
	FR5	−0.036	0.000	0.000
		(0.022)	(0.000)	(0.000)
New entrants	NT1	−0.117	0.001	0.000
		(0.072)	(0.000)	(0.000)
	TMC	−0.118	0.002	0.000
		(0.072)	(0.001)	(0.000)
	D8	−0.101	0.001	0.000
		(0.062)	(0.000)	(0.000)
	FR4	−0.041	0.000	0.000
		(0.025)	(0.000)	(0.000)
	Gulli	−0.061	0.000	0.000
		(0.038)	(0.000)	(0.000)
	D17	−0.080	0.000	0.000
		(0.050)	(0.000)	(0.000)
	W9	−0.097	0.001	0.000
		(0.060)	(0.001)	(0.000)

Note: E^V_{ji}_SG denotes the cross-elasticities between channels within the same group (incumbents and entrants); E^V_{ji}_DG denotes the cross-elasticities between channels of two different groups (incumbents and entrants). Standard errors computed by delta method are in parentheses

The authority was, however, concerned about the eventual anti-competitive effects of merging ASHs of the three channels, due to the dominant position of TF1 Group in TV advertising market. Before the acquisition, the ASH of TF1 channel held a 40 percent market share, while the ASHs of channels NT1 and TMC held, respectively, two and three percent market shares. The merger could simply reinforce the position of TF1 Group in the advertising market, which would translate into an increase in either advertising quantity or prices. To avoid any detrimental effect of the acquisition on TV advertising market, the authority decided to impose a behavioral remedy - blocking the merger of ASHs of the three channels for at least a period of five years.[17]

Below we first provide some reduced-form evidence on the impact of the acquisition in TV advertising market. We next explain such effects by the changes in broadcasting quality of the three channels following the acquisition and by the two-sided network externalities between viewers and advertisers. In details, we estimate the changes in broadcasting quality of the three channels from our viewers demand model; then, we counterfactually simulate the acquisition effects in the absence of the two-sided network externalities between viewers and advertisers, to discompose the implication of the changes in broadcasting quality and the impact of two-sided network externalities on the advert auqntities and prices of the merging channels. Finally, we counterfactually simulate the advert quantities and prices of different TV channels in case where the ASH of channels NT1 and TMC merged with the ASH of TF1 channel, to comment on the effectiveness of the behavioural remedy.

5.1 Evidence on the impact of the acquisition in TV advertising market

To get a first insight on the impact of the acquisition on advertising quantities and prices of the merging channels, we estimate the following regression, in line with Ashenfelter and Hosken (2010) and Björnerstedt and Verboven (2015):

$$\ln A_{jt} = \mu_j + \rho_j PostAcquistion_t + \eta_{jt};$$

$$\ln P_{jt} = \tau_j + \lambda_j PostAcquisition_t + \omega_{jt},$$

where A_{jt} and P_{jt} denote respectively the advertising quantity and price of channel j during period t; μ_j and τ_j denote the channel-fixed effect; the variable $PostAcquisition$ is equal 0 from March 2008 to January 2010, and is equal to 1 from January 2010 to December 2013.

As noted in Björnerstedt and Verboven (2015), these regressions can be interpreted as difference-in-difference estimators - where the difference between the merging firms' ρ_j (λ_j) and the competitors' ρ_j (λ_j) measures the merger effect on the advert quantities (prices) - under the assumption that the merger does not have an impact on the competitors' advert quantities (prices). In practice, however, the merger could raise the competitors' prices as well; then, the difference between the merging firms' ρ_j (λ_j) and the competitors' ρ_j (λ_j) could be viewed as a lower bound of the merger effect on the advert quantity (price) of channel j.

We use our full sample (22 months pre-acquisition data and four years post-acquisition data) to estimate the channel-specific treatment effects ρ_j and λ_j.[18] Estimation results are reported in Table 7.

We note that the acquisition led to a significant increase in advertising quantities and prices of the two purchased channels (NT1 and TMC), but seems not to have a significant impact on the

[17] The ASHs of the three channels remained separated after the effective period of the behavioral remedy, eventually because TF1 Group does not want to provoke higher level of inspection by the antitrust authority.

[18] As a robustness check, we have also estimated ρ_j and λ_j using only one year pre-acquisition data and one year post-acquisition data, i.e, 288 observations for 12 parameters in each equation. We find similar coefficients as using the full sample but the estimated ρ_j becomes insignificant, due to the small number of observations.

Table 7: Actual advert quantity and price effects

	Advert Quantity (% change)		Advert Price (% change)	
	coef.	(s.e.)	coef.	(s.e.)
$TF1 \times Acquisition$	10.71	(0.067)	- 2.50	(0.056)
$NT1 \times Acquisition$	28.42***	(0.078)	68.77***	(0.097)
$TMC \times Acquisition$	23.31***	(0.074)	59.80***	(0.093)
$Others \times Acquisition$	Yes		Yes	
Channel FE	Yes		Yes	

Note: The percentage advert quantity and price effects are obtained from a transformation of the parameters ρ_j and λ_j using $exp(\rho_j)-1$ and $exp(\lambda_j)-1$. $Others \times Acquisition$ reports the mean percentage effects of the acquisition on the advertising quantities and revenue shares of the non-merging channels. Standard errors are computed using the delta method. ***p<0.01, **p<0.05,***p<0.1

advertising quantity neither price of channel TF1. These effects could eventually be explained by the increase in their broadcasting quality following the acquisition. Intuitively, viewers' demand is less elastic to advertising quantity during better broadcasting content, which implies that the ASH of the two purchased channels has incentive to increase their advertising level following the acquisition as a strategic reaction to an increase in their broadcasting quality; better programs attract more viewers, which in turn increase the advertisers' willingness to pay for these two channels. As we find insignificant effect of the acquisition on the advert quantity and price of TF1 channel, we conjecture that there could be a reallocation of high quality programs from TF1 to NT1 and TMC, i.e., an increase in broadcasting quality of NT1 and TMC, but a decrease in broadcasting quality of TF1. We will estimate the post-acquisition changes in broadcasting quality of the three channels from our viewers demand model in Section 5.3 below.

5.2 Market Equilibrium

We now write down the profit maximization problem of advertising sales houses (ASHs), which will be used to perform different counterfactual simulations. The profit of ASHs depends on the demands of viewers and of advertisers, and on the feedback loop between the two groups of consumers. Each ASH maximizes the joint profit from advertising slots of all channels under its management. Formally, the profit function of an ASH $\mathscr{H}_k, k = \{1, ..., K\}$, in month t is given by

$$\Pi_{kt} = \sum_{j \in \mathscr{H}_k} \Pi_{jt} = \sum_{j \in \mathscr{H}_k} (p_{jt} - c_{jt}) A_{jt}, \tag{6}$$

where c_{jt} is the marginal cost of commercializing one second of advertising on channel j in month t for the ASH $\mathscr{H}_k$.

At equilibrium, advertising quantity is the variable which links both sides of the market: it has an impact on both the viewership and the advertising prices of TV channels. An ASH internalizes network externalities between viewers and advertisers by choosing the advertising quantity which

maximizes its profits. Namely,

$$\max_{\{A_{jt}\}_{j\in\mathscr{H}_k}} \sum_{j\in\mathscr{H}_k} \left[\left(p_{jt}(\mathbf{A}_t, Y_t(\mathbf{A}_t)) - c_{jt}\right) A_{jt}\right]$$

Assuming that a pure strategy Nash equilibrium in advertising quantity exists and omitting the time index t for the sake of clarity, the first-order condition (FOC) associated with above profit maximization problem is given by:

$$(p_j - c_j) + \sum_{k\in\mathscr{H}_k} \left[A_k \left(\frac{\partial p_k}{\partial A_j} + \frac{\partial p_k}{\partial Y} \sum_{i,\forall i} \frac{\partial Y}{\partial y_i} \frac{\partial y_i}{\partial A_j}\right)\right] = 0, \forall j \tag{7}$$

$\frac{\partial p_k}{\partial A_j}$ measures the impact of advertising quantity of channel j on the advertisers' willingness to pay for the advert slots of channel k; $\frac{\partial p_k}{\partial Y}\frac{\partial Y}{\partial y_i}$ measures the impact of viewership of channel i on the advertisers' willingness to pay for the advert slots of channel k; $\frac{\partial y_i}{\partial A_j}$ is the impact of advertising quantity of channel j on the viewership of channel i.

Using the estimated demands of viewers and advertisers and the observed prices and quantities, we solve Equation (7) for the marginal costs of commercializing one second c_{jt} of all channels j in month t of all ASH $\mathscr{H}_k$, Now, using above FOC (Equation (7)) and the estimated demand parameters α, σ, γ_j, γ_{ij}, θ_j, as well as the marginal costs c_{jt}, we can perform counterfactual simulations, to first exhibit the implication of two-sided network externalities between viewers and advertisers in the acquisition effects highlighted in Section 5.1, and to next evaluate the effectiveness of the behavioural remedy imposed by the competition authority.

5.3 Implication of two-sided network externalities in the acquisition effects

This section aims to clarify the following points: i) The average broadcasting quality of the three merging channels has increased following the acquisition; more precisely, the broadcasting quality of the two purchased channels (NT1 and TMC) has increased, while the broadcasting quality of TF1 channel has decreased. ii) The advertising sales houses (ASHs) react to the changes in broadcasting quality of TV channels by adjusting their advert quantities and prices. iii) In the absence of the negative externalities that advertisers generate to viewers, the ASHs respond to the increase in willingness to pay of advertisers for the merging channels - as a result of the increase in their broadcasting quality (therefore their viewership) - by restricting the total quantity of advert slots on the merging channels and thereby increase their advert prices. iv) The two-sided network externalitites between viewers and advertisers incentivize the ASHs to increase the advert quantities of the merging channels - following the increase in their broadcasting quality - since viewers are less sensitive to the advert quantities during better quality of programs. v) The joint effect of the increase in broadcasting quantity of the merging channels and the two-sided network externalities between viewers and advertisers is that both the advert quantities and prices of the merging channels have increased following the acquisition - regardless of a behavioural remedy aiming to limit such effect.

Changes in broadcasting quality of the three merging channels

The acquisition was cleared to improve the broadcasting quality of channel NT1 and TMC. To prevent detrimental effects on the advertising market, a behavioral remedy requiring NT1 and TMC to sell their advertising time separately from channel TF1 is imposed by the antitrust authority

upon approval of the acquisition. We will check if the expected positive effect on the broadcasting quality of NT1 and TMC has been achieved.

We can estimate the TV channels' broadcasting quality from our nested-logit model of viewers' demand. Formally, according to the TV viewer's utility function (1), the mean quality of channel j at time t can be measured by q_{jt} (see equation (2)). The estimated percentage changes in value of q_{jt} from 2010 to 2013 are reported in the first row of Table 8 for each of the three channels. We find a clear reallocation of quality from channel TF1 to channels NT1 and TMC; the average quality of the three merging channels has increased by 16.5%.[19]

Together with the change in broadcasting quality of different TV stations (in particular, an improvement in broadcasting quality of NT1 and TMC), we observe a significant increase in advertising quantities and prices of the two purchased channels (see Panel 1 of Table 8).

Table 8: Acquisition effects (merging only the BS): changes from 2010 to 2013

	TF1	NT1	TMC	Average TF1 Group
Quality (q_{jt})	−15.03%	19.01%	10.39%	16.49%
Panel 1: viewers are sensitive to advert quantity				
Ad quantity (A_{jt})	1.56%	19.37%	12.39%	10.76%
Ad price (p_{jt})	1.00%	59.78%	22.86%	5.68%
Panel 2: viewers are assumed to be insensitive to advert quantity				
Ad quantity (A_{jt})	−10.83%	−3.09%	−2.74%	−5.62%
Ad price (p_{jt})	0.94%	60.86%	22.86%	5.61%

Note: q_{jt} is estimated from the demand model (equation (2)); A_{jt} and p_{jt} reported in Panel 1 are directly observed in the data, A_{jt} and p_{jt} reported in Panel 2 are simulated according to the procedure described in Section 5.2. BS: broadcasting side

Implication of the changes in broadcasting quality on advertising quantities and prices

As shown clearly by equation 7 above, each ASH $\mathscr{H}_k$ trade-off among three effects when determining the advert quantity of a channel j at equilibrium: impact of the advert quantity A_j on the viewership of different TV channels y_i ($\frac{\partial y_i}{\partial A_j}, \forall i$), impact of viewership of different TV channels on the willingness to pay of advertisers for the advert slots of the ASH p_k ($\frac{\partial p_k}{\partial y_i} \equiv \frac{\partial p_k}{\partial Y}\frac{\partial Y}{\partial y_i}, \forall i, \forall k \in \mathscr{H}_k$), the direct impact of advert quantity A_j on its own advert price p_j and on the advert price of the other channels managed by the same ASH p_k ($\frac{\partial p_k}{\partial A_j}, \forall j \in \mathscr{H}_k$).

[19] In practice, both NT1 and TMC got the broadcasting right of some attractive programs that might have been scheduled on TF1 channel without the acquisition. For instance, since 2011, NT1 started to broadcast some popular foreign series such as "True Blood", "Falling Skies' and started to offer a new culture program "Tous Différents", which is 100% produced by TF1 Group and which has a significant audience size; TMC got the live broadcasting right of the marriage of His Serene Highness Prince Albert II of Monaco with the South African swimmer Charlene Wittstock in 3 July 2011, and broadcast the movie Bodyguard in 13 February 2012, in tribute to the singer Whitney Houston, deceased - thanks to the broadcast right previously acquired by TF1 Group; both shows have generated significant peaks in audience for TMC.

The broadcasting quality of a TV channel j ($q_j, \forall j$) impacts its advertising level (A_j) in two ways: first, via its impact on the viewers' demand elasticity with respect to its advertising level (the value of $\frac{\partial y_i}{\partial A_j}, \forall i$ depends on the value of q_j, which is captured by the nested logit model for viewers demand); second, through its impact on the flexibility of advertising prices with respect to its advertising quantity (the value of $\frac{\partial p_k}{\partial A_j}, \forall j \in \mathscr{H}_k$ depends on the value of q_j, because the value of p_k depends on the viewership of different TV channels: $p_k = f(y_1, ..., y_J)$; this feature is captured by the translog model for advertisers demand).

Intuitively, improving broadcasting quality of a TV channel incentivizes its ASH to choose a higher advertising level, as it reduces the TV viewers' demand elasticity with respect to the advertising quantity of this channel.[20] However, there maybe an off-setting incentive for the ASHs to reduce the advert quantity but increase the advert price instead, due to the increase in flexibility of advertising prices with respect to advertising quantity.[21] The first incentive comes from the negative externalities that the advertisers generate to viewers; the second incentive is the implication of changes in broadcasting quality of TV channels on their advert quantities and prices.

Simulating the acquisition effects in the absence of two-sided network externalities

To comment on the implication of two-sided network externalities on the acquisition effects, we simulate the equilibrium level of advertising quantities and prices of the three merging channels, under the assumption that the TV viewers' demand is inelastic to the advertising quantity. The goal of this exercise is to clarify what would be the acquisition effects in advertising market without the two-sided network externalities between viewers and advertisers.

In the counterfactual simulation, we keep the broadcasting quality of different TV channels at the same level as in the observed equilibrium (with two-sided network externalities), so that the simulated results are directly comparable to the observed acquisition effects.

The equilibrium choices in advert quantity of the 12 TV stations are simulated simultaneously. The simulation procedure (detailed below) takes into account the strategic reactions between different TV channels. For instance, the ASH of TF1 channel acknowledges that the advert quantity of TF1 channel impacts not only the viewership of TF1 but also the viewership of the other channels, which will all have an impact on the equilibrium level of advert price of TF1 channel.

Such simulation can be performed using the first order condition derived in Section 5 (equation (7)). Viewers' demand is inelastic to advertising implies that the term $\frac{\partial y_i}{\partial A_j}$ is equal to 0, $\forall i$. Omitting time index t for the sake of clarity, equation (7) can be simplified as:

$$(p_j - c_j) + \sum_{k \in \mathscr{H}_k} A_k \frac{\partial p_k}{\partial A_j} = 0, \forall j \tag{8}$$

The simulated changes in advertising quantities and prices of the three merging channels from 2010 to 2013 are reported in the Panel 2 of Table 8 above.[22][23] The results suggest that the

[20] $d\frac{\partial y_j}{\partial A_j}/dq_j < 0$.

[21] The value of $d\frac{\partial p_k}{\partial A_j}/dq_j$ can be either positive or negative in practice.

[22] We have carefully checked that the simulated advertising quantities are below the maximum levels imposed by the regulator.

[23] Notice that the advertising level in a given period should be indeed higher when viewers don't care about advertising quantity than when they do. The simulated total advertising time is 12.34 percent higher within the period 2010-2013 under the assumption that viewers do not care about advertising. The negative values reported in the first row of Panel 2 in Table 8 are changes in advert quantities from 2010 to 2013, which captures the effects of change in broadcasting quality of the merging channels in the absence of the negative externalities that advertisers generate to viewers.

increase in broadcasting quality of TV channels has increased the flexibility of advertising prices with respect to the advertising quantity: the optimal strategy of the ASHs - in the absence of the two-sided network externalities between viewers and advertisers - is to restrict the advertising quantity to increase the advertising prices following an increase in TV channels' broadcasting quality.

Impacts of the two-sided network externalities between viewers and advertisers

Comparing the simulated acquisition effects in Panel 2 of Table 8 to the observed acquisition effects in Panel 1, we could derive two conclusions. First, the negative externalities that advertisers generate to viewers incentivize the ASHs to increase advertising quantity following an increase in TV channels' broadcasting quality, as indicated by the difference between the advert quantity (A_{jt}) reported in Panel 1 and Panel 2; Second, the joint effect of the two-sided network externalities and the broadcasting quality reallocation (from TF1 to NT1 and TMC) is to increase both the advertising quantities and prices of all the three merging channels, as reported in Panel 1 of Table 8.

5.4 Effectiveness of the antitrust decision

This section aims to evaluate the effectiveness of the antitrust decision. In particular, we wish to comment on the effects of the behavioral remedy imposed by the French authority in counterpart of its approval of the acquisition of channels NT1 and TMC by the TF1 Group. Our sample covers three years of post-acquisition periods (2010-2013), where we observe the realized market equilibrium under the remedy which requires that the ASH of channel NT1 and TMC remains separate from the ASH of TF1 channel. One practical way to assess the effectiveness of the implemented behavioral remedy is to compare the observed market equilibrium to a counterfactual situation, where one unique ASH determines the advert quantities of the three channels which maximize the joint advert profits from them. As we observe the quality adjustment of different TV channels following the acquisition, our counterfactual simulation - using ex-post data from 2010 to 2013 - takes into account the acquisition effect on product quality that has been assessed recently by Chen ans Gayle (2019).[24]

The simulated results are reported in the Panel 2 of Table 9.[25] To facilitate the comparison with the observed acquisition effects (changes in advert quantities and prices from 2010 to 2013, reported in Panel 1 of Table 9), we report directly the simulated changes from 2010 to 2013 in Panel 2 of Table 9.[26]

Comparing the numbers reported in Panel 2 to the numbers reported in Panel 1 of Table 9 allows us to conclude on the impacts of the behavioral remedy. We note that merging ASHs of the three channels has almost no impact on their advertising prices, while their total advert quantity has only increased slightly. This result is not surprising, providing that the substitutional effects of advertising quantity on the viewers' side is small, and that the advertisers consider the advert slots of NT1 and of TMC to be complementary to the advert slots of TF1 channel (see results in Section 4.2). It is well known that merger between complementary firms should not lead to a significant price increase since it eliminates a pricing externality. (See Cournot, 1838 and Economides and Salop, 1992.)

The behavioural remedy was adopted to prevent anti-competitive effects that a common ASH for the three merging channels could eventually cause in TV advertising market. The antitrust

[24] The broadcasting quality q_{jt} is estimated as in Section 5.3.

[25] We have carefully checked that the simulated advertising quantities are below the maximum levels imposed by the regulator.

[26] Panel 1 of Table 9 are identical to Panel 1 in Table 8.

Table 9: Changes from 2010 to 2013

	TF1	NT1	TMC	Average TF1 Group
Panel 1: Actual changes (merging only BS of TF1, NT1 and TMC)				
Ad quantity (A_{jt})	1.56%	19.37%	12.39%	10.76%
Ad price (p_{jt})	1.00%	59.78%	22.86%	5.68%
Panel 2: Simulated changes (merging both BS and AS of the three channels)				
Ad quantity (A_{jt})	8.44%	18.85%	7.73%	11.49%
Ad price (p_{jt})	1.07%	61.25%	23.03%	5.76%

Note: A_{jt} and p_{jt} reported in Panel 1 are directly observed in the data, A_{jt} and p_{jt} reported in Panel 2 are simulated according to the procedure described in Section 5.3. BS: broadcasting side; AS: advertising side

authority worries that merging ASHs of the three channels might disadvantage the other competing ASHs and the consumers (viewers and advertisers). We now evaluate the welfare effects of the acquisition and the behavioral remedy, in order to conclude on the effectiveness of the antitrust decision. We can evaluate the variation in viewer surplus from our nested-logit model, as in Small and Rosen (1981): $CS_{\_viewers} = -\frac{1}{\alpha} ln[1 + \sum_g [\sum_{j \in g} exp(\frac{q_{jt} + \alpha A_{jt}}{(1-\sigma)})]^{(1-\sigma)}]$. The variation in advertisers' surplus can be evaluated by $C_t = \sum_j p_{jt} \times A_{jt}$ which measures the total advertising cost. The advertising profit of an ASH k is given by equation (6): $\Pi_{kt} = \sum_{j \in \mathcal{H}_k} (p_{jt} - c_{jt}) A_{jt}$.

The estimated welfare changes following the acquisition (from 2010 to 2013) under the behavioral remedy - merging only broadcasting services of the three channels - and without the behavioral remedy - merging both broadcasting services and ASHs of the three channels - are reported in Table 10.

Table 10: Welfare changes from 2010 to 2013

	Viewers' surplus	Total advert cost	Total profit (TF1 Group)	Total profit (others)
Merging only BS:	−7.94%	13.26%	4.03%	71.18%
Merging BS & AS	−8.33%	−0.08%	10.13%	−3.22%

Note: Results reported in the second row are computed from the observed data, results reported in the third row are computed from the simulated data. BS: broadcasting side; AS: advertising side

The first row of Table 10 reports the welfare effects of the acquisition under behavioral remedy, i.e., the welfare effects of merging only broadcasting services of channel NT1, TMC and TF1. The reported changes in viewers' surplus in the first row of Table 10 indicates that the surplus of TV viewers has decreased following the acquisition. This is first because the TF1 Group reallocates some high quality programs from TF1 channel to the two purchased channels, the broadcasting quality of its major channel - which is also the most popular channel of the market - has decreased following the acquisition. In addition, the total advertising quantity increased from 2010 to 2013, which negatively impacted the surplus of TV viewers as well. The reported change in total advert

cost in the first row of Table 10 indicates that the advertisers' total advertising costs has increased following the acquisition, since both the market average level of advertising quantity and of price have increased from 2010 to 2013.

The second row of Table 10 reports the welfare effects of the acquisition without the behavioral remedy, i.e., the welfare effects of merging both the broadcasting services and the ASHs of channel NT1, TMC and TF1. Considering the difference between the results reported in the second row and the results reported in the first row, we should conclude that the remedy does not have a significant positive effect on the surplus of TV viewers, but has increased significantly the total cost for advertisers. If there was one common ASH which maximizes the joint profits from the advert slots of the three channels, the other non-merging ASHs would have to reduce their advert quantities and prices to attract viewers and advertisers following the acquisition - as strategic reactions to the advert quantity and prices chosen by the common ASH of the three merging channels; the total advert profits of the ASH of TF1 Group would be higher, while the total advert profits of the other non-merging ASHs would be lower - compares to the case where two separate ASHs manage the advert slots of channels NT1, TMC and TF1 (i;e, the results reported in the first row of Table 10). Our finding suggests that the implemented behavioral remedy has benefited the competing ASHs of TF1 Group, but has disadvantaged the advertisers. Whether or not the merger of ASHs of the three channels of TF1 Group should be cleared depends on how the authority weighs the different market players.

6 Conclusion

This paper empirically studies the merger effects in a market with two-sided network externalities by exploiting the consequences of a special antitrust decision in France which only approved the merger on the broadcasting side of a two-sided TV market.

Using ex-post data, we evaluate the consequences of the acquisition. We show that the acquisition - which only cleared the merger of broadcasting services of three TV channels - has positive effect on their average broadcasting quality; however, blocking the merger of their respective advertising sales houses (ASHs) - through a behavioural remedy - is ineffective in limiting the increase in their advert quantities and prices.

We show by counterfactual simulation that the ASHs react to the changes in broadcasting quality of TV channels by adjusting their advert quantities and prices. In the absence of the negative externalities that advertisers generate to viewers, the ASHs respond to the increase in willingness to pay of advertisers for the merging channels - as a result of the increase in their broadcasting quality (therefore their viewership) - by restricting the total quantity of advert slots on the merging channels and thereby increase their advert prices. We show further that the two-sided network externalitites between viewers and advertisers incentivize the ASHs to increase the advert quantities of the merging channels as well - following the increase in their broadcasting quality - since viewers are less sensitive to the advert quantities during better quality of programs. The joint effect of the increase in broadcasting quantity of the merging channels and the two-sided network externalities between viewers and advertisers is that both the advert quantities and prices of the merging channels have increased - regardless of a behavioural remedy aiming to limit such effect.

To comment on the effectiveness of the behavioral remedy, we counterfactually simulate the acquisition effects without it. Our results show that the implemented remedy does not have a significant positive effect on the surplus of TV viewers and has increased the advertisers' total cost. We note, however, that merging ASHs of the three TV channels involved in the acquisition would shift the total advert profits from the non-merging channels to the merging ones. Whether

or not the merger of ASHs of the three channels should be cleared depends on how the authority weighs the different market players.

This paper makes two contributions to the literature. First, we propose a novel approach to model the demand of advertisers, which allows for multi-homing and complementarity. Second, we contribute to the antitrust policy in two-sided market, by showing that the two-sided network externalities impact significantly the outcome of antitrust decision.

APPENDIX

Table 11: Ratio of observed advertising quantities to authorized ceilings

		2008	2009	2010	2011	2012	2013
Incumbents	Channel 1	50.9%	43.5%	53.6%	53.8%	43.3%	44.4%
	Channel 2	41.0%	29.9%	38.1%	38.6%	35.6%	39.1%
	Channel 3	20.0%	22.1%	28.2%	29.7%	27.6%	27.7%
	Channel 4	83.7%	56.9%	64.7%	58.3%	56.4%	70.1%
	Channel 5	92.6%	67.7%	73.6%	69.7%	71.6%	75.3%
New entrants	Channel 6	23.5%	33.6%	39.6%	43.5%	59.0%	74.7%
	Channel 7	34.3%	35.3%	33.2%	30.5%	33.2%	43.4%
	Channel 8	33.0%	34.0%	37.8%	49.2%	62.5%	54.9%
	Channel 9	19.8%	29.8%	38.0%	35.3%	29.2%	37.6%
	Channel 10	18.3%	19.6%	20.2%	24.5%	31.6%	38.4%
	Channel 11	36.6%	45.2%	48.7%	52.0%	70.0%	77.5%
	Channel 12	41.9%	44.3%	52.0%	50.1%	69.0%	77.9%

Note: The names of TV channels are not reported for confidentiality reasons.

Table 12: Audience shares of incumbent channels versus new entrants

Year	Channel	Audience shares	
		Mean	Std.Dev.
2008	Incumbent	13.2%	0.074
	New	1.2%	0.005
2009	Incumbent	12.7%	0.071
	New	1.5%	0.006
2010	Incumbent	12.1%	0.067
	New	1.7%	0.007
2011	Incumbent	11.6%	0.063
	New	2.2%	0.007
2012	Incumbent	11.5%	0.060
	New	2.2%	0.007
2013	Incumbent	11.2%	0.060
	New	2.2%	0.008

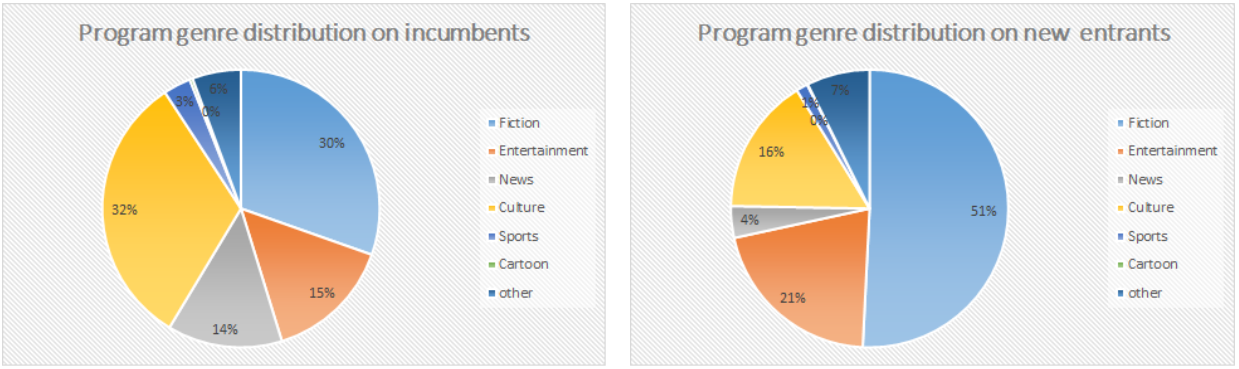

Figure 2: Genre distribution of incumbents versus new channels

Table 13: First stage estimation of TV viewers' demand

	A_{jt}	$\ln \bar{s}_{jt/g}$
Entertainment of all competing channels	-0.529***	0.034***
	(0.056)	(0.012)
News of all competing channels	0.596***	-0.029
	(0.107)	(0.024)
Entertainment of competing channels in a group	-0.252***	0.046**
	(0.032)	(0.023)
News of competing channels in a group	0.197***	-0.022*
	(0.049)	(0.012)
Broadcasting hours of different programs	Yes	Yes
Channel FE	Yes	Yes
Month FE	Yes	Yes
Year FE	Yes	Yes
No. observations	840	840

Standard errors of estimates are in parentheses: ***p<0.01, **p<0.05, *p<0.1

Table 14: OLS versus IV estimation of TV viewers' demand

	(OLS) $\ln s_{jt} - \ln s_{0t}$	(IV) $\ln s_{jt} - \ln s_{0t}$
Advertising quantity (α)	0.052***	-0.111***
	(0.008)	(0.031)
Within-nest share (σ)	1.025***	0.636***
	(0.038)	(0.192)
Broadcasting hours of different programs	Yes	Yes
Channel FE	Yes	Yes
Month FE	Yes	Yes
Year FE	Yes	Yes
No. observations	840	840

Standard errors of estimates are in parentheses: ***p<0.01, **p<0.05, *p<0.1

Table 15: Robustness check: TV viewers' demand estimation

	Results in Table 5 (favorite)	Results with additional IVs (robustness)
Advertising quantity (α)	-0.111***	-0.121***
	(0.031)	(0.031)
Within-nest share (σ)	0.636***	0.659***
	(0.192)	(0.193)
Fiction	0.003	0.003
	(0.003)	(0.003)
Culture/Science	0.001	0.002
	(0.004)	(0.004)
News	0.068***	0.070***
	(0.009)	(0.009)
Entertainment	-0.255***	-0.260***
	(0.078)	(0.079)
Sport	0.011	0.012
	(0.009)	(0.009)
Cartoon	0.461**	0.473***
	(0.111)	(0.113)
Channel FE	Yes	Yes
Month FE	Yes	Yes
Year FE	Yes	Yes
No. observations	840	840
Cragg-Donald Wald F statistic	14.665	11.914
Hansen J statistic (p-value)	0.440	0.303

The second column reports the estimates using monthly broadcasting hours of news and entertainment of all competing channels, as well as monthly broadcasting hours of news and entertainment of all competing channels in a group (incumbent or entrant). The third column reports the estimates using one additional set of IVs: monthly broadcasting hours of fiction of all competing channels; monthly broadcasting hours of fiction of all competing channels in a group (incumbent or entrant). Including more IVs than what we used in Table 6 results in similar estimates but decreases the Cragg-Donald Wald F statistics. Standard errors of estimates are in parentheses: ***p<0.01, **p<0.05,*p<0.1

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