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Competition and regulation of the advertising financed media platforms

Jiekai Zhang

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Soutenue par **Jiekai ZHANG**

Dirigée par Olivier Bomsel

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COMPOSITION DU JURY :

M. Pierre Dubois
Toulouse School of Economics
(Rapporteur)

M. Xavier d'Haultfoeuille
Crest-Ensa
(Rapporteur)

Mme. Margaret K. Kyle
Mines ParisTech
(Présidente du jury)

M. Marc Ivaldi
Toulouse School of Economics
(Examineur)

M. Olivier Bomsel
Mines ParisTech
(Examineur)



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Introduction

Advertising-financed media platforms include broadcast TV, radio, video-sharing websites (YouTube), internet searches engines (Google), social networks (Facebook) and online shopping malls (Amazon). These platforms provide services (or contents) free of charge to their users but bill heavily the advertisers. By using the platforms, users see the advertisements and thereby generate positive network externalities to the advertisers. Depending on the service (contents) proposed by the platforms, users may either appreciate or disappreciate the advertising. In other words, advertisers can generate either positive or negative externalities to the platform users. This preference determines the functioning of a market. When users welcome advertising, the media platforms connect two groups of consumers (users and advertisers) both generating positive network externalities on each other. In such case, the media platforms are facing similar network externalities as the two-sided credit card system. However, when the advertising is undesirable to the platform users, the media platforms have to internalize two opposite network externalities in order to make their strategic decisions. On the one hand, media platforms has an incentive to enlarge their advertising spaces as they earn revenues from advertising; on the other, too many ads may reduce the platforms' userships, which in turn reduce the willingness to pay of advertisers. Testing the platform users' preference for advertising is an empirical issue. Feedback loop between users and advertisers complicate the strategic behaviors of the platforms. As a consequence, the competition landscapes and regulation implications on these markets differ from the other markets. This thesis aims at exploring the particularity of the advertising-financed media platforms as two-sided markets. In particular, it evaluates the competition and regulation policies on these markets from a welfare perspective.

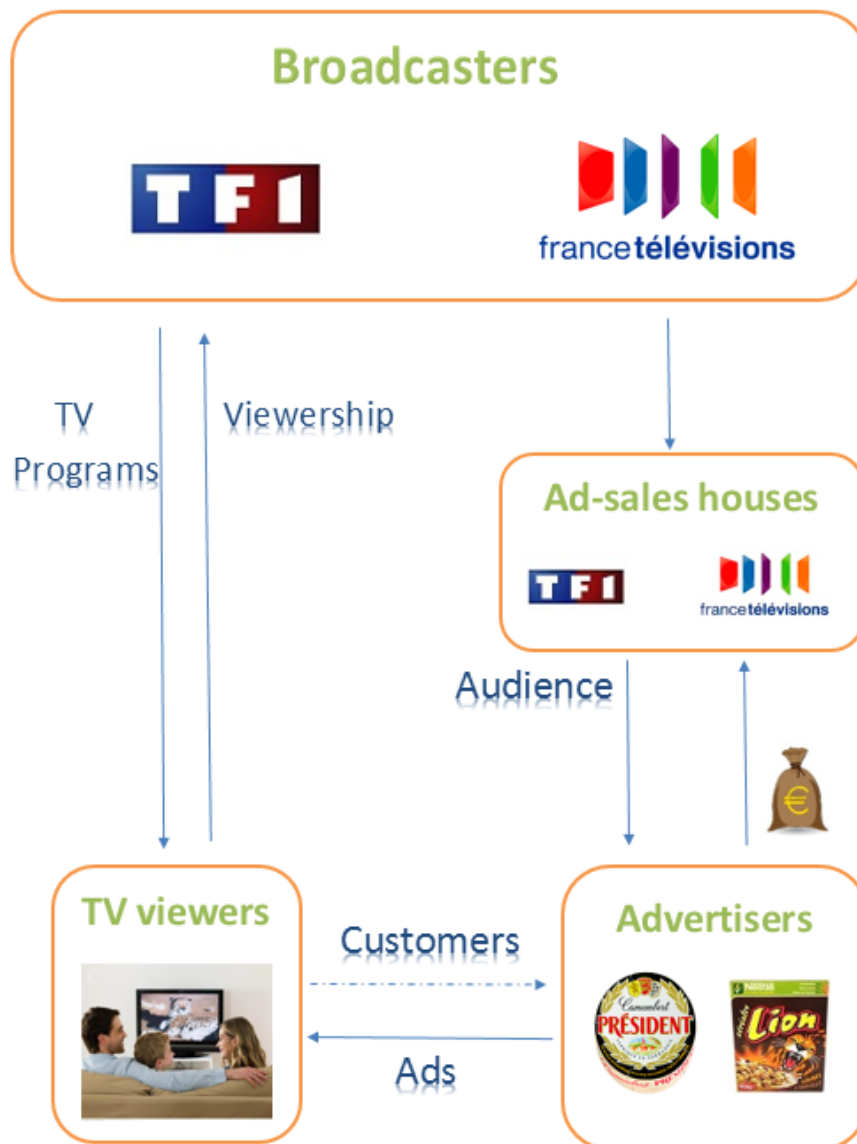
The thesis is composed of three essays. The two first ones are empirical. The third one combines a theoretical model and an empirical test. All the empirical works use data on the French broadcast TV market, mainly collected from the Conseil Supérieur de l'Audiovisuel (CSA). The reason why I chose broadcast TV market as an example of advertising-financed media platforms is twofold: first, data are relatively rich and accessible on this market; second, the television continuously dominates the leisure time of consumers. As reported by the Bureau of Labor Statistics' American Time Use Survey (ATUS), American consumers spend more than 10% of all available time, and more than 50% of the leisure time, watching TV. This trend is stable over the past 10 years, from 2003 to 2013. (See Handbook of Media Economics, 2015, Chapter 5.) According to the published report of the Observatoire des loisirs des Français in 2014, the television consists of an essential medium of leisure for 22% of the total French population (for 33% of the seniors, 29% of the pensioners, and 21% of women).

French broadcast TV industry

The economics of television markets are largely common across countries. For most of the television industry's history, we distinguish typically the broadcast and pay television. The recent development of digital broadcast distribution of (free and pay) television has weakened this distinction. To avoid misunderstanding, I will frequently use the term "free-broadcast television" all along this thesis. Pay television is supported as least in part by payments from subscribers (viewers). Free-broadcast television, in contrast, cannot charge the TV viewers, but relies mainly on advertising revenue. The broadcast television in France began in 1945. Until 2005, it was transmitted to audience through the analogue network. The commercial launch of digital terrestrial television in France took place on 31st March, 2005. This new technology gradually replaced the aged analogue broadcasting mode of free TVs. The French households

used to watch free-broadcast television. According to the survey of the CSA, in 2014, there are in total 207 pay TV channels in France, while their cumulative audience share is equal to 14%.

Broadcast TV stations are generally licensed by a national regulatory authority because the electromagnetic spectrum used by broadcasters is a public resource and licensing is required to prevent interference among broadcasters. In France, they are licensed by the Conseil Supérieur de l'Audiovisuel (CSA). The broadcasters do not pay license fee in France. However, as an exchange to the broadcasting rights, the broadcasters are subject to different obligations of participation in audiovisual production. As well, the broadcast TV stations are entirely responsible for the programming expenditure in France. This feature is different to the US broadcast TV market, where there is often a separation of ownership between content providers (broadcast networks) and distributors (broadcast stations). Figure below describes the two-sided business model of the French broadcast TV stations.



The first chapter of the thesis studies the advertising competition on the French broadcast TV market. We use a unique dataset on the French broadcast television market including

audience, prices, and quantities of advertising of twenty-one TV channels from March 2008 to December 2013. We specify a structural model of oligopoly competition and identify the shape and magnitude of the feedback loop between TV viewers and advertisers. We also implement a simple procedure to identify the conduct of firms on the market. We find that the nature of competition in the French TV advertising market is of the Cournot type. Further, we provide empirical evidence that the price-cost margin is not a good indicator of the market power of firms operating on two-sided markets.

In the second chapter, I study the welfare implications of the widespread regulation on TV advertising quantity. To my knowledge, this is the first work which structurally investigates this issue within a two-sided market framework. The essay exploits a novel dataset of per hour data on 12 broadcast TV channels in France during one year (2014). I first estimate the demand of TV viewers and of advertisers, which allows me to account for the two-sidedness of the market in the supply decision of TV stations. I identify the shadow prices of regulation based on the observed regulatory constraints. Finally, I conduct two counterfactual experiments to calibrate the welfare effects of the regulation. My results suggest that regulating advertising quantity is unnecessary on a competitive market, given the two-sided market structure of the broadcast TV industry. However, if TV broadcasters collude on their advertising supply, the regulation can improve upto 5.75% of consumer surplus, but decrease until 4.8% of the industry's profit.

Finally, in the last chapter, I use a theoretical model to analyze the competitive behavior of advertising financed media platforms. The platforms are specified to be horizontally differentiated and the market form is an oligopoly. The first major insight of the model is that the different platforms behave as strategic complements under Cournot competition. In particular, if a platform increases its quantity of advertising, it is optimal for its competitors to raise their respective advertising quantities as well. The model suggests that the merger of advertising sales houses of several platforms increases the advertising offers of all the competing platforms of the market (both the merged and unmerged), holding the quality of platforms unaffected. I further test the theoretical prediction with TV market data and model used in the first chapter, the empirical counterfactual simulation suggests same results as the theoretical model.

Chapter 1

Advertising Competition in the Free-To-Air TV Broadcasting Industry¹

English summary

This chapter empirically investigates the advertising competition in the French broadcast television industry within a two-sided market framework. We use a unique dataset on the French broadcast television market including audience, prices, and quantities of advertising of twenty-one TV channels from March 2008 to December 2013. We specify a structural model of oligopoly competition and identify the shape and magnitude of the feedback loop between TV viewers and advertisers. We also implement a simple procedure to identify the conduct of firms on the market. We find that the nature of competition in the French TV advertising market is of the Cournot type. Further, we provide empirical evidence that the price-cost margin is not a good indicator of the market power of firms operating on two-sided markets.

Résumé français

Ce chapitre étudie la situation concurrentielle du marché de la télévision en clair. A l'aide d'un modèle de concurrence oligopolistique, nous identifions la nature et l'ampleur des externalités entre téléspectateurs et annonceurs publicitaires. Nous contribuons à la littérature en mettant en œuvre une procédure simple permettant de tester le type de comportement des entreprises sur un marché. Nous démontrons que la nature de la concurrence sur le marché publicitaire de la télévision est de type Cournot (i.e. une concurrence sur la capacité d'offre d'écrans publicitaires). En outre, nos estimations nous permettent de conclure que, sur un marché biface, des taux de marge élevés sur une des faces du marché ne signifient pas une absence de concurrence. Nous validons ainsi empiriquement un résultat théorique établi par Tirole et Rochet en 2006.

¹Co-authored with Marc Ivaldi

1.1 Introduction

Consider a platform which provides two goods (or services) to two distinct but interrelated groups of consumers. By using the platform, each group generates either positive or negative externalities to the other groups of consumers. When one group of consumers is desirable (undesirable) to another group, the platform can strategically decrease (increase) the fee charged to the desirable (undesirable) group, thereby increasing the willingness to pay of the other group. In the case of free TV, the platforms (i.e., the TV channels) enable interactions between two groups of end users, namely the viewers and the advertisers; more precisely, they broadcast TV programs free-to-air to the TV viewers but charge the advertisers, observing that the advertisers' willingness to pay increases with the viewership of TV channels. In other words, the broadcast TV market is a particular two-sided market.² As explained in Rochet and Tirole (2008), taking into account the two-sidedness of markets can challenge the usual tests in competition analysis since the pricing strategies of two-sided platforms differ to those of firms operating on one-sided markets. This paper aims to provide an empirical evaluation on the significance and the magnitude of two-sided network externalities in a two-sided market. More specifically, we explore the two-sidedness of the broadcast TV industry in order to identify the shape of the feedback loop between TV viewers and advertisers, to clarify the conduct of TV channels on the advertising market, and to provide a credible evaluation of traditional economic tools implemented by competition authorities on this market.

Our work is motivated by a recent acquisition case in the French broadcast TV industry. On 26 January 2010, the French competition authority (Autorité de la concurrence, AdC) authorized the acquisition of two free broadcast TV channels TMC and NT1 by the media-holding company, the TF1 Group, subject to various conditions. Before the acquisition, the TF1 Group, as the most active media group in the French free TV broadcasting industry, already enjoyed a dominant position on the national TV advertising market by holding approximately 40% – 50% of the market. The acquisition of these two free channels strengthens the Group's position. If all three channels (i.e., TF1, TMC and NT1) could offer their advertising spaces through one common advertising sales house, the operation could lessen the degree of competition in the advertising market. For this reason, the AdC approved the acquisition only under behavioral remedies, among which the preservation of the separation in advertising offers of TF1 on the one hand, and of TMC and NT1 on the other hand.³

Behavioral remedies are usually difficult to administer, and the non-discriminatory firewalls are best implemented when the firms involved are subject to the scrutiny of the industry regulator (See Motta, 2004). Being aware of this fact, the practice of the TF1 Group was monitored by the Conseil supérieur de l'audiovisuel (CSA) for five years, i.e., from 26 January 2010 to 26 January 2015, during which time the remedies should have been respected.⁴ According to the CSA, the commitments have been respected, particularly because TMC and NT1 on one side and TF1 on the other side have managed their advertising offers through independent advertising sales houses. It remains to be seen whether the aim of the remedies has been achieved, i.e., whether the implemented remedies have been efficient in protecting the consumer surplus.

This evaluation exercise is not straightforward, as the decision of the authority coincided with the launch of the digital terrestrial TV (DTTV) in 2005 and with the extension of its

²Note that this situation is similar to the case of internet. Indeed users search on the web free of charges; however, when they click on specific hyperlinks, they also trigger ads which generate revenues for the owner(s) of web browsers.

³ See the AdC's decision at

<http://www.autoritedelaconcurrence.fr/pdf/avis/10DCC11decisionversionpublication.pdf>.

⁴ The Conseil Supérieur de l'audiovisuel is an independent authority whose main objective is to protect audiovisual communication freedom.

coverage over the French territory until 2012.⁵ This new technology has boosted the audience for TVs; thus, without market concentration, the surplus of French households' free TV consumption would have been expected to rise over the period. At the same time, the acquisition could allow the TF1 Group to broadcast the same TV programs on the different channels of the Group through a coherent programming, which may contribute to a widening of the audience. To decipher the role of respective determinants in the change in consumer surplus following the adoption of the above behavioral remedies, a complete market analysis is required.

Contrary to pay TV channels for which the subscription fees of TV viewers represent a significant share of income, the TV channels broadcasting free-to-air draw their revenue only from advertising. Their business model is distinctive in the sense that the demand of TV viewers can affect their revenues only indirectly through its interaction with the demand of advertisers. The larger the audience size of a TV channel, the higher advertiser willingness to pay for advertising spaces; however, the TV viewers may be ad-averse, in which case, the larger the quantity of advertising, the higher the risk that the audience size of the TV channel shrinks. In other words, the free TV channels experience a feedback loop between viewers and advertisers. If these network externalities are identified to be significant, it is necessary to consider the feedback loop in the analysis of competition outcomes.

This calls for considering the free TV channels as two-sided platforms selling two distinct products: TV programs to viewers on the one side and advertising slots to advertisers on the other side. A first econometric task here amounts to specifying a structural model of oligopoly competition among free TV channels and identifying the two-sided nature of this industry.

Rochet and Tirole (2003) and Armstrong (2006) provide a framework for analyzing two-sided markets. Based on this approach, theoretical articles by Anderson and Coate (2005), Cunningham and Alexander (2004), and Nilssen and Sørgard (2000), among others, have addressed TV advertising competition by assuming that the ads are a nuisance to TV viewers and the TV channels compete by setting advertising quantity. However, only a few empirical analyses use this approach. Until now, the empirical studies have examined the two-sided structure of the industries of newspapers (Chandra and Collard-Wexler, 2009; Argentesi and Ivaldi, 2007; Argentesi and Filistrucchi, 2007), magazines (Song, 2011), yellow pages (Rysman, 2004), and radios (Jeziorski, 2014). Wilbur (2008) used the two-sided concept to analyze the importance of TV viewers' and advertisers' preferences in driving TV channels' programming choices and the impact of ad-avoidance technology on TV channels' advertising revenues with data of six US TV channels. Previous empirical findings suggested that the attitudes of the audience (readers/viewers/listeners) toward advertising vary by industry: The audience tends to appreciate advertising in magazines, yellow pages, and certain types of newspapers, but it dislikes advertising in broadcasting industry (radio and TV). Hence, it is an empirical issue to identify the sign of the network effects between the two sides of the market, and this is crucial because depending on this sign, one can expect from the theory that it impacts the pricing of the distinct product on each side of the market.

Broadcasting TV channels constitute the most important medium for advertising. However, only a few papers have empirically analyzed the advertising competition in this industry. Some, such as Masih (1999) and Ekelund *et al.* (2000), have estimated the price-elasticity of advertising demand, but in models that do not account for the feedback loop between TV viewers and advertisers. Our paper contributes to this literature by investigating the advertising competition in the French free TV industry cast in a two-sided market framework using a unique monthly dataset on 21 French national free TV channels from March 2008 to December 2013. Estimating the demand of both sides (viewers and advertisers) of TV channels, our estimation

⁵See the details on the launching of DTTV channels in France below.

results suggest that the TV viewers dislike advertising on TV and that the network effects between TV viewers and advertisers are significant.

To perform the competitive analysis raised by the merger between the channels TF1, TMC, and NT1 in this setup, it is necessary to well identify the conduct of TV channels. In quantitative analysis for competition policy, it is usual to assume Bertrand competition; however, in the context of broadcasting markets, Cournot competition is often considered. In the French case, because of some regulatory rules limiting TV advertising, there is a strong presumption that the Cournot case is well adequate. To confirm this conjecture, we implement a simple procedure to test for the market conduct of French free broadcast TV channels by checking for the realism of estimated marginal costs that we derive from the estimates of our model under the two alternative conduct assumptions.

We are in the position to perform a competitive analysis of the outcomes in the French broadcast TV industry after the merger that we propose to investigate. Our results show that, everything else being equal, there is no significant difference in terms of advertising quantities between the observed situation under which the remedies imposed by the competition authority apply and the counterfactual scenario where the remedies have not been implemented. This means that, with or without remedies, the market outcomes are equivalent. This result is mainly explained by the fact that the effect of a higher level of cooperation among advertising sales houses is defeated by the viewers' adverse taste for advertising.

This paper is organized as follows. In Section 2, we present the market characteristics and data sources. In Section 3, we propose a structural model for the TV industry. Section 4 is devoted to the econometric specification, Section 5 to the estimation method and results, and Section 6 to the economic analysis of our estimated model to determine, in particular, the conduct that provides the best representation of the data generating process. The competitive analysis is carried out in Section 7 to assess the market power of TV channels and to discuss the counterfactual experiment aimed at evaluating the impact of a merger between advertising agencies in the French TV market. We then conclude in Section 8. representation of the data generating process. The competitive analysis is carried out in Section 7 to assess the market power of TV channels and to discuss the counterfactual experiment aimed at evaluating the impact of a merger between advertising agencies in the French TV market. We then conclude in Section 8.

1.2 Market and data analysis

1.2.1 Market characteristics

Digital terrestrial television (DTTV) was formally introduced in France in the beginning of 2005 and gradually replaced the aged analogue broadcasting mode of free TV.⁶ This new technology offers more broadcasting capacity, and its implementation stimulated the arrivals of several new TV channels. Before the commercial launch of DTTV, there were only five national TV channels broadcasted free-to-air in France. After the CSA officially allowed and promoted the adoption of DTTV, 11 new free-broadcast TV channels were launched at once. Later, in December 2012, six additional channels were initiated. Currently, French households have access to a total of 22 free broadcasting TV channels.⁷

⁶ With DTTV, households can receive many more channels than with a traditional TV aerial, all in digital quality. To switch to DTTV, households need an adapter (a set top box) for their television and to adapt their aerials.

⁷ Notice that our analysis only focuses on the free-broadcast TV market. Pay TV channels are included in the outside goods of our econometric model below. During the period of observation (2008–2013), while there are between 184 and

The newly launched DTTV channels, as entrants in the national TV market, do not enjoy the same market position as the five incumbent channels. In Table 1.1 and Table 1.2, we provide comparative statistics on *audience shares* and *advertising revenue shares* of the incumbent channels versus the new arrivals. The market shares of new entrants are remarkably lower than the incumbents on both sides.

Among these 22 free TV channels, 17 channels are private and 5 are publicly owned. Fifteen of them are general, offering a wide range of program genres and targeting a large audience. Aside from these, two channels are specialized in news broadcasting, one in music, one in children's programs, one in documentaries, one in films and another in sports. Many of these channels belong to the same TV group. In Table 1.3, we provide a list of TV channels in our dataset with their type (generalist, news, music, movie, sport, child, or documentary), ownership nature (public or private), and TV group membership.

Broadcast TV stations are two-sided platforms connecting TV viewers to advertisers. TV viewers value the media content and are willing to pay for it. As they watch TV, they generate audiences that, in turn, are valuable for advertisers. Contrary to pay TV channels that charge subscription fees to viewers, the broadcast TV stations only require the viewers to bear the advertising.

On the advertising market, advertisers look for audiences, and TV channels supply them. Advertisers value audience for the ability to inform and/or persuade viewers on the merits of products or services they have to commercialize. The TV channels sell their advertising spaces through advertising sales houses (ASHs). In general, each TV group that holds several TV channels owns or cooperates with one ASH. In practice, each TV group determines the capacity of advertising spaces for all of its channels based on their program schedules and communicates the various advertising spots to its ASH. Advertisers search for ad-spots that match their expected audience (in terms of number of viewers and their demographics) from different ASHs. Advertisers and ASHs agree, for each ad-slot, on a cost per thousand (CPT), which corresponds to the value of reaching 1000 viewers. A channel's revenue from an advertising spot is equal to the spot's CPT *times* the number of viewers of the spot. On this basis, we derive the average price per minute of an advertising spot by dividing the observed revenue by the corresponding number of advertising minutes.

In France, TV programs are published one month prior to the broadcasting time; last minute adjustment occurs rarely. In contrast, the advertising campaigns are adjusted in real time to reach the desired effects.

We notice from our data that the number of advertising spots does not vary much from one channel to another, while there is a large difference in the prices of the advertising spots of incumbent channels and new entrants (See Table 1.4 for details on the standard errors of advertising prices and quantities). The prices considered in this study are average prices of an advertisement but are not on a per-viewer basis. Differences in the prices of advertising spots between two categories of TV channels reflect differences in their viewerships.

In France, the number of advertising minutes on TV is regulated. The CSA imposes double caps on different TV channels on the basis of clock hours and daily average levels.⁸ As we use

207 pay TV channels available in France, their cumulated audience share amounts to not more than 10% in total, and their cumulated revenue share is approximately 16% to 18%. The individual market share of any of these pay TV is then negligible, and statistics on the market share of each pay channel are not available.

⁸ 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. (Source: [https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000019986596dateTexte.](https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000019986596dateTexte))

monthly average level of advertising herein, what matters is whether the regulation caps on maximum minutes of advertising per day are binding. In Table 1.5, we compare the observed advertising minutes to the maximum minutes authorized by the CSA. Note that the regulation constraints (at monthly average level) are never binding over the entire period of observation.⁹

1.2.2 Data

The CSA has given us access to a first dataset consisting of information on audience, gross advertising revenues and advertising quantities. This dataset covers detailed monthly information on 21 free TV channels in France from March 2008 to December 2013.¹⁰

The broadcasting 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. 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 approximately 10,500 individuals aged 4 and over. In each home, Médiamétrie installs one or more (depending on how many pieces of equipment they have) audimeters 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.¹¹ This survey gathers information of the audience shares, the total population having access to TV services (all reception modes together) in metropolitan France, and the average watching time per day per individual. The average watching time per day per individual is at aggregate level, as we do not have detailed per channel data for this variable.

The advertising data are measured by Kantar Media. We have access to the number of advertising minutes and the gross advertising revenues per month of different TV channels. From these data, we construct the number of advertising spots and their corresponding prices. The number of advertising spots is obtained by dividing the number of advertising minutes by the standard length of an advertising spot, which lasts for 30 seconds. The price of an advertising spot is calculated by dividing the gross advertising revenues by their corresponding numbers of advertising spots. The prices calculated in such a way correspond to the equilibrium prices established on the market on the basis of the channels' audience performance and quantities of advertising supply.

In addition to the dataset provided by CSA, we collected complementary information from published reports of the Centre national du cinéma et de l'image animée (CNC), Kantar Media and different TV channels. The list of variables include the total amount of advertising investment in the cinema market, the total quantity of advertising on radio, the total number of hours of French audiovisual programs broadcast during the year, the number of movies broadcast during the prime time (20:30 - 22:20), the amount of subsidies allocated to the public broadcasters, the financial participation of each channel in the production of movies and French audiovisual programs, and the total number of employees of each TV group.¹² These data either serve as instrumental variables or as components of cost equations at the estimation stage. Their units,

⁹ The restrictions on advertising minutes is an important issue, though our data do not allow exploration of its effect. This topic is studied in Crawford *et al.* (2012) and Zhang (2016).

¹⁰ Our sample excludes Arte, the Franco-German public channel, because we have no information on its advertising revenues. Nevertheless, this should not affect the significance of our results because the audience share of this channel is very small, less than 2%.

¹¹ Source Médiamétrie: <http://www.mediametrie.fr> .

¹² Many channels in our sample share a common ownership, i.e., belong to the same media group. It is impossible to distinguish the number of employees of different channels in the same media group.

periodicities, and means are provided in Table 1.6.

1.3 Structural model

We specify a structural model of oligopoly competition for the French broadcast TV industry. There are J channels belonging to K owners that each broadcast 24 hours per day free-to-air. The TV channel operators face two interacting markets: a market for broadcasting and a market for advertising. The TV viewers watch the programs for free, so there is no direct profit generated from the broadcasting market. However, the audience of free channels affects the demand of advertisers. By allowing the channels to compete on the advertising market through audience, our model specification explicitly captures the interactions between viewers and advertisers. This model setting comprises three parts: the demand of audience, the demand of advertisers, and the supply of TV channels.

1.3.1 Demand of TV viewers

Let I be the potential market size corresponding to the total French population. At each point in time, an individual $i = \{1, \dots, I\}$ chooses to watch one and only one of the broadcasting channels $j = \{1, \dots, J\}$, or to exercise an outside option (like watching a pay channel, reading a magazine, going to a cinema, or another substitutable activity). As, in the empirical analysis, we consider the national TV channels for six calendar years only, the too weak variability in individual demographics at this level for such a short period of time cannot allow us to identify the heterogeneity of viewers' tastes. This is why we here adopt a nested logit model to specify the demand of TV viewers.¹³

As already mentioned in Section 2.1, French households certainly differentiate between watching an incumbent and a newly launched channel. The implementation of DTTV service has been achieved region by region, and the newly launched DTTV channels were made accessible to the French households progressively during the entire period of our observation.¹⁴ Those who get used to watching the incumbent channels do not switch to the new channels immediately, as the latter lack notoriety. To account for the difference in notoriety between the incumbent and entrant channels denoted by m and n respectively, we classify them into two separate nests. Then, in what follows, we assume that a TV viewer first chooses among three categories $g = \{m, n, 0\}$, where 0 stands for the outside option that corresponds to all the activities other than watching the free TV; second, (s)he decides to watch a channel $j \in C_g$, where C_g refers to the set of channels belonging to the category g .¹⁵ Finally, to account for a change in notoriety over time, we introduce time specific effects at the empirical stage below.

At each given period t , the indirect utility of consumer i from watching channel j , belonging to the category g , is given by

$$U_{jgt}^i = \delta_{jt} + \zeta_{jgt}^i, \quad (1.1)$$

¹³ Grigolon and Verboven (2014) address the issue about whether and when the logit and nested logit (NL) models can be used as reasonable alternatives to the computationally more demanding random coefficient logit (RC) model and find that the specific distributional assumptions of the RC and NL models regarding the evolution for the group dummy variable (i.e., the variable that characterizes the different nests) do not matter much.

¹⁴ At the moment where the DTTV was formally adopted in 2005, only 35% of the French population was covered by its service. This coverage rate has been gradually raised to 85% in 2007 and to 97% by the end of 2011.

¹⁵ We tested more complex specifications by adding nests according to the channels' type, nature, and group membership. None of them allow us to obtain economically meaningful models and/or to identify the corresponding parameters of the additional nests.

with

$$\delta_{jt} = \bar{V}_{jt} + \alpha A_{jt} + \xi_t + \xi_{jt}, \quad (1.2)$$

and

$$\zeta_{jgt}^i = \varepsilon_{gt}^i + (1 - \sigma)\varepsilon_{jt}^i, \quad (1.3)$$

where δ_{jt} represents the mean utility level of TV viewers from watching channel j at time t and ζ_{jgt}^i captures the departure of consumer i 's preference from the common utility level. The component \bar{V}_{jt} is a deterministic part that depends on the idiosyncratic characteristics of channel j , A_{jt} represents the quantity of advertising at channel j and time t , ξ_t is a time specific component, ξ_{jt} is a random term reflecting the effect of unobserved factors of channel j at time t on the mean utility of TV viewers. The parameter of interest to be estimated, i.e., α , measures the audience's attitude towards advertising. The error term ζ_{jgt}^i is specified as a weighted sum of two unobserved variables: ε_{gt}^i , which affects the individual i 's preferences common to all channels belonging to category g , and $(1 - \sigma)\varepsilon_{jt}^i$, which impacts the individual i 's preferences specific to product j . The error terms ε_{gt}^i and ε_{jt}^i 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 parameter of interest to be estimated, $\sigma \in [0, 1)$, measures the degree of substitutability of TV channels belonging the same category from the TV viewers' point of view. As σ approaches one, the different channels within the category g are perceived as highly substitutable for TV viewers, while as σ decreases, the correlation of preferences for channels within a same category 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 category.

Note that there is no price in this model because watching TV is free. In fact, the quantity of advertising plays the role of price in the usual differentiated-products oligopoly model. However, here, the parameter α can be either positive or negative according to the attitude of viewers towards advertising: If α is positive, viewers value ads positively; if it is negative, they dislike advertising.

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

$$\ln(s_{jt}) = \bar{V}_{jt} + \alpha A_{jt} + \sigma \ln(\bar{s}_{jt/g}) + \ln(s_{0t}) + \xi_t + \xi_{jt}, \quad (1.4)$$

where s_{jt} (s_{0t} , respectively) is the probability that an individual chooses to watch channel j (to take the outside option) at time t . The probability s_{jt} is decomposed as the product of two probabilities: the probability $\bar{s}_{jt/g}$ of watching channel j given that channel j belongs to category g and the probability \bar{s}_{gt} that the individual chooses to watch channels of category g . This decomposition matters because of the different accessibility of incumbent and new DTTV channels.

Given that we assume a representative consumer, the choice probabilities s_{jt} , $\bar{s}_{jt/g}$, s_{0t} coincide at the aggregate level with the market share of channel j , the market share of channel j within its category and the market shares of the outside goods, respectively. If, at time t , Y_t is the market size (that we precisely define later) and if y_{jt} is the number of TV viewers watching TV j , the market share of channel j and its market share within its category are measured as $s_{jt} = y_{jt}/Y_t$ and $\bar{s}_{jt/g} = s_{jt} / \sum_{j \in C_g} s_{jt}$, respectively, while the market share of the outside good is obtained as $s_{0t} = 1 - \sum_j s_{jt}$.

From Equation (1.4), we define the number of viewers as $y_{jt} = s_{jt}Y_t \equiv y_{jt}(A)$, where $A = \{A_1, \dots, A_j, \dots, A_J\}$ is the vector of advertising quantities of all channels.

1.3.2 Demand of advertisers

In the spirit of the model in Rysman (2004), we consider a representative advertiser whose expected revenue per viewer from an advertising spot on channel j , denoted by r_j , is such that $r_j = \tau_j (CPT_j/1000)$, where CPT_j measures how much (s)he received from reaching an audience of 1000 individuals and where τ_j is a scale factor at least larger than one.¹⁶ In what follows, for simplicity of notation, we consider the vector $c = (c_1, c_2, \dots, c_j, \dots, c_J)$, where $c_j = CPT_j/1000$. Let $p = (p_1, p_2, \dots, p_j, \dots, p_J)$ be the vector of per minute price of advertising spots of different TV channels. We specify the representative advertiser's profit function as¹⁷

$$\Pi^A = \sum_{j=1}^J (\tau_j C_j - p_j a_j). \quad (1.5)$$

On the advertising market, TV stations and the advertiser agree on a CPT_j (or c_j) based on four variables: 1) the length of advertising messages, a_j ; 2) the total capacity of channel j , A_j ; 3) the viewership of channel j , y_j , and 4) the decomposition of audience, D_j , in terms of socio-demographic characteristics. We thus specify the market-determined c_j using a Cobb-Douglas form, namely,

$$c_j = D_j^{v_1} a_j^{v_2} A_j^{v_3} y_j^{v_4}. \quad (1.6)$$

Specifically, v_2 measures the decreasing return of large advertisement,¹⁸ v_3 captures the "business stealing effect,"¹⁹ and v_4 measures the sensitivity of advertisers to the viewership of TV channels. We expect the value of v_2 to be between 0 and 1, the value of v_3 to be negative, and the value of v_4 to be positive.

Replacing the expression (1.6) into Equation(1.5) and maximize Π^A over a_j , we obtain the inverse demand of advertising as:

$$p_j = v_2 \tau_j D_j^{v_1} a_j^{(v_2-1)} A_j^{v_3} y_j^{v_4}. \quad (1.7)$$

Denote the size of advertising market to be \bar{m} , then $a_j = A_j/\bar{m}$, thus,

$$p_j = v_2 \tau_j D_j^{v_1} \bar{m}^{(1-v_2)} A_j^{(v_2+v_3-1)} y_j^{v_4}, \quad (1.8)$$

which yields, with time index and in logarithmic form:

$$\log p_{jt} = \log[v_2 \tau_{jt} D_{jt}^{v_1} \bar{m}^{(1-v_2)}] + (v_2 + v_3 - 1) \log A_{jt} + v_4 \log y_{jt}. \quad (1.9)$$

The final empirical specification of this inverse demand function is discussed below.

1.3.3 Supply of TV channels

The J free-broadcast TV channels belong to K different media groups on the French market. Each media group owns or cooperates with a private advertising sales house through which

¹⁶ It is appropriate to assume that the willingness to pay of the advertisers (CPT_j) represents only a fraction of their expected benefit from advertising (r_j).

¹⁷ We drop the time index t in what follows, as it does not generate misunderstanding.

¹⁸ It is expected that a long advertising message has more chance to be remembered by the TV viewers, but the viewers may get tired of the same ad in time. Therefore, the advertiser's willingness to pay takes parabola form with respect to the length of the advertising message.

¹⁹ That is to say, the fact that an advertisement is easily ignored in a broadcast network with a massive amount of advertisements.

its channels exchange with the advertisers. Channels within the same media group maximize jointly their profits taking account of the strategic reactions of other groups.

The profit function of a media group G_k , $k = \{1, \dots, K\}$ from selling advertising spaces is given by

$$\Pi_{G_k} = \sum_{j \in G_k} \Pi_j = \sum_{j \in G_k} [(p_j - c_j) A_j - F_j], \quad (1.10)$$

where c_j and F_j are the marginal and fixed costs of channel j , respectively. TV stations broadcast their programs free-to-air but mainly cover their programming costs from advertising revenues. The fixed cost F_j measures the sunk investment of channel j on the acquisition of its programs' broadcasting right. The variable costs of advertising include mainly the management cost of advertising and fixed discounts proposed by the TV channels to the advertisers. In practice, at the beginning of every year, the TV stations agree with each of their potential advertisers on a discount for the advertisers' advertising messages during the year. Such a practice consists in a marketing strategy of TV stations to capture future clients. Because the discount is specific between each channel and advertiser, it varies with time and channels.

The conduct of TV groups affects the way the feedback loop between TV viewers and advertisers works. Under Cournot competition, when a media group raises the advertising quantity broadcast for one of its channels, the prices of advertising spots on this channel drop, and the channel attracts less ad-averse TV viewers; as a consequence of the loss in audience, the advertisers' willingness to pay for ads on this channel diminishes. In the case of competition à la Bertrand on the advertising market, when a TV group raises the advertising prices for one of its channels, some advertisers will drop their advertising, while some of ad-averse TV viewers will be attracted. However, as this attracts more viewers because of the lower quantity of advertising, advertisers' willingness to pay for advertising on this channel will rise, so the channel will advertise more. This will in turn affect viewership and subsequently advertising, and so on.

Formally, under Cournot competition, each group G_k determines the optimal advertising quantities of channels within the group (A_{jk} , $j \in G_k$), taking the advertising quantities of other groups as given, namely,

$$\max_{A_{jk}; j \in G_k} \{\Pi_{G_k} | A_{-j}\} = \max_{A_{jk}; j \in G_k} \sum_{j \in G_k} \{(p_j [A_j, y_j(A)] - c_j) A_j | A_{-j}\}, \quad (1.11)$$

where $p_j [A_j, y_j(A)]$ is the inverse-demand curve of advertisers and A_{-j} is the set of strategic advertising decisions of all channels other than j . The associated first-order condition is obtained as

$$(p_j - c_j) + A_j \frac{\partial p_j}{\partial A_j} + A_j \frac{\partial p_j}{\partial y_j} \frac{\partial y_j}{\partial A_j} + \sum_{i \neq j, i \in G_k} A_i \frac{\partial p_i}{\partial y_i} \frac{\partial y_i}{\partial A_j} = 0, \forall j \in G_k. \quad (1.12)$$

The advertising quantity affects the market clearing price through two ways: directly, by the standard price response to the advertising quantity supplied, which is given by the second term on the left-hand side of Equation (1.12), and indirectly, by the network effect between viewers and advertisers, represented by the third and fourth terms.

Under Bertrand competition, each group G_k determines the optimal spot price of advertising of channels within the group (A_{jk} , $j \in G_k$), taking the pricing of the other groups as given, namely,

$$\max_{p_{jk}; j \in G_k} \{\Pi_{G_k} | p_{-j}\} = \max_{p_{jk}; j \in G_k} \sum_{j \in G_k} \{(p_j - c_j) A_j [p_j, y_j(A)] | p_{-j}\}, \quad (1.13)$$

where $A_j [p_j, y_j(A)]$ is the direct demand curve of advertisers, and p_{-j} is the set of advertising prices of all channels other than j . The associated first-order condition is

$$A_j + (p_j - c_j) \frac{\partial A_j}{\partial p_j} + (p_j - c_j) \frac{\partial A_j}{\partial y_j} \frac{\partial y_j}{\partial A_j} \frac{\partial A_j}{\partial p_j} + \sum_{i \neq j, i \in G_k} (p_i - c_i) \frac{\partial A_i}{\partial y_i} \frac{\partial y_i}{\partial A_j} \frac{\partial A_j}{\partial p_j} = 0, \forall j \in G_k. \quad (1.14)$$

The explanation of the different terms of Equation (1.12) applies here for Equation (1.14), as well.

In Section 6.2, we conduct a test on the estimated marginal costs to conclude on the nature of the competition in the French broadcast TV industry.

1.4 Econometric specification

1.4.1 Demand of TV viewers

The deterministic part of the indirect utility of consumers \bar{V}_{jt} in Equation (1.4) is specified as a linear combination of channel-fixed effects, i.e., dummies for all channels. In addition, two types of temporal effects are considered through the term ξ_t in Equation (1.4), which is composed with dummies for each year and for each month: the yearly dummies capture potential changes in policy, fluctuations of the economic climate and the generalization of the digital TV technology, while the monthly dummies capture the seasonality of TV advertising.

Here, the market share of TV channel j , s_{jt} , differs from the so-called *audience share*, q_{jt} , used in the jargon of media marketing. The audience share, which is directly available from media marketing companies such as Mediametrie, is measured in terms of *the total population watching the TV over a market*. Here, for any given period of time, we consider the French population choosing to watch a free TV channel (j) or to select an activity other than watching free TV, which includes the possibility to watch a pay channel or enjoy other entertainments, such as going to a movie theater or reading a newspaper. To do so, we consider, for each period, the total population having access to a TV service, M_t , and we derive the augmented audience y_{jt} , i.e., the total number of TV viewers watching channel j as $y_{jt} = q_{jt}M_t$. Then, if Y_t denotes the size of the French population at period t , we estimate the market share of channel j as $s_{jt} = (y_{jt}/Y_t)$.²⁰

Finally, from Equation (1.4), the TV viewers' demand function to be estimated is given by

$$\ln(s_{jt}) - \ln(s_{0t}) = \alpha A_{jt} + \sigma \ln(\bar{s}_{jt/g}) + X_{jt}\beta + \xi_{jt}, \quad (1.15)$$

where X_{jt} includes all the dummy variables mentioned above.

1.4.2 Demand of advertisers

From Equation (1.9), we specify the inverse demand of advertisers to be estimated as

$$\ln(p_{jt}) = \theta \ln(A_{jt}) + \nu_4 \ln(y_{jt}) + X_{jt}^A \beta^A + \xi_{jt}^A, \quad (1.16)$$

where

$$\theta \equiv \nu_2 + \nu_3 - 1. \quad (1.17)$$

²⁰ As using the size of the population having access to a TV service to measure the total population watching TV is indeed an approximation, we implement a robustness check by estimating the model for different values of M_t . The details are presented in the next section.

In other words, we approximate the term $\log[v_2\tau_{jt}D_{jt}^{v_1}\bar{m}^{(1-v_2)}]$ by $X_{jt}^A\beta^A + \xi_{jt}^A$ by $X_{jt}^A\beta^A + \xi_{jt}^A$, where X_{jt}^A and ξ_{jt}^A represent, respectively, the observable and unobservable characteristics of channel j at time t that impact the demand of advertisers. We specify X_{jt}^A as a linear combination of dummies to identify channel, monthly, and annual fixed effects. Note that $\theta = \nu_2 + \nu_3 - \mu^{-1}$ captures the joint effect of business stealing and decreasing return to scale of advertising, and ν_4 measures the sensitivity of advertisers to the viewership of TV channels as discussed in the model above. We expect the estimated value of θ to be negative and the estimated value of ν_4 to be positive.

1.5 Estimation

The demand of TV viewers (Equation (1.15)) and the demand of advertisers (Equation (1.16)) are separately estimated using the two-stage least squares (2SLS) estimator. Because both equations encounter problems of endogeneity, an IV method is required; below, we explain our choice of instrumental variables for each equation.

1.5.1 Identification

Equation (1.15) entails two identification problems. The first one concerns the parameter σ . Conceptually, observing the viewers' switch between channels within the same category (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 category. These variations can be the result of either changes in channels' characteristics or changes in the number of channels operating on the market. However, there is a potential endogeneity problem if viewers switch a channel because of some unobserved changes in the characteristics of the TV channel. Indeed, in Equation (1.15), 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 category 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.

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 (its market share s_{jt}) will be high (or low). Hence, without controlling for this fact, the estimate of α would be biased upward (or downward, respectively).

Data on advertising in markets other than the free TV market can be used to instrument the advertising quantity of TV channels, A_{jt} . Variables such as the total amount of advertising investment in the cinema market and the total quantity of advertising (in number of advertising spots) in the radio market are available on a monthly basis and constitute the best candidates to instrument A_{jt} . Indeed, they are correlated with the quantities of TV channels' advertising because of competition across media for advertising. However, as it is unlikely that consumers

switch from radio or cinema to TV because of the advertising on these two media, these two variables are potentially exogenous with respect to the number of TV viewers.

To instrument the channel’s audience share within its own category, i.e., $\bar{s}_{jt/g}$, we need variables reflecting the status of TV channels in their own categories. In France, the broadcasting contents of TV channels are partially regulated. French law stipulates that TV channels broadcast more than 40% of French audiovisual programs within some particular hours of the day; the incumbent channels must accomplish this obligation within the 5 hours in the evening, from 18:00 to 23:00, while the new digital TV channels must satisfy the obligation within the day. As a consequence, we expect the incumbent channels to broadcast more French audiovisual programs. In addition, as a policy intended to protect the French cinema sector, the capacity of TV channels to broadcast movies is restricted, especially during the prime time (i.e., the time slot between 20:30 and 22:30). However, this constraint is somehow less stringent for the new digital channels. Hence, we use the total number of hours of French audiovisual programs and the number of films broadcast during the slot 20:30 – 22:30 to instrument $\bar{s}_{jt/g}$. We expect that their variations identify the demand for channels within the nests (incumbent and new). The quantity of French audiovisual programs and the number of movies during prime time do not determine the global demand for a TV channel during one month, i.e., these two variables should be exogenous in Equation (1.15). In Tables 1.7 and 1.8, we provide a comparison on how these two measures vary both between and within the nests.²¹ As expected, we observe, from the means reported on column 5 of Tables 1.7 and 1.8, that the incumbent channels broadcast on average more French audiovisual programs each year, while the new channels broadcast more movies during the prime time. From the values of standard deviations on column 6, we conclude that the regulation rules result in more important variations within the incumbent nest than within the new channels nest.

In Table 1.9, we report the OLS regression results of the instrumented variables on the instrumental variables to get a clearer idea of their explanatory relationships. Note that all of the four instrumental variables explain the quantity of advertising and the number of movies, while the quantity of French audiovisual programs explains the channels’ audience share within the nest.

The variables $\ln A_{jt}$ and $\ln y_{it}$ may be endogenous in Equation (1.16). While the fact that the analysts do not observe the quality of programs is taken into account through the unobserved component ξ_{jt}^A , the advertising agencies and the TV channels have more information on their respective qualities. In particular, they may anticipate when peaks (or drop) in audience on channel j at time t could happen. In this case, the advertisers are willing to pay more (or less) for the corresponding advertising spaces, while channel j sets more (or fewer) ads during time period t , as well. Then, $\ln A_{jt}$ and ξ_{jt}^A are correlated. Now, if $\ln A_{jt}$ is positively (negatively) correlated with ξ_{jt}^A , the estimate of θ is biased upwards (downwards). Likewise, the quality of programs (in terms of attractiveness of audience) is unobserved by the econometricians but is likely to be observable by the advertising agency. That is, $\ln y_{it}$ is correlated either positively or negatively with ξ_{jt}^A . Without controlling for this potential endogeneity problem, the estimate of parameter v_4 would be biased either upward or downward.

Summing up, the number of films broadcast during prime time, the total amount of French audiovisual programs broadcast, and the total quantity of advertising on the radio market are used to instrument $\ln A_{jt}$. To instrument the number of TV viewers of TV channels, $\ln y_{it}$, we use a published indicator called the average watching time per day per individual. This

²¹ A referee has suggested using the “characteristics (type of programs) of other channels within the same group” as an alternative instrument. However, it is practically impossible to collect such information for the period under investigation.

variable measures the average number of minutes per day that an individual spent watching either a broadcast or a pay TV in France. It is an indicator of the change in consumption demand for TV; so, it is clearly correlated with the audience of any TV channel $\ln y_{it}$. However, this variable does not reflect the particular quality of any broadcast TV channel; therefore, it should be considered as exogenous in the equation of demand of advertisers. For the viewers' demand, in Table 1.10, we report the OLS regression results of the instrumented variables on the instrumental variables to get a clearer idea of their explanatory relationships.

To validate our choice of instruments, we now proceed to the IV estimation of Equations (1.15) and (1.16) and conduct statistical tests for weak instruments and overidentification, which are reported in Table 1.11. Recall that, as using the size of the population having access to a TV service to measure the total population watching TV is indeed an approximation, we estimate the model for different values of the market size, M_t . For both equations and for all values of M_t , the Kleibergen-Paap rk LM statistic rejects the null of under-identification at the 1% significance level; 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 5% and 10% significance levels. In other words, our instruments are statistically acceptable.

1.5.2 Estimates

The estimation results of Equations (1.15) and (1.16) are now separately reported in Tables 1.12 and 1.13. Note that scaling down the value of M_t does not significantly affect the estimated coefficients. This means that our estimates are robust and that, for the sequel, we can choose any market size. In practice, we use the total population watching TV.

For the TV viewers' demand, both the coefficient of advertising and of within-nest shares are significant at the 5% significance level. As expected, the TV viewers respond to an increase of advertising by reducing their watching demand, i.e., $\hat{\alpha} < 0$. The estimate $\hat{\sigma}$ is significantly less than 1, indicating that there exists competition between the five incumbents and the new channels; however, the significance level of $\hat{\sigma}$ suggests that there is segmentation between categories.

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 1.14. 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. Moreover, with the nested-logit model specification, the value of $\hat{\sigma}$ should be between 0 and 1. This constraint is not satisfied by the OLS estimation, though it is respected with the instruments described above.

For the advertisers' demand, the coefficient $\hat{\theta}$ associated with the logarithm of the advertising quantity is significant at the 5% significance level, while the coefficient associated with the logarithm of the audience level $\hat{\nu}_4$ is significant at the 1% significance level. The estimated results are consistent with our expectation in theory: the parameter $\hat{\nu}_4$ is positive, which suggests that advertisers' willingness to pay increases with the viewership of TV channels. The negative sign of $\hat{\theta}$ reflects the combined effect of business stealing and decreasing return to scale of advertising.

As for the demand of TV viewers, we compare the results from the IV estimation with those from OLS in Table 1.15. We observe that the IV estimates are not significantly different from the OLS estimates. Our results suggest that the endogeneity problems in Equation (1.16) are not statistically significant. In the sequel, we adopt the IV estimates, while the results below would not change significantly by using the OLS estimates.

1.6 Empirical analysis

1.6.1 Demand elasticities

The estimated elasticities of demand of TV viewers are reported in Tables 1.16–1.18. On average, the TV viewers dislike advertising. It is estimated that a 1% increase in advertising reduces the audience of a TV channel by 0.5%. The TV viewers are more sensitive to ads on the new digital channels than on the incumbent channels. Moreover, we notice that the viewers become more and more sensitive to ads over time, i.e., their averseness to advertising increases with time. This may be due to the greater number of offers on the TV market. Finally, we observe that the own-advertising-elasticities of audience differ according to the nature of the TV channel: public channels, private news channels, and other private channels.

Looking at the viewers' cross-advertising elasticities of demand between pairs of TV channels, the estimates indicate that an increase in the advertising quantity of one TV channel has a non-negligible positive effect on the audience of the other TV channels. On average, a 1% increase in the advertising quantity of a TV channel raises the audience of another TV channel by 0.03%.²² Overall, it seems more likely to observe a raise in the audience of other channels when an incumbent channel increases its advertising quantity.

Considering the side of advertisers, the own price elasticity is on average equal at 2.7. However, as shown by Huang (2007), this value is biased because it is derived from advertiser's inverse demand function.²³ Nonetheless, given the high value obtained, one can reasonably suspect that the advertisers' demand is rather elastic, which is a sign that the advertising market is competitive. However, this invites further investigation of the degree of competition in this market.

By estimating the inverse demand of advertisers, we can estimate *the flexibility of advertising prices*.²⁴ The ad-price flexibility with respect to audience and advertising can be directly obtained from their associated parameters in Equation (1.16), i.e., θ and ν_4 . From the estimates, a 1% increase in the audience of a TV channel increases the ad price by 0.6% on average, while a 1% increase in the ad quantity of a TV channel decreases its average ad price by 0.4%.

1.6.2 Marginal costs and market conduct

To derive the values of marginal costs of different TV channels, we solve the first-order conditions associated with the profit maximization function of different TV groups, under either Cournot or Bertrand competition, namely, Equation (1.12) and Equation (1.14). To do so, we need to take into account the ownership of TV channels. The 21 TV channels in our data set

²² More disaggregated cross-advertising elasticities of audience are available from the authors upon request.

²³ Gregory Crawford et al. (2012) refer to Huang's article, where it is shown that the price elasticity derived from an inverse demand elasticity can be biased upward or downward as the projection of one variable on another is not the inverse of the projection of that variable on the first one. Note that it is not straightforward to determine the sign of the bias.

²⁴ The *price flexibility* is the percentage change in the price of a commodity associated with a 1% increase in the quantity demanded of that commodity or a related variable, all else remaining constant." (See Houck, 1965).

belong separately to 10 different TV groups, and 9 groups of the 10 use one common advertising sales house for all channels within the groups. The exceptional case is the TF1 Group. The channels TMC and NT1 manage their advertising offers through an advertising sales house independent of that of the TF1 Group during the entire period of observation. We specify the four channels of the TF1 group as belonging to two independent entities, each with its own profit maximization problem.

A comparison of estimated marginal costs under these two alternatives is provided in Table 1.19. Clearly, the estimates under the Bertrand assumption do not sound economically meaningful, as they are either negative or much larger than observed prices. In practice, the quantities of advertising on TVs are at least physically constrained by the time of the day. In light of the literature on market conduct under capacity constraints, we conjecture that the channels compete in quantity setting on the advertising market.²⁵

To test this conjecture, we implement a variant of the Davidson and MacKinnon (1981) J test, which aims to select the specification of an econometric model in the presence of one or more alternative hypotheses that purport to explain the same phenomenon. In our context, it can be applied using the estimated marginal costs of TV channels to test between the null hypothesis H_0 of Cournot competition against the alternative hypothesis H_1 of Bertrand competition.

Let c_{co} (c_{be}) and MK_{co} (MK_{be}) denote the vectors of estimated marginal costs and estimated mark-ups under Cournot and Bertrand assumptions, respectively. Let p denote the vector of observed prices, and Z is a vector of variables affecting the marginal costs of different TV channels across different periods of time.

Under the Cournot assumption, we assume that

$$c_{co} = Z\mu + \varepsilon_1 \quad (1.18)$$

and $p = MK_{co} + c_{co}$, while under the Bertrand assumption,

$$c_{be} = Z\lambda + \varepsilon_2 \quad (1.19)$$

and $p = MK_{be} + c_{be}$, with ε_1 and ε_2 following centered normal distributions.

The Davidson and MacKinnon (1981) J test consists first in estimating by OLS a linear regression of the following form:

$$p = (1 - \alpha)(MK_{co} + Z\mu) + \alpha(MK_{be} + Z\hat{\lambda}) + u, \quad (1.20)$$

where $\hat{\lambda}$ is the OLS estimate in Equation (1.19), and u is white noise. If $\alpha = 0$, the conduct is of the Cournot type, while $\alpha = 1$ corresponds to Bertrand competition. The value of α remains to be tested by an asymptotic t-test.

In Appendix 2, we provide details on the test and prove that estimating Equation (1.20) is equivalent to estimate

$$c_{co} = \alpha(MK_{be} - MK_{co}) + Z\gamma + u. \quad (1.21)$$

We cannot reject Cournot competition if $\hat{\alpha} \approx 0$ and $\hat{\gamma} \approx \hat{\mu}$, where $\hat{\mu}$ is the OLS estimate in Equation (1.18).

To implement this procedure, we include in the vector Z the following variables: number of employees of different TV groups and dummies for controlling for channel and time fixed

²⁵ On this point we refer to Kreps and Scheinkman (1983) who study a two-stage oligopoly game where, under a quantity precommitment, the Cournot outcome is the unique equilibrium solution of the price competition. In a related setting, Osborne and Pitchik (1986) show that, if capacities are chosen simultaneously before prices, the set of equilibrium capacities coincides with the set of Cournot quantities.

effects.²⁶ The results of the test are provided in Table 1.20. From column 2, we can conclude that we cannot reject H_0 , i.e., we cannot reject that $\hat{\alpha} = 0$ and $\hat{\gamma} = \hat{\mu}$. In other words, we cannot reject the Cournot outcome as the best hypothesis to explain the data generating process.

Equivalently, we could test Bertrand against Cournot by estimating the following equation:

$$p = (1 - \beta)(MK_{be} + Z\lambda) + \beta(MK_{co} + Z\hat{\mu}) + v. \quad (1.22)$$

Our estimate of β is not significantly different from one, which allows us to reject the Bertrand assumption.

1.7 Competitive analysis

1.7.1 Lerner Index

Considering the estimated marginal costs under Cournot competition, we can compute the TV channels' price-cost margins on the advertising market. More specifically, the estimated profit margins of TV channels can be ranked in three levels: approximately 40% – 50% for the public channels, above 80% for the private new channels, and approximately 60% – 80% for the other private channels.²⁷

Now, following Rochet and Tirole (2006), the Lerner Index of a TV channel can be expressed as follows:

$$\frac{p_j - (c_j + p_j^v)}{p_j} = -\frac{1}{E_{A_j, p_j}}, \quad (1.23)$$

where E_{A_j, p_j} is the price elasticity of advertisers' demand and p_j^v , which represents the advertising cost on the viewers' side, is defined as

$$p_j^v = -p_j E_{y_j, A_j} E_{p_j, y_j} - \frac{1}{A_j} \sum_{i \neq j, i \in G_k} A_i p_i E_{p_i, y_i} E_{y_i, A_j}, \quad (1.24)$$

where E_{y_j, A_j} and E_{y_i, A_j} are the own- and cross- advertising elasticity of viewers' demand and E_{p_j, y_j} is the advertisers' willingness to pay for the TV channel's viewership.

In general, the sign of p_j^v is indeterminate. The first term on the right-hand side of Equation (1.24) ($-p_j E_{y_j, A_j} E_{p_j, y_j}$) is positive when viewers dislike advertising and negative in the opposite case. However, it always has an opposite sign to the second term ($-\frac{1}{A_j} \sum_{i \neq j, i \in G_k} A_i p_i E_{p_i, y_i} E_{y_i, A_j}$). In our case, as viewers dislike advertising, the second term (which is negative here) is always smaller than the first term in absolute value because of the small estimated values of the cross-advertising elasticity of TV viewers (E_{y_i, A_j}). Hence, the sign of p_j^v is positive for all the observations. In other words, as viewers dislike advertising, the disutility increases the effective marginal cost of advertising to TV channels.

Then, the "opportunity cost", namely, $c_j + p_j^v$, of an additional minute of advertising is positive and higher than the marginal cost (c_j), as it induces additional nuisance to TV viewers, and so a potential decrease in advertisers' willingness to pay. In this case, the Lerner index defined by Equation (1.23) is lower than the price-cost margins. In fact, the average estimated value of Lerner Index is equal to 37%, which is much less than the price-cost margins provided above. In other words, in such a two-sided market, the price-cost margin is not the right indicator of firms' market power.

²⁶ The number of employees is used here to approximate the size of TV groups.

²⁷ Disaggregated values on the margins are available upon request to the authors.

To complement this point and to show how important it is to account for two-sidedness, we compute the ratio p^v/p to provide the share of advertising prices, which are, in some sense, devoted to compensating viewers for the adverse effect of advertising. The estimated ratio p^v/p can be ranked in two levels: 5% – 16% for the public channels and 21% – 52% for the private channels.²⁸

It is noteworthy to mention that, despite the TF1 channel’s important position on the advertising market (with approximately 40% – 50% of market share), its estimated Lerner index is not higher than that of the other private channels. That is, given the two-sided structure of the broadcast television industry, a stronger position on one side of the market does not necessarily imply a higher profit margin of a TV channel. A simple measurement of the firms’ market shares is not enough to conclude on the degree of competition in a two-sided market. This should be taken into account in competition law and policy.

1.7.2 Evaluation of a merger between advertising sales houses

In 2010, the French competition authority (AdC) approved the acquisition of channels TMC and NT1 by the TF1 group under several behavior remedies. One of the main concerns of the AdC is that the TF1 group could abuse its dominant position on the advertising market to raise unilaterally either its advertising spot prices or the number of advertising minutes. According to the AdC, the TF1 group could force the advertisers, who want the advertising spaces of the TF1 channel to buy the advertising spaces of the TMC and NT1 channels at the same time. Therefore, as one of the established behavioral remedies of the merger, the AdC requires the independence of advertising offers between the TF1 channel and the TMC and NT1 channels.

Given the network externalities between TV viewers and advertisers, the merger of ads-sales houses on the quantity of advertising supply is indeterminate. As discussed previously, a rise in the quantity of advertising could have a negative effect on the viewership of TV channels, which in turn would reduce advertisers’ willingness to pay. Broadcasters could either increase or decrease their advertising supply to maximize their profits.

Looking at the historical change in consumer surplus on observed data, one cannot conclude that the remedies have been effective. Indeed, the consumer surplus keeps increasing after the French competition authority’s decision, which could be due to either the remedies or other effects, such as the extension of the digital market.²⁹

It is then required to be able to compare the observed situation with a counterfactual experiment, where the merger would have been fully approved, maintaining all else as equal. To do so, we insert the estimated demand side parameters in the supply equation to simulate the equilibrium outcome in a scenario where the supply decision of the three merging channels is made by one unique entity. We assume here that the merger of the two advertising agencies would not have brought about any additional efficiency gains on variable costs and that other trends are kept identical.

Comparing the observed and simulated situations provides a clear conclusion: the merger of the two advertising agencies does not affect the market equilibrium outcomes. There is no significant difference in terms of advertising quantities between the two situations. More precisely, under the merger, the advertising quantity slightly increases, but only by 3%. This means that, with or without remedies, the market outcomes are equivalent. In other words, the effect of a higher level of cooperation among advertising sales houses is defeated by the viewers’ adverseness for advertising, i.e., by the effect of the feedback loop between viewers and

²⁸Disaggregated values on the ratios are available upon request to the authors.

²⁹Detailed empirical and statistical results for this section are available from the authors upon request to authors.

advertisers. This feedback loop works like a countervailing power to the change in the level of cooperation among advertising sales houses.

These results provide evidence that the remedies imposed by the French competition authority in this concentration operation are basically unnecessary.

1.8 Conclusion

This paper investigated the advertising competition in the French TV broadcast industry. Following the approval of the acquisition of channels TMC and NT1 by the TF1 Group under behavioral remedies, we evaluate the impact of this acquisition on the consumer surplus. Given the two-sided nature of the free TV channels, we specify a structural model of oligopoly competition and separately estimate the demands of TV viewers and of advertisers using French market data.

Our findings suggest first that the indirect network externalities between TV viewers and advertisers are significant and affect the competition outcomes at equilibrium: the fraction of profit margins as a result of these externalities among viewers and advertisers is very large. Thus, a strong position on the advertising market is not enough for a channel to enjoy a higher market power than its competitors because of the feedback loop between viewers and advertisers.

We then implement a simple procedure to test for the market conduct of the TV channels, and we identify the nature of competition in the French free TV industry to be of the Cournot type. Strong network effects between TV viewers and advertisers as well as the relatively small market size restricting the channels' capacity for advertising offers explain the Cournot nature of competition in the French free TV broadcasting industry.

Finally, we conduct a counterfactual experiment to simulate the market equilibrium outcome in a scenario where the advertising sales house of TF1 and that of TMC and NT1 merge at the moment of acquisition of TMC and NT1 by the TF1 Group. Comparing the result of this simulation to the observed situation, where the advertising sales houses are kept separate following the remedies imposed by the French competition authority to approve the acquisition of TMC and NT1 by the TF1 Group, shows that the merger of the advertising sales houses would have increased the total advertising spaces on the TV market but would have decreased the advertising prices on average. However, these effects are almost negligible. In other words, we can conclude that these behavioral remedies appear unnecessary in this context.

As usual, this paper opens new questions. In particular, our analysis is based on at least three assumptions: the quality of TV programs is exogenous, the link between advertising and the choice of TV programs is given, and the discounts on the advertising prices are linear. Relaxing these assumptions calls for further research to develop an extensive analysis of the working of TV markets and advertising competition.

1.9 Appendix: Tables

Table 1.1: Audience shares of incumbent channels versus new channels

Year	Channel seniority	Min	Max	Mean	Std.Dev.
2008	Incumbent	2.5%	25.8%	13.2%	0.074
	New	0.3%	2.2%	1.0%	0.006
2009	Incumbent	2.4%	25.0%	12.7%	0.071
	New	0.4%	2.7%	1.3%	0.006
2010	Incumbent	2.7%	23.3%	12.1%	0.067
	New	0.6%	3.4%	1.7%	0.008
2011	Incumbent	2.9%	22.7%	11.6%	0.063
	New	0.6%	3.6%	1.9%	0.008
2012	Incumbent	3.0%	21.9%	11.5%	0.060
	New	0.7%	3.4%	2.0%	0.008
2013	Incumbent	2.8%	22.2%	11.2%	0.060
	New	0.2%	3.4%	1.4%	0.010

Table 1.2: Advertising revenue shares of incumbent versus new channels

Year	Channel seniority	Min	Max	Mean	Std.Dev.
2008	Incumbent	0.4%	5.29%	17.0%	0.189
	New	0.4%	3.0%	1.5%	0.006
2009	Incumbent	0.3%	55.8%	15.7%	0.188
	New	0.5%	4.6%	2.2%	0.010
2010	Incumbent	0.3%	50.2%	14.8%	0.174
	New	0.2%	5.7%	2.6%	0.013
2011	Incumbent	0.3%	45.6%	13.7%	0.160
	New	0.3%	6.4%	3.2%	0.015
2012	Incumbent	0.3%	45.2%	13.2%	0.158
	New	0.3%	6.3%	3.4%	0.016
2013	Incumbent	0.2%	42.4%	12.8%	0.152
	New	0.2%	6.6%	2.4%	0.018

Table 1.3: List of TV channels

Channels	Type	Nature	Media Group membership
TF1	generalist	commercial	TF1 Group
M6	generalist	commercial	M6 Group
F2	generalist	public	FTV Group
F3	generalist	public	FTV Group
F4	generalist	public	FTV Group
F5	generalist	public	FTV Group
TMC	generalist	commercial	TF1 Group*
NT1	generalist	commercial	TF1 Group*
W9	semi-generalist	commercial	M6 Group
I-Télé	news	commercial	Canal plus Group
BFM	news	commercial	NextRadioTV Group
D17	music	commercial	Canal plus Group**
D8	generalist	commercial	Canal plus Group**
RNJ12	generalist	commercial	RNJ Group
Gulli	child	commercial	Lagardère Group
RMC Découverte	documentary	commercial	NextRadioTV Group
Numéro 23	semi-generalist	commercial	La télédiversité Group
6ter	generalist	commercial	M6 Group
Chérie 25	generalist	commercial	NRJ Group
HD1	film	commercial	TF1 Group
L'Équipe 21	sport	commercial	Amaury Group

Note: * Since 2010; ** Since October 2012.

Table 1.4: Means and standard errors of advertising prices and quantities

	Spot_price		Number_spots	
	Mean	Std.Dev.	Mean	Std.Dev.
2008	4.939	7.733	5.388	2.091
2009	4.831	7.096	5.850	2.379
2010	4.984	6.942	6.658	2.672
2011	5.315	7.235	7.101	2.860
2012	4.178	6.658	6.900	2.888
2013	4.015	6.358	7.093	2.906

Note: Units of prices are not reported for confidentiality reasons.

Table 1.5: Ratio of observed advertising quantities to authorized ceilings

		2008	2009	2010	2011	2012	2013
Incumbent Channels	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%
Channels launched in 2012	Channel 6	43.2%	50.5%	66.6%	68.1%	61.9%	81.1%
	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	29.1%	31.4%	37.4%	58.0%	71.4%	72.1%
	Channel 12	36.6%	45.2%	48.7%	52.0%	70.0%	77.5%
	Channel 13	41.9%	44.3%	52.0%	50.1%	69.0%	77.9%
	Channel 14	23.5%	33.6%	39.6%	43.5%	59.0%	74.7%
	Channel 15	45.2%	51.0%	51.9%	58.0%	64.8%	85.0%
Channels launched in 2012	Channel 16						29.3%
	Channel 17						27.2%
	Channel 18						45.3%
	Channel 19						26.6%
	Channel 20						33.6%
	Channel 21						54.9%

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

Table 1.6: List of additional variables

Variable name	Unit	Periodicity	Mean
Average watching time	Minutes per day per individual	monthly	217.65
Total amount of advertising investment in the cinema market	Millions of Euros	monthly	26798.182
Total quantity of advertising in the radio market	Number of spots	monthly	128071.7
Total amount of French audiovisual programs	Number of hours per channel	annually	48.010
Number of movies broadcast from 20h30-22h30	Per channel	annually	75.869
Financial participation on movie production	Per channel	annually	8.353
Financial participation on regulated audiovisual production	Per channel	annually	44.493
French population size	Millions	annually	62.97
Subsidy	Millions of Euros	annually	698.501
Employees	Per media group	annually	9712.947

Table 1.7: Number of broadcasting hours of French audiovisual programs by channel type

Year	Channel seniority	Min	Max	Mean	Std.Dev.
2008	Incumbent	49.6	64.5	57.64	6.46
	New	0	62.6	40.61	21.42
2009	Incumbent	50.1	68.7	58.76	6.72
	New	0	67.4	41.66	22.18
2010	Incumbent	49.3	72.5	59.14	8.81
	New	0	68.8	42.97	22.92
2011	Incumbent	48.6	76.5	60.72	10.65
	New	0	72.4	44.26	23.87

Table 1.8: Number of movies broadcast during prime time

Year	Channel seniority	Min	Max	Mean	Std. Dev.
2008	Incumbent	0	60	46.4	21.08
	New	0	147	86.9	57.02
2009	Incumbent	2	65	45.4	22.45
	New	0	145	91	55.14
2010	Incumbent	1	60	42.6	22.46
	New	0	143	95.6	56.57
2011	Incumbent	5	64	40.8	20.01
	New	0	146	100.1	53.19

Table 1.9: First stage estimation of viewers' demand (No. of observations: 689)

	Advertising quantity A_{jt}	Logarithm of conditional market share $\ln(\bar{s}_{jt g})$
No. of movies during prime time	-0.002*** (0.0004)	-0.003*** (0.0004)
No. of hours of French audiovisual programs	0.005*** (0.002)	-0.009*** (0.002)
Advertising investment in the cinema market	0.002** (0.001)	-0.0004 (-0.001)
No. of advertising spots in the radio market	0.003*** (0.001)	0.0003 (0.001)
R-squared	0.535	0.220

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

Table 1.10: First stage estimation of advertisers' demand
(No. of observations: 689)

	Logarithm of advertising quantity $\ln(A_{jt})$	Logarithm of number of viewers $\ln(y_{jt})$
No. of movies during prime time	-0.003*** (0.001)	0.0002 (0.001)
No. of hours of French audiovisual programs	0.009*** (0.003)	-0.010*** (0.003)
No. of advertising spots in the radio market	0.004*** (0.001)	0.0003 (0.002)
Average watching time x incumbent channel dummy	-0.004** (0.002)	-0.006*** (0.002)
Average watching time * new channel dummy	0.002 (0.002)	0.001 (0.002)
R-squared	0.585	0.538

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

Table 1.11: Tests for the validity of instruments

Market size	0.25 M_t	0.5 M_t	0.75 M_t	M_t
Test for the viewers' demand equation				
<i>Kleibergen-Paap rk LM statistic (p-value)</i>	0.000	0.000	0.000	0.000
<i>Cragg-Donald Wald F statistic (p-value)</i>	11.059	11.059	11.059	11.615
<i>Hansen J statistic (p-value)</i>	0.195	0.169	0.127	0.058
Test for the viewers' demand equation				
<i>Kleibergen-Paap rk LM statistic (p-value)</i>	0.000	0.000	0.000	0.000
<i>Cragg-Donald Wald F statistic (p-value)</i>	8.638	8.638	8.638	8.638
<i>Hansen J statistic (p-value)</i>	0.107	0.107	0.107	0.107

Table 1.12: Estimation of TV viewers' demand (*No. of observations: 689*)

Market size	0.25 M_t	0.5 M_t	0.75 M_t	M_t
Quantity of advertising (α)	-0.667** (0.274)	-0.653** (0.272)	-0.626** (0.270)	-0.551** (0.251)
Within-nest share (σ)	0.359* (0.186)	0.355* (0.186)	0.347* (0.184)	0.367** (0.184)
<i>F-Statistic</i>	41.04	42.76	46.12	59.44
<i>R-Squared</i>	0.421	0.433	0.456	0.545

Note: (i) M_t denotes the total French population having access to TV service; (ii) Estimations are performed by applying the two-step feasible GMM; (iii) Standard errors are in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 1.13: Estimation of advertisers' demand (*No. of observations: 689*)

Market sizes	0.25 M_t	0.5 M_t	0.75 M_t	M_t
Log(Quantity of advertising) (θ)	-0.373** (0.153)	-0.373** (0.153)	-0.373** (0.153)	-0.373** (0.153)
Log(No. of viewers) (v_4)	0.606*** (0.149)	0.606*** (0.149)	0.606*** (0.149)	0.606*** (0.149)
<i>F-Statistic</i>	19.66	19.66	19.66	19.66
<i>R-Squared</i>	0.430	0.430	0.430	0.430

Note: (i) M_t denotes the total French population having access to TV service; (ii) Estimations are performed by applying the two-step feasible GMM; (iii) Standard errors are in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 1.14: Estimation of the TV viewers' demand (*No. of observations: 689*)

	OLS	IV
Quantity of advertising (α)	0.342*** (0.116)	-0.551** (0.251)
Within-nest share (σ)	1.030*** (0.142)	0.367** (0.184)
<i>R-Squared</i>	0.795	0.545

Note: The dependent variable is log market share of a TV channel minus log market share of the outside goods (See Equation 16). In the table, we compare OLS estimates to the IV estimates. The robustness correction is applied to both estimations so that the standard errors are robust to the presence of arbitrary heteroskedasticity. The standard errors of estimates are in parentheses. The significant levels are such that *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. The channel fixed effect, yearly dummies and monthly dummies are included in the regressions. Their estimates are not reported but are available upon request. All of these coefficients are statistically significant.

Table 1.15: Estimation of advertisers' demand (*No. of observations: 689*)

	OLS	IV
Log(Quantity of advertising) (θ)	-0.261* (0.126)	-0.373** (0.153)
Log(No. of viewers) (v_4)	0.723*** (0.149)	0.606** (0.149)
<i>R-Squared</i>	0.433	0.430

Note: The dependent variable is log spot price of advertising (see Equation 17). In the table, we compare OLS estimates to the TV estimates. The robustness correction is applied to both estimations so that the standard errors are robust to the presence of arbitrary heteroskedasticity. The standard errors of estimates are in parentheses. The significant levels are such that *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. The channel fixed effect, yearly dummies and monthly dummies are included in the regressions. Their estimates are not reported but are available upon request. The monthly dummies are very significant but the yearly dummies are not.

Table 1.16: Own-advertising-elasticity of audience of incumbents versus new arrivals

	2008	2009	2010	2011	2012	2013
Incumbent	-0.373 (0.234)	-0.365 (0.229)	-0.425 (0.266)	-0.409 (0.256)	-0.390 (0.240)	-0.430 (0.269)
New	-0.465 (0.292)	-0.527 (0.311)	-0.593 (0.373)	-0.657 (0.413)	-0.641 (0.404)	-0.642 (0.408)

Note: The standard errors computed by delta method are in parentheses.

Table 1.17: Own-advertising-elasticity of audience

	2008	2009	2010	2011	2012	2013
Public channels	-0.227 (0.143)	-0.216 (0.136)	-0.272 (0.172)	-0.272 (0.171)	-0.235 (0.112)	-0.258 (0.163)
Private news channels	-0.668 (0.425)	-0.761 (0.483)	-0.887 (0.563)	-0.937 (0.594)	-0.846 (0.536)	-0.923 (0.585)
Other private channels	-0.477 (0.299)	-0.523 (0.327)	-0.578 (0.361)	-0.625 (0.391)	-0.634 (0.397)	-0.638 (0.402)

Note: The standard errors computed by delta method are in parentheses.

Table 1.18: Cross-advertising-elasticity of audience

	2008	2009	2010	2011	2012	2013
Incumbent	0.053 (0.032)	0.051 (0.031)	0.057 (0.035)	0.053 (0.033)	0.050 (0.031)	0.078 (0.049)
New	0.011 (0.009)	0.013 (0.011)	0.017 (0.014)	0.020 (0.016)	0.020 (0.015)	0.017 (0.013)

Note: The standard errors computed by delta method are in parentheses.

Table 1.19: Estimated marginal costs

Year	Observed average price	Marginal cost under Cournot	Marginal cost under Bertrand
2008	4939	1784	31241
2009	4844	1615	9060
2010	4844	1463	5829
2011	5315	1541	-4996
2012	5600	1618	-1173
2013	4179	1087	15562

Table 1.20: Test Cournot versus Bertrand (*No. of observations: 689*)

	Step one Estimation of Equation (1.18)	Step two Estimation of Equation (1.21)
Difference of mark-ups		0.0002* (0.0001)
No. of employees	-0.002* (0.001)	-0.002* (0.001)
Fixed effects		
<i>Channel</i>	Yes	Yes
<i>Month</i>	Yes	Yes
<i>Year</i>	Yes	Yes
R-Squared	0.122	0.133

Note: The estimates of fixed effects included in the regressions are not reported but are available upon request. The standard errors of estimates are in parentheses. The significant levels are such that *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

APPENDIX 2: Test Cournot versus Bertrand

We develop the expression of Equation (1.20) as follows:

$$p = MK_{co} - \alpha MK_{co} + (1 - \alpha)Z\mu + \alpha(MK_{be} + Z\hat{\lambda}) + u.$$

Rearranging, one obtains

$$p - MK_{co} = \alpha(MK_{be} - MK_{co}) + Z(\mu - \alpha\mu + \alpha\hat{\lambda}) + u$$

and

$$c_{co} = \alpha(MK_{be} - MK_{co}) + Z\gamma + u,$$

where $\gamma = \mu - \alpha\mu + \alpha\hat{\lambda}$. If $\hat{\alpha} = 0$, we have $\hat{\gamma} = \hat{\mu}$.

Chapter 2

Regulating Advertising Quantity: Is This Policy Efficient?

English summary

EU and UK regulators impose strict regulation on TV advertising quantity today to protect the welfare of TV viewers, while in the US, the Justice Department seems more concerned about the welfare of advertisers and has agreed with the broadcasting industry to eliminate restraints on the duration of television commercials since 1982. How the regulation policy affects consumers and advertisers has not been well understood. This paper investigates the consequence of regulation on TV advertising quantity. To my knowledge, it is the first paper which structurally analyzes this issue within a two-sided market framework. The paper exploits a novel dataset of per hour data on 12 broadcast TV channels in France during one year (2014). I first estimate the demand of TV viewers and of advertisers, which allows me to account for the two-sidedness of the market in the supply decision of TV stations. I identify the shadow prices of regulation based on the observed regulatory constraints. Finally, I conduct two counterfactual experiments to calibrate the welfare effects of the regulation. My results suggest that regulating advertising quantity is unnecessary on a competitive market, given the two-sided market structure of the broadcast TV industry. However, if TV broadcasters collude on their advertising supply, the regulation can improve upto 5.75% of consumer surplus, but decrease until 4.8% of the industry's profit.

Résumé français

En Europe et au Royaume-Uni, les régulateurs imposent une réglementation stricte sur la quantité de publicité à la télévision pour protéger les téléspectateurs. En revanche, aux États-Unis, le Département de la Justice semble plus préoccupé par le surplus des annonceurs publicitaires et a convenu avec les chaînes de télévision d'éliminer les contraintes sur la durée de publicité depuis 1982. Comment la politique de régulation impacte les consommateurs et les annonceurs publicitaires n'a pas été bien comprise. Dans ce chapitre, j'analyse l'effet de la régulation par plafonnement des volumes publicitaires sur les chaînes de télévision en clair. J'exploite une nouvelle base de données par tranche horaire sur 12 chaînes de télévision en France pendant un an (2014). J'estime d'abord la demande des téléspectateurs et des annonceurs, ce qui me permet de tenir compte de la nature biface du marché dans la spécification de la décision stratégique des chaînes. J'identifie ensuite les «prix fictifs» de la régulation à partir des con-

traintes observées. Enfin, je conduis deux simulations contrefactuelles pour calibrer les effets de la régulation. Mes résultats suggèrent que la régulation n'est pas nécessaire sur un marché concurrentiel, compte tenu de la structure biface de cette industrie. Cependant, si les chaînes de télévision s'entendent sur leur offre publicitaire, la régulation peut augmenter jusqu'à 5,75% le surplus des consommateurs, mais diminuer jusqu'à 4,8% le profit de l'industrie.

2.1 Introduction

Broadcast TV stations are two-sided market platforms connecting TV viewers to advertisers. They share the same business model with the recent developed digital online platforms such as Facebook, Google, Amazon, etc. On these markets, users and advertisers interact and exert either positive or negative externalities on each other. These platforms offer service (or contents) free of charge to their users, but bill heavily the advertisers. The platforms have an incentive to enlarge their advertising spaces, as the advertising revenues consist of their main revenue source. However, the platforms have limited capacities: more advertisements mean less contents. In fact, while a webpage can contain both the searched information and advertisements, each broadcasting hour is composed of minutes for TV programs and minutes for advertisements.

EU and UK regulators wish to protect the welfare of consumers (platform users) who *may* dislike advertising and to ensure the reception of information and the accessibility of culture contents of the general public. Not only the platforms have limited capacities, but each consumer also has a finite time to spend on media consumption. Too much exposure to advertising reduces systematically our reach of information and of culture contents. The recent developed *ad-blocking* software allows the internet users to remove or alter advertising contents from a website. Regulators generally take the view that “users have the freedom to install software on their devices that disables the display of advertisement”.¹ In the case of broadcast TV, restrictions of advertising lengths on TV have long been widespread in developed countries. In particular, the European Audiovisual Media Services Directive (AVMSD) sets up since 2010 the standard of 12 minutes maximum of advertising for each single hour for all the EU member states. On the basis of this principle, European countries generally apply double regulation caps: less than 12 minutes for each single hour; less than 216 minutes a day.² Similar restrictions exist as well in the UK and Australia.

On the one hand, TV broadcasters continuously call for more freedom in allocating their advertising spaces. On the other, according to a survey conducted by Ofcom in 2011, TV viewers would not welcome an increase in advertising.³ A conspicuous example of unregulated market is the US. According to the Nielsen report, the US broadcast networks on average ran 14 minutes and 36 seconds of commercial per hour in 2014. The European markets differ from the US market in many aspects; it is difficult to conclude on whether the TV advertising level in a European country would be as important as in the US without regulation. A careful analysis on the market specific consumer preferences and on the complex interactions between the market players, namely viewers, advertisers, and broadcasters is required. It is the aim of this paper.

In practice, there are two potential sources of market failure in this industry which call for intervention of regulator. First, imperfect competition between TV broadcasters. As discussed

¹See the new online privacy rule proposed by European Commission in 2017: http://europa.eu/rapid/press-release_M-EMO-17-17_en.htm.

²The daily restriction varies with countries, 216 minutes a day is the most tolerant level that I know.

³See Ofcom report 2011: https://www.ofcom.org.uk/data/assets/pdf_file/0021/19083/advertising_minutage.pdf

in Caves (2000), each TV broadcaster is monopoly provider of their broadcasting content. Non-substitutable content generates unique viewers, and therefore market power on advertising supplies. The elasticity of demand of advertisers and the degree of horizontal differentiation between TV channels determine to what extent the market competition fails to prevent excessive provision of advertising. Secondly, two-sided network externalities can either control for or boost the incentive of TV channels on advertising supply. If viewers are ad-adverse, too many ads reduce the viewerships of TV channels and thereby reduce the willingness to pay of advertisers. It is not optimal for the TV stations to oversupply advertising in this case, given the shape of feedback loop between viewers and advertisers. However, if viewers welcome advertising, more ads generate more viewers, and give rise to higher willingness to pay of advertisers by consequence. We should expect a high level of advertising supply in this situation.

In this paper, I specify a structural econometric model to evaluate the welfare policy of regulating TV advertising quantity. The model framework allows to estimate the competitive degree of a market, and to identify the shape of feedback loop between viewers and advertisers. Despite being an important issue, the impact of regulating TV advertising quantity has not been extensively studied by academic researchers. Empirical findings are particularly lacking. Anderson (2007) uses a two-sided market model to investigate theoretically the effect of advertising caps on social welfare. The model shows that the level of advertising in equilibrium may be excessive (or insufficient) with respect to the social optimum if the TV viewers are highly (or weakly) ad-averse. A regulation cap is socially beneficial in the first case and harmful in the second case. Kerkhof and Münster (2015) studies the same question but in the presence of commercial media bias. In their paper, commercial media bias arises out of a conflict of interest between advertisers and audiences over media content. Broadcasters face a trade-off between increasing the number of viewers by sending content that is highly valued by viewers, and increasing the price of advertising by choosing advertiser friendly content. They conclude that the advertising length caps can be welfare improving, given the conflict of interest between viewers and advertisers. Filistrucchi et al. (2012) analyzes the impact of commercial advertising ban on the public TV channels from 8 p.m to 6 a.m in France. Their preliminary results suggest that advertising which was previously broadcast on public TV in the time slot 8 p.m - 6 a.m did not switch to private channels in the same time slot; rather, most of the advertising was switched to public TV in the time slot 6 a.m - 8 p.m, contradicting claims made at the time the policy was introduced. An empirical paper close in spirit to mine is the one conducted by Crawford et al. (2012). The authors study the inverse demand for advertising in the UK. They find that increasing the public TV channels' advertising minutes to the level permitted for private TV channels would increase both the revenue of the public TV broadcasters and of the industry.

Both of the two above-cited empirical papers use reduced form regressions and focus on the advertising side of the market. To the best of my knowledge, the present paper is the first one which investigates the welfare effects of regulating TV advertising quantity, using two-sided structural econometric models. Broadcast TV stations compete on the advertising market through their audience achievement. One cannot explain the transaction between TV channels and advertisers without considering the preference of TV viewers. A two-sided market framework taking into account the demand of both viewers and advertisers, as well as their interactions is necessary for the purpose of this study. As previously mentioned, TV channels are horizontally differentiated and competition degree of the market determine its social need for regulation. Structural econometric model ensures a precise identification of the substitution patterns across differentiated TV channels. This paper complements the findings of the previous works. Moreover, by using a two-sided market framework, my approach considers the sensitivity

of TV viewers to advertising and the interactions between viewers and advertisers in the supply decisions of TV broadcasters. The structural econometric models adopted here allow to take into account the competitive landscape of a market through the horizontal differentiation among TV channels. Most importantly, I identify the precise shadow prices related to regulation constraints, which consist in important indicators for policy makers. Finally, using rich data on the broadcasting side, I am able to conclude on the impact of regulation on viewers' welfare.

The paper exploits a novel set of hourly data on 12 broadcast TV channels in France during one year (2014). Details include the number of TV viewers watching each of the 12 TV channels, total number of TV viewers watching (both free and pay) TV during each hour, the genre of broadcasting contents (classified into 20 categories) on each TV channel, the lengths of advertising breaks (in minutes). Reduced form analyses confirm that the two-sidedness and the competition degree of the market matter for the TV stations' supply of advertising spaces.

As a first step, I estimate the demand of TV viewers and of advertisers. Demand of TV viewers is modeled by a random coefficient logit model, such that a viewer's utility from watching TV depends on the broadcast TV programs, and on the length of advertising breaks. The reliability of the estimation hinges on the precise identification of the demand shapes and of substitution patterns across differentiated TV channels. The use of aggregate data on audience makes the ability to accommodate the viewers' heterogeneity of demand especially crucial, as the individual preferences for advertising and for broadcasting content are confounded in the aggregate data. The literature of empirical industrial organization has addressed this need using random coefficient logit models (Berry, 1994; Berry, Levinsohn and Pakes, henceforth, BLP, 1995; Nevo, 2000 and 2001), which prove ability of providing rich and plausible substitution patterns in diverse applications, from cars (BLP, 1995), to food (ready-to-eat cereals in Nevo, 2000 and 2001), to pharmaceuticals (Dubois and Lasio, 2015), and to broadcasting industry (Wilbur, 2008 and Jeziorski, 2014). I follow these previous works to model the demand of TV viewers, so that the heterogeneity in individuals is controlled. I estimate the model using recent methodological advances, and carefully checked the property of the obtained minimum. (See Train, 2003 and Knittel and Metaxoglou, 2014). Different to the discrete choice of TV viewers, the advertisers may advertise simultaneously on several TV channels. In the spirit of the model of Rysman (2004), I specify a demand model of advertisers for broadcast TV industry. By considering the profit maximization problem of a representative advertiser, the model allows the advertisers to be multi-homing, and leads to estimate their inverse demand curve. More specifically, the willingness to pay of advertisers depends on the TV channels' viewership, and on the lengths of advertising messages.

The estimation results suggest that the TV viewers are ad-adverse on average, while their preferences are fairly heterogeneous across individuals. The prices of advertising spaces are estimated to be highly flexible with respect to audience, but the joint effect of *business stealing* (an advertisement get more easily ignored in a broadcast network with massive amount of advertisements) and *decreasing return to scale of advertising* (the fact that a long advertising message has more chance to be remembered by the TV viewers, but the viewers may get tired of the same ad in time) is estimated to be much less important. The small cross-advertising elasticities of audience suggest that the TV channels are horizontally differentiated. Viewers do not systematically substitute one channel by another due to the nuisance of advertising. On the one hand, it is not profitable for a TV channel to broadcast too much ads, given the shape of feedback loop between TV viewers and advertisers: viewers dislike advertising, while advertisers are sensitive to audience. On the other hand, the horizontal differentiation among TV channels—combined with the weak *business stealing* and *decreasing return to scale* of advertising—imply that the broadcast TV stations hold a certain level of market power to

increase their advertising minutes.

In light of the opposite effects of two-sided network externalities and of horizontal differentiation of TV channels, analyzing the supply function of TV broadcasters is crucial to understand the necessity and impact of the regulation. In this paper, I model the broadcast TV stations as two-sided market platforms which internalize the network externalities between viewers and advertisers. Their interactions affect the profits of TV stations through feedback loops: the lengths of advertising messages act on the prices of advertising spaces directly by standard price response to quantity supplied, and indirectly, by influencing the viewership of TV channels. Ownership structure of the market is also taken into account. In practice, each TV group chooses the number of advertising minutes for all of its channels to maximize their joint profits, given the strategic reactions of the other groups, and the regulation constraints.

I can derive expression of the shadow prices of regulation constraints from first order conditions of the TV groups' constrained profit maximization programs. In practice, it is the Lagrangian multipliers associated with the constrained optimization problems, and depends on the elasticities of demand, viewership of TV channels, prices and quantities of advertising, and marginal costs of broadcast TV stations. I don't observe directly the marginal costs of TV channels. However, I can explain their values by some observed and unobserved cost shifters across channels and periods. Using the difference in estimated marginal costs between the binding and non-binding regulation constraints, I identify the shadow prices of the regulation. My results suggest that the infinitesimal change in profit from an infinitesimal change in the constraint on advertising minutes is more important for a private broadcaster than for a public broadcaster. On average, a public broadcaster is willing to give up EUR 2200 of public subsidy for relaxing an additional minute of regulation constraint.

Finally, I conduct two counterfactual simulations to calibrate the welfare effect of the regulation. My results suggest first that regulating advertising quantity is unnecessary on the current French TV market. In other words, network externalities between viewers and advertisers partially correct the market failure in advertising supply. However, this result is partially thanks to the policy of prohibition of communication on advertising supply between advertising sales houses. I further simulated the impact of regulation in the situation where TV broadcasters collude on their advertising supply. If indeed collusion between advertising sales houses is possible, the regulation can improve upto 5.75% of consumer surplus, but decrease until 4.8% of the industry's profit.

The contribution of this paper is threefold. First, to my knowledge, it is the first empirical paper which structurally investigates the welfare effects of the restrictions on TV advertising quantity. Such regulation is widespread in many countries nowadays, it is important to evaluate its implied welfare benefits and costs. Structural econometric analysis allows for clarify the potential sources of market failure in this industry and quantify the exact impact of the regulation policy. Second, the underlying economic rationale of the regulation in broadcast TV industry apply broadly. Where the two-sided network externalities exist, the prediction of the traditional theories of competition does not hold anymore. My results can be generalized to different industries with two-sided market structure. For instance, similar regulation exists in broadcast radio industry, but not for newspapers neither the Internet. Broadcast radio industry is the closest to the broadcast TV industry, from the business model to the social function. The conclusion of this paper applies directly to regulation on radio advertising. The ad-financed online platforms' business model is also similar to that of broadcast TV stations, while the degree of competition between different online platforms is another issue to investigate. As discussed previously, the consequence of regulation depends on the opposite effects of two-sided network externalities and of competition. The econometric models of this paper

provide a framework for studies about online advertising. Differently, many newspapers charge both sides of the market, in which case the model need to be adjusted to consider the price effect on demand of newspaper readers. My work is still suggestive, as it demonstrates the importance of two-sided network externalities to the market equilibrium. Beyond the media sector, industries with two-side market structure includes: credit-card, airport, shopping mall, etc. Regulation of all types exist in different countries. The analysis of this paper contributes to the general debate about regulation of two-sided markets. Third, my paper provides also two methodological contributions. In the spirit of the model proposed in Rysman (2004), I specify a demand model of advertisers for the broadcast TV industry. The specificity of the broadcasting networks is that every advertising space is different. An advertising space during the prime-time (20:00-22:00) is much more valuable than an advertising space in the morning, since the audience size of the former is much larger. Within the same hour, a commercial break during a sport event is different to a break during a series, as the two programs attract different audience. When advertising on an information market (like: yellow pages and newspapers), the advertisers decide how much spaces to book, while advertising on a broadcasting network, the advertisers choose rather which advertising space(s) to buy. The framework proposed in this paper avoids the assumption that the advertisers choose how much advertising spaces to book at equilibrium. This framework applies to both radio and TV broadcasting networks. Besides, the shadow price of a regulation policy consists of an important indicator for the policy makers. I show in this paper how to identify it from the observed regulation constraints and the supply functions of firms. My identification strategy is derived from the techniques proposed by Dubois and Lasio (2015) where the authors identify the unobserved regulation constraints in pharmaceutical industry. My approach applies to industries where the regulation constraints are observed.

The reminder of this paper is organized as follows. In section 2, I present the general background of the industry, the regulation framework and the data. In section 3, I introduce the econometric model. In section 4, I discuss the identification strategy. The results of estimation are presented in section 5. In section 6, I analyze the (short-run) welfare effects of the regulation policy. Finally, I conclude and discuss the long-run welfare effect of regulation in section 7.

2.2 Context

2.2.1 Free-Broadcast TV Industry

The free-broadcast TV channels are two-sided platforms, connecting TV viewers to advertisers by broadcasting TV contents. The viewers value the entertainment they get from watching TV programs, and are willing to pay for it. Contrary to the pay TV channels which charge subscription fee to the TV viewers, the TV channels broadcast free to air requires only its viewers to bear the advertising. The TV viewers and the advertisers interact through feedback loops: the larger the audience size of a TV channel, the higher the advertisers' willingness to pay for its advertising spaces; the TV viewers may be ad-adverse, in which case the more extensive the advertising quantity of a TV channel, the lower its viewership.

On the advertising market, the advertisers look for audience and the TV channels supply them. The TV channels sell the advertising spaces via the intermediary of the advertising sales houses (ASHs). In France, many broadcast TV stations share common ownership (i.e. belong to the same TV group). Each TV group owns or cooperates with an ASH, through which its channels get in touch with the advertisers.

As an industry practice, the ASHs establish a private contract with each of their potential advertisers at the beginning of the year, which fix a discount for each advertiser’s advertising messages during the year. The discount is specific between every single channel and advertiser. Its form and value are confidential information that I cannot access. However, I know from the experts’ explanation that it depends on the characteristics of different channels and advertisers, and is therefore channel specific and time specific.

Based on the TV programs and on the regulation constrains, each TV group determines the capacity of advertising spaces for its different channels, and communicate the various advertising slots to its ASH. Advertisers search the ad-slots matching their expected audience reach (in terms of number of viewers and demographics) from their contracted ASHs. The ASHs (representatives of TV groups) and the advertisers finally agree on a cost per thousand (CPT) for each ad-slot. The CPT corresponds to the payment before discount of the advertiser for every 1000 reached viewers.

The TV programs are fixed and published one month prior to the broadcasting time. There was no last minute adjustment in 2014 according to the Conseil supérieur de l’audiovisuel (CSA)⁴. In contrast, the advertisements are adjusted in real time in order to achieve the desired effect.

2.2.2 French Regulatory Framework

In line with the European Audiovisual Media Services Directive—which limits the number of advertising minutes on TV to 12 minutes maximum per clock hour—the French law imposes double caps to broadcast TV channels on the basis of clock hours and daily average levels. In 2014, the private TV channels dispose of 9 minutes per hour of advertising and the public channels dispose of 6 minutes per hour on average within 24 hours (0:00 - 23:59). For each clock hour, the private channels are limited to 12 minutes maximum of advertising, and the public channels are limited on 8 minutes maximum. Furthermore, commercial advertising is completely banned on the public channels from 8 p.m to 6 a.m. Ads of service nature (paid public announcements such as: “You have the power, save energy.”) remain authorized during the commercial bans (8 p.m to 6 a.m) on the public TV channels.

Besides of the advertising revenues, the public TV broadcasters receive a subsidy from the French Government every year. This subsidy is collected from TV viewers and some public sponsors through taxes.

2.2.3 Data and Descriptive Statistics

This study uses hourly data on 12 broadcast TV channels in France during one calendar year (2014). In France, there are in total 22 TV channels broadcasting free-to-air. The 12 channels that I considered in this study are the most representative in terms of audience performance; their cumulative audience share exceeds 90% excluding viewers of pay TV, and equals to 75, 32% over total TV population in 2014. These 12 channels are listed in Table 2.1.

In this study, I match up data from three different sources in order to analyze the demand and supply on both sides of the market at equilibrium.

The first dataset consists of information on audience of different TV channels, and is provided by Médiamétrie. The channels’ audience is measured based on a panel of households equipped with one or more TV sets in their main residence. This panel consists of nearly

⁴The French regulator on television and radio.

Table 2.1 – List of TV channels

Channels	Nature	Membership
TF1	commercial	TF1 Group
F2	public	FTV Group
F3	public	FTV Group
M6	commercial	M6 Group
F5	public	FTV Group
D8	commercial	Canal plus Group
RNJ12	commercial	RNJ Group
NT1	commercial	TF1 Group
F4	public	FTV Group
TMC	commercial	TF1 Group
Gulli	commercial	Lagardère Group
D17	commercial	Canal plus Group

4300 households, which corresponds to around 10500 individuals aged 4 years and more. The panel is constructed to represent both the socio-demographic characteristics of households in metropolitan France and the characteristics of the different television offers. In each sampled household, Médiamétrie installs one or more (depending on how many pieces of equipment they have) audimeters, 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.⁵ This survey allows to know the number of TV viewers on each broadcast TV channel and the total population watching (both free and pay) TV instantaneously.

To complete the first set of data on the broadcasting market, I collect, with help of the CSA, detailed information on genre of broadcasting programs of different TV channels.⁶ These programs are classified into 20 categories (*e.g. News, Documentaries, Films, Series, Sports.*) following the industry practice. A list of the 20 program genres is provided in Table 2.6 in Appendix. These 20 genres summarize all the categories of TV programs in France. A reconstruction of this dataset allows me to know the exact types and lengths of programs that each channel has broadcast every hour of every day.

Data on the advertising market are provided by Kantar Media, via contract with the CSA. To support this study, Kantar Media provides hourly measurements on gross advertising revenues (revenues before discounts, in thousands of euros) and advertising lengths (in minutes) of the 12 broadcast TV channels. I divide the gross advertising revenues by the corresponding minute of advertising, to obtain the average prices per minute of advertising messages for each channel-period pair of observation. The per minute price of advertising conveys the TV channels' audience performance and advertising capacities. As explained previously, channels and advertisers agree on the costs per thousand (CPT) of different advertising messages before broadcasting. Channels' realized gross advertising revenue is equal to the pre-established cost per thousand (CPT) times the number of viewers of the corresponding ad-spot, divided by 1000. There are in general two or three advertising spots broadcast within one clock hour. Competition between advertisers as well as the length of each individual advertising message affect the willingness to pay of advertisers.⁷

⁵Source Médiamétrie: <http://www.mediametrie.fr>.

⁶I gratefully acknowledge the CSA for uniting these data.

⁷I discuss more in details this point when modelling the demand of advertisers in section 3.2.

Matching up the three datasets together, each observation (channel-period pair) is uniquely identified by the name of the TV channel, the corresponding TV group and the period of observation (hour/day/month/year) in my final database.

Summary statistics of the main variables are reported in Table 2.2. *Number of viewers* reports the viewership of each TV channel in my sample; it varies with time and with channel. *TV population* measures the total population watching (both free and pay) TV; it varies every hour. In Figure 2.7 in Appendix, I plot the average level of *TV population* by broadcasting hour, the data suggest that there is an important audience peak from 7 p.m to 11 p.m, with more than 17 millions of people watching TV. These hours (7 p.m - 11 p.m) are known as TV prime time. In practice, there are hours (especially in the evening) during which the audience of broadcast TV stations is close to zero. During these hours, channels either rebroadcast the same program of the day, or show some old but unattractive programs that they have in stock.⁸ There is no advertising during these hours. In what follows, I will call these hours the “inactive hours”, as the statistics on viewership of TV channels count only the number viewers having been exposed to advertising. The inactive hours are blank spaces in my panel data. In sum, there are in total 8760 broadcasting hours in 2014; none of the 12 channels in my sample has been active for more than 7700 hours. In Table 2.7 in Appendix, I provide a detailed description on the active hours of each TV channel by clock hours (from 00:00 to 23:59). Due to the policy of commercial advertising bans in the evening on public TVs, we observe that the public TV stations (CH2: F2, CH3: F3, CH5: F5, CH9: F4) active only on a very low frequency from 8 p.m to 6 a.m.⁹ I notice also that that there is no advertising at 6 a.m., neither on public nor on private TV channel. In Figure 2.8 in Appendix, I plot the averaged cumulative audience shares of the 12 TV channels in my sample by clock hour.¹⁰ I notice that only a small share of TV viewers are exposed to advertising from 3 a.m to 7 a.m. However, from 7 p.m to 9 p.m, advertising audience of the 12 TV channels in my sample exceed 50% of the total TV population, i.e. more than 8.5 millions people, while the advertising levels of these 12 channels also achieve their maximums during these two hours, with more than 8 minutes per hour on average (see Figure 2.9 in Appendix). Regulating TV advertising, especially its quantities from 7 p.m to 9 p.m., is a crucial issue given its involved welfare of a large population.

Table 2.2 – Summary statistics

Variable	Unit	Periodicity	Mean	Std. Dev.	Min.	Max.
# of viewers	Millions per channel	Hourly	0.55	0.94	0.001	13.94
TV population	Millions	Hourly	10.14	6.98	0.52	30.34
Ad prices	Per minute per channel*	Hourly	12.03	25.32	0.004	411.20
Ad lengths	Minutes per channel	Hourly	7.41	3.61	0.10	23.93

* *The monetary unit of price is not reported for confidentiality reason*

More detailed audience shares, advertising revenues and advertising lengths of different TV channels are reported in Figure 2.10- 2.12 in Appendix. The audience shares of different

⁸TV channels usually have many low quality/unattractive programs in stock due to the practice of bundle selling of program producers.

⁹I discuss this issue more in details in section 7 and in Figure 10 in Appendix.

¹⁰Notice that I here use the number of viewers (having been exposed to advertising) of each channel over total TV population, but not the channels’ audience share in broadcast TV market. the total TV population include also viewers of pay TVs channels.

TV channels vary from one hour to another, but are stable at monthly average level. The TV stations choose advertising lengths strategically, based on their predictions of audience performance and on the regulation constraints. In general, the advertising spaces in the evening (after 7 p.m) are more expensive than those during the days. Due to regulation and various physical constraints, the TV channels set similar level of advertising quantities; however, the per minute prices of advertising spaces vary importantly with channels. In Table 2.10 in Appendix, I provide a comparison on the mean and standard deviation of the per hour level of advertising lengths versus prices.

My data indicate that the daily average level of advertising constraints is never binding during the entire period of observation, but it has happened to all the TV channels to bind the hourly level of advertising constraints (8 minutes per hour for the public broadcasters, 12 minutes per hour for the private broadcasters). In total, there are only 3% of observations (station-hours) that hit the regulation constraints. However, advertising supply of each TV channel is a strategic decision anticipating the potential reactions of its competitors. A channel's advertising supply may not hit the regulation caps on a market because its competitors advertise less. Literally, one should consider a broadcasting hour as a binding market as long as there is a TV channel which hit the regulation constraints within that hour. In my sample, there are in total 8384 active markets (broadcasting hours), among which 1773 are binding. Namely, the observed frequency of binding markets (hours) is equal to 21.15% in 2014 in France. Most of these binding markets are in the evening when there are more people watch TV. In Figure 2.1, I report more detailed frequencies of binding markets by clock hours (00:00 – 23:59). I notice that the regulation limits mainly the advertising levels within three hours: from 4 p.m to 5 p.m. and from 7 p.m to 9 p.m. As mentioned previously, the advertising level from 7 p.m to 9 p.m concerns welfare of more than 8.5 millions people. If indeed the channels would broadcast many more advertisements without regulation, the implied social harm could be considerable. In this regard, regulating advertising quantity is important.

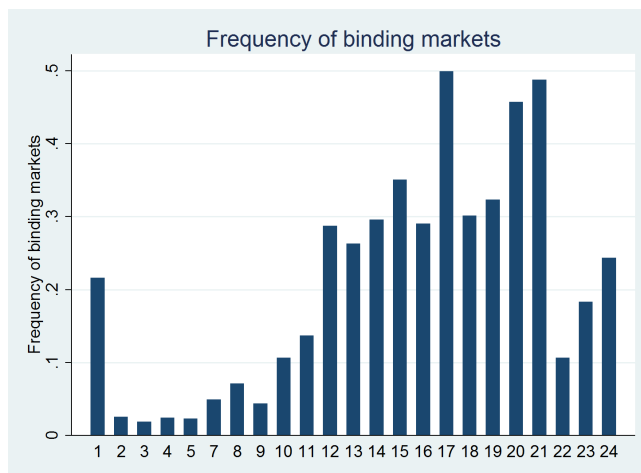


Figure 2.1 – Frequencies of binding hours

2.2.4 Model-Free and Reduced-Form Evidence

Two main factors determine the advertising supply of TV channels: Sensitivity of TV viewers towards advertising; competition degree of a market.

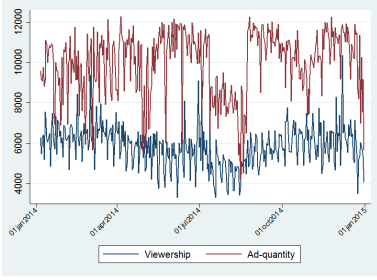


Figure 2.2 – TF1, 8-9 p.m

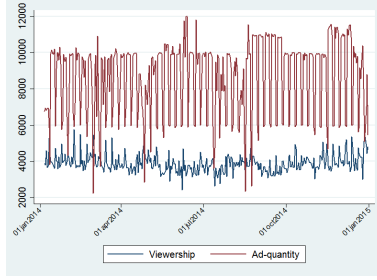


Figure 2.3 – TF1, 1-2 p.m

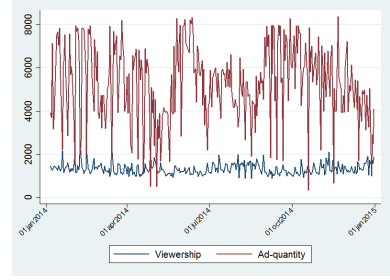


Figure 2.4 – FR2, 1-2 p.m

- How do ads affect viewers?

In Figure 2.2 - Figure 2.4, I show time series of audience and advertising quantities of two representative TV channels (private channel: TF1 and public channel: FR2) during two different broadcasting hours (1-2 p.m and 8-9 p.m). I notice clearly a drop in audience when there is an increase in ads. As a specific feature of two-sided market, broadcast TV stations internalize interactions between two groups of consumers: advertisers buy audience, their willingness to pay increases with the viewership of a TV channel; however, if the audience are ad-adverse, it is not profitable for the channel to introduce too much advertisements. I further considered a reduced-form regression of TV channels' viewership on the lengths of advertising breaks, controlling for the genres of TV programs, the channel-fixed effects and various time-fixed effects. The results are reported in Table 2.11 in Appendix. Estimates show that the lengths of advertising breaks have a negative impact on the viewership of TV channels, suggesting that the market may not oversupply advertising even without regulation.

- How do ads affect the cost per view?

Advertisers and TV channels agree on a cost per view prior to the broadcasting time. Advertisers may worry about the competition with other advertisers on the viewers' attention. With my data, I can compute the average level of cost per view per channel per hour. I regress the computed cost per view onto the total quantities of ads per hour, controlling for the channel-fixed effects and different time-fixed effects. The result suggests that the density of advertising negatively affects the established cost per view between advertisers and TV broadcasters.¹¹

- What about competition between TV channels?

Finally, TV channels compete on audience since it determines the willingness to pay of advertisers. As the channels broadcast different TV programs, they are horizontally differentiated. To investigate if competition still exists among TV channels regardless of their differentiation in broadcasting contents, I generate a series of indexes which count the number of same genre of programs broadcast at the same time. Intuitively, if the viewership of a TV channel decreases with the number of similar programs broadcast within the same hour, we should conclude that the program differentiations are imperfect, and that competition between channels exists. In Table 2.12 in Appendix, I report the results of a reduced form regression of the channels' viewership on the generated indexes of competition for each genre of programs, controlling for the channel-fixed effects and different time-fixed effects. For instance, the index variable

¹¹The OLS estimation establishes a statistically significant negative impact of ad-quantity on the cost per view. I do not disclose the value of estimates here due to confidentiality reason.

“*comp_documentaries_{jt}*” measures the potential competition faced by the documentary program broadcast on channel j during hour t ; it counts the number of channels except j which broadcast documentaries within hour t and is specified to be 0 if channel j does not broadcast documentary during hour t . Estimates show that, for 12 program genres over 20, the viewership of a TV station is negatively affected by the number of other channels broadcasting the same genre of programs at the same time. In other words, 12 genres of programs over 20 are estimated to be substitutable in the eyes of TV viewers. We should conclude that competition among TV channels indeed exists.

Above analysis suggests that a structural modelling of the market demand and supply which takes into account the interactions between viewers and advertisers, and the competition among TV channels is necessary to evaluate the impact of regulation.

2.3 Econometric Model

In what follows, I specify a structural model of oligopoly competition for the French free-broadcast TV industry. There are J channels belonging to K TV groups that broadcast free to air. The operators of TV stations are facing two interacting groups of consumers: TV viewers and advertisers. The TV viewers watch the programs for free, so there is no direct profit generated from the broadcasting side. However, the willingness to pay of advertisers depends on the viewership of TV channels. By allowing the TV groups to compete on the advertising market through audience, the model explicitly captures the interactions between viewers and advertisers. The regulation constraints affect the TV channels’ strategic choices in advertising supply. When the market demand for advertising is greater than the level authorized by the law, the regulation induces a shadow prices for the TV broadcasters. The model presented below shows how to identify the monetary values of the shadow prices of regulation constraints. This model setting is composed of three parts: the demand of viewers, the demand of advertisers and the supply of TV groups.

2.3.1 Demand for TV Viewers

The model specifies a TV viewer i ’s utility by watching channel $j \in 1, \dots, J$ during hour t as:

$$U_{ijt} = G_{jt}\beta_i + \alpha_i A_{jt} + X_{jt}\delta + \xi_{jt} + \epsilon_{ijt}, \quad (2.1)$$

where G_{jt} denotes 20 dummies of program genres, A_{jt} measures the number of minutes of advertising on channel j within hour t , X_{jt} includes all the other observable attributes (dummies for channels, hours of the day, day of the week, and month of the year). The 20 genres summarize all types of TV programs in France. ξ_{jt} captures the unobserved quality of the TV channel. ϵ_{ijt} is a mean zero stochastic term. The model is completed by the inclusion of an outside good, which corresponds to not watch any of the J TV channels during hour t , with a normalized indirect utility $u_{i0t} = \epsilon_{i0t}$.

A TV viewer i chooses to watch one channel in the choice set $0, 1, \dots, J$ during hour t according to the maximum utility (refeq:U1). The preference parameters are individual specific:

$$(\beta_i^l, \alpha_i) = (\beta^l + \sigma_{\beta^l} v_i^l, \alpha + \sigma_{\alpha} v_i^A) \quad (2.2)$$

where $(v_i^1, \dots, v_i^l, \dots, v_i^L, v_i^A)$ summarizes all the unobserved individual characteristics and $(\sigma_{\beta^l}, \sigma_{\alpha})$ characterizes how the tastes of different TV viewers vary according to these unobserved characteristics. The indirect utility can be redefined as the sum of a mean utility $\delta_{jt}(X_{jt}, A_{jt}, \xi_{jt}; \theta_1) =$

$G_{jt}\beta_i + \alpha_i A_{jt} + X_{jt}\delta + \xi_{jt}$, a deviation from the mean utility $\mu_{ijt}(G_{jt}, A_{jt}, V_i; \theta_2) = \sum_l \sigma_{\beta^l} v_i^l g_{jt}^l + \sigma_{\alpha} v_i^A A_{jt}$, and an idiosyncratic error ϵ_{ijt} :

$$U_{ijt} = \delta_{jt} + \mu_{ijt} + \epsilon_{ijt}. \quad (2.3)$$

Under the assumption that ϵ_{ijt} is independently and identically distributed according to Gumbel (extreme value type I) distribution, the choice probability of alternative j by individual i is

$$s_{ijt}(\mathbf{X}_t, \mathbf{A}_t, \xi_t) = \frac{\exp(\delta_{jt} + \mu_{ijt})}{1 + \sum_k \exp(\delta_{kt} + \mu_{ikt})}, \quad (2.4)$$

and the outside good choice probability is

$$s_{i0t}(\mathbf{X}_t, \mathbf{A}_t, \xi_t) = \frac{1}{1 + \sum_k \exp(\delta_{kt} + \mu_{ikt})}. \quad (2.5)$$

Assuming that $V_i = (v_i^1, \dots, v_i^L, \dots, v_i^L, v_i^A)$ is distributed with p.d.f. φ , the audience share of channel j , s_{jt} , is given by

$$s_{jt}(\mathbf{X}_t, \mathbf{A}_t, \xi_t) = \int s_{ijt}(\mathbf{X}_t, \mathbf{A}_t, \xi_t) \varphi(V_i) dV_i. \quad (2.6)$$

The own- and cross-advertising elasticities of the audience share s_{jt} are:

$$\frac{\partial s_{jt}}{\partial A_{kt}} \frac{A_{kt}}{s_{jt}} = \begin{cases} \frac{A_{jt}}{s_{jt}} \int \alpha_{it} s_{ijt} (1 - s_{ijt}) \varphi(V_i) dV_i, & \text{if } j = k \\ -\frac{A_{kt}}{s_{jt}} \int \alpha_{it} s_{ijt} s_{ikt} \varphi(V_i) dV_i, & \text{otherwise.} \end{cases}$$

2.3.2 Demand of Advertisers

In the spirit of the model in Rysman (2004), I consider a representative advertiser, whose expected revenue per viewer from an advertising spot on channel j , denoted by r_{jt} , is such that $r_j = \tau_j (CPT_j/1000)$, where CPT_j measures how much (s)he agrees to pay for reaching an audience of 1000 individuals and where $\tau_j \geq 1$.¹² For simplicity of notation, I will consider directly $\mathbf{C} = (C_1, C_2, \dots, C_J)$, where $C_j = CPT_j/1000$ in what follows. Let $\mathbf{P} = (P_1, P_2, \dots, P_J)$ be the vector of per minute price of advertising spots of different TV channels. The representative advertiser's profit function can be specified as:¹³

$$\Pi^A = \sum_{j=1}^J (\tau_j C_j - P_j a_j) \quad (2.7)$$

On the advertising market, TV stations and the advertiser agree on a cost per thousand, CPT_j , based on four variables: 1) the length of the advertising message, a_j ; 2) the total capacity of channel j , A_j ; 3) the viewership of channel j , y_j ; 4) the decomposition of audience in terms of socio-demographic characteristics, D_j . I thus specify the market-determined $C_j = CPT_j/1000$ using a Cobb-Douglas form, namely:

$$C_j = D_j^{\gamma_1} a_j^{\gamma_2} A_j^{\gamma_3} y_j^{\gamma_4}. \quad (2.8)$$

¹²It is appropriate to assume that the willingness to pay of the advertisers (CPT_j) represents only a fraction of its expected benefit from advertising (r_j).

¹³I drop the time index t in this section as it does not generate misunderstanding.

Specifically, γ_2 measures the decreasing return of large advertisement,¹⁴ γ_3 captures the “business stealing effect”,¹⁵ and γ_4 measures the sensitivity of advertisers to the viewership of TV channels. I expect the value of γ_2 to be within 0 and 1, the value of γ_3 to be negative, and the value of γ_4 to be positive.

Replacing the expression 2.8 into Equation 2.7 and maximize Π^A over a_j , one obtains the inverse demand of advertising as:

$$P_j = \gamma_2 \tau_j D_j^{\gamma_1} a_j^{(\gamma_2-1)} A_j^{\gamma_3} y_j^{\gamma_4}. \quad (2.9)$$

Denote the size of advertising market to be \bar{m} , then $a_j = A_j/\bar{m}$, thus,

$$P_j = \gamma_2 \tau_j D_j^{\gamma_1} \bar{m}^{(1-\gamma_2)} A_j^{(\gamma_2+\gamma_3-1)} y_j^{\gamma_4}, \quad (2.10)$$

which yields, with time index and in logarithmic form:

$$\log P_{jt} = \log[\gamma_2 \tau_{jt} D_{jt}^{\gamma_1} \bar{m}^{(1-\gamma_2)}] + (\gamma_2 + \gamma_3 - 1) \log A_{jt} + \gamma_4 \log y_{jt}. \quad (2.11)$$

Given the data available for this study, I approximate the term $\log[\gamma_2 \tau_{jt} D_{jt}^{\gamma_1} \bar{m}^{(1-\gamma_2)}]$ by some observed and unobserved characteristics across channels and times: $X_{jt}^A \beta$ and ξ_{jt}^A . Thereby, the final equation to estimate takes the form of an inverse demand curve:

$$\log P_{jt} = \theta \log A_{jt} + \gamma \log y_{jt} + X_{jt}^A \beta + \xi_{jt}^A. \quad (2.12)$$

To be consistent with the theoretical model, I expect the estimate $\hat{\theta}$ which measures the joint effect of decreasing return and business stealing to be negative and the estimate $\hat{\gamma}$ which measures the sensitivity of advertisers to the viewership of TV channels to be positive. X_{jt}^A is specified as a linear combination of channel fixed effects and several time fixed effects: dummies for months, hours and days of the week. Channel-fixed effect captures the bargaining powers of different TV channels. The market size \bar{m} (total number of advertisers) varies with months, hours and days of the week. The hourly fixed effect also consist on a good proxy for demographics of viewers: an individual only spends limited hours of a day on watching TV; the aging population has a different habit from the young. The unobserved characteristics ξ_{jt}^A are the purchasing powers of different advertisers.

2.3.3 Supplies of TV Channels

There are J broadcast TV channels belonging to K different TV groups active on the advertising market. Each TV group owns or cooperates with a private advertising sales house, through which its channels get in touch with the advertisers. As a matter of fact, channels within the same TV group maximize jointly their profits taking account of the strategic reactions of other groups.

A channel’s profit from each advertising minute is equal to its gross revenue P_{jt} minus the marginal costs c_{jt} of advertising. Channel j ’s gross revenue from advertising minute t is equal to the pre-determined cost per view C_{jt} times the realized audience y_{jt} . Namely, $P_{jt} = C_{jt} y_{jt}$.

¹⁴It is expected that a long advertising message has more chance to be remembered by the TV viewers, but the viewers may get tired of the same ad in time. Therefore, the advertiser’s willingness to pay takes parabola form with respect to the length of the advertising message.

¹⁵That is to say, the fact that an advertisement get easily ignored in a broadcast network with massive amount of advertisements.

The marginal cost of one additional minute of advertising implies mainly its marketing cost: discounts. As previously explained, TV channels agree with each of its potential advertisers on a discount for the advertiser's advertising messages during the year. The discount consists on a channels' marketing strategy to attract future clients. However, whenever a channel decides to include one additional minute of advertising, it bears a cost c_{jt} according to its agreement with the advertiser in question. The discount is a cost for the TV channels. As the discount is specific between each channel and advertiser, its value varies with channel j and with time t .

The profit of a TV group $G_k, k = \{1, \dots, K\}$ by selling advertising spaces of its channels during hour t is therefore given by:

$$\Pi_{G_{kt}} = \sum_{jt \in G_{kt}} \Pi_{jt} = \sum_{jt \in G_{kt}} [(P_{jt} - c_{jt})A_{jt}]. \quad (2.13)$$

A TV group's timing of decision is as following: fixing TV programs and advertising spaces of different TV channels in the first stage, and determining the exact lengths of advertising breaks on each channel hour-by-hour by matching the demand (targeted audience) and willingness to pay of advertisers to different advertising spaces in the second stage. The decisions on lengths of advertising breaks are constrained by regulation. This paper investigates mainly the short run welfare effect of the regulation policy and will focus on the second stage of the game.¹⁶

The length of advertising break A_{jt} affects the viewership y_{jt} but also the payoff of each advertising minute P_{jt} . In fact, as explained in section 3.2, the length of each advertising message and the competition from other ads within the same broadcasting hour are factors that determine cost per view C_{jt} . Therefore, the length of advertising break A_{jt} affects a channel's gross advertising revenues P_{jt} through two arguments: directly, by acting on its viewership $y_{jt} \equiv y_{jt}(A_{jt} | \mathbf{A}_{t-jt})$, where $\mathbf{A}_t = (A_{1t}, A_{2t}, \dots, A_{Jt})$, and indirectly, by influencing the cost per view $C_{jt} \equiv C_{jt}(A_{jt})$. As a matter of fact, $P_{jt} = C_{jt}y_{jt} \equiv P_{jt}(A_{jt}, y_{jt}(\mathbf{A}_t))$.

The regulation constraints for a private (public) TV channel are such that 216 (144) minutes maximum of ads within a day, and 12 (8) minutes maximum of ads per clock hour. Channels of the same TV group G_k chose their advertising minutes jointly to maximize profit of the group. The choice of TV channels are subject to double regulation constraints. TV group G_k 's constrained profit maximisation program can be written done as:

$$\begin{aligned} \text{Max} \quad & \{\Pi_{G_{kt}} | \mathbf{A}_{-jt}\} = \max_{A_{jkt}; jt \in G_{kt}} \sum_{jt \in G_{kt}} [(P_{jt}(A_{jt}, y_{jt}(\mathbf{A}_t)) - c_{jt})A_{jt} | \mathbf{A}_{t-jt}], \\ \text{s.t.} \quad & A_{jt} \leq \bar{A}_{jt}, \\ & \sum_t^{24} A_{jt} \leq \tilde{A}_{jt}, \end{aligned}$$

where \bar{A}_{jt} equals to 12 (8) and \tilde{A}_{jt} equals to 216 (144) for a private (public) TV channel.

Define the Lagrange multipliers associated with the constraint $A_{jt} \leq \bar{A}_{jt}$ to be λ_{jt} , and the Lagrange multipliers associated with the constraint $\sum_t^{24} A_{jt} \leq \tilde{A}_{jt}$ to be μ_{jt} . Under the assumption that the technical conditions for the existence of a pure-strategy Cournot-Nash equilibrium in quantities are satisfied, and that the equilibrium quantities are positive, the constrained profit-maximizing quantities of advertising should satisfy the following Kuhn-Tucker

¹⁶Analyzing the long-run effect of regulation requires knowledge on the TV stations' investment strategy and data for a long period of time, and is out of the scope of this paper.

conditions:

$$\begin{aligned} \frac{\partial \Pi_{G_{kt}}}{\partial A_{jt}} - \lambda_{jt} - \mu_j &= 0, \\ \min[\lambda_{jt}, \bar{A}_{jt} - A_{jt}] &= 0, \\ \min[\mu_{jt}, \tilde{A}_{jt} - \sum_t^{24} A_{jt}] &= 0, \\ &\forall jt \in G_{kt} \end{aligned}$$

The complementary slackness conditions (in the second and third row) state that, for any channel j at time period t , the constraint is either binding (“active”), or nonbinding in which case $\lambda_{jt} = 0$ or $\mu_{jt} = 0$.

During the period of observation, the constraint on advertising minutes within a day is never binding (“active”) for any TV channel. Therefore, $\mu_{jt} = 0, \forall jt$. The first order condition (in the first row) can thus be simplified as:

$$(P_{jt} - c_{jt}) + A_{jt} \frac{\partial P_{jt}}{\partial A_{jt}} + A_{jt} \frac{\partial P_{jt}}{\partial y_{jt}} \frac{\partial y_{jt}}{\partial A_{jt}} + \sum_{i \neq j, it \in G_{kt}} A_{it} \frac{\partial P_{it}}{\partial y_{it}} \frac{\partial y_{it}}{\partial A_{jt}} = \lambda_{jt}, \forall jt \in G_{kt}. \quad (2.14)$$

where λ_{jt} measures the **shadow prices** of restriction on advertising minutes of channel j during period t .

2.4 Identification and Estimation

2.4.1 Demand of TV Viewers

Identification of random coefficient logit models on aggregate data (Equation 2.6) is based on moment conditions between the structural demand error ξ_{jt} and some instrumental variables (BLP, 1995 and Nevo, 2000). The instrumental variables are needed to account for the endogeneity due to correlations between the lengths of advertising breaks A_{jt} and the unobserved demand factors ξ_{jt} (Berry, 1994 and BLP, 1995).

ξ_{jt} can be either unobserved quality of the TV channel, or unobserved tastes for ads and/or quality of TV programs. These characteristics are unknown to the econometricians but are likely to be observed by the TV channel. If a channel anticipates the viewers to be less sensitive to ads during a program of period t , according to unobserved information ξ_{jt} , it includes more advertising breaks during that period as well. Without controlling this fact, the estimate of α will be biased upward.

To instrument “the number of advertising minutes of channel j during a given hour t ” (A_{jt}), I use “the number of advertising minutes of the same channel j during the rest of the day, excluding the hour before and after the hour t ”. This instrumental variable varies with channel and hour. Its validity relies on the fact that each channel has limited advertising minutes a day. Even though the regulation caps on daily average level of advertising minutes are not strictly binding, the presence of this regulatory rule obliges the channels to consider their advertising capacities during the rest of the day when choosing the length of advertising breaks for a particular hour t . Channel j can include more than 9 minutes of ads during hour t only if it has not exceed 9 minutes per hour during the other 23 hours of the same day. However, if a TV program of hour t starts from hour $t - 1$ or/and lasts until hour $t + 1$, the advertising breaks during hour $t - 1$ or/and $t + 1$ could reveal the quality of programs within hour t (so

correlated with ξ_{jt}). I therefore construct the instrumental variable “the sum of advertising minutes during the rest of the day” by excluding the advertising minutes during hour $t - 1$ and $t + 1$. Controlling the channel-fixed effect, this variable should have no effect on the viewership of the TV channel. Idea of this instrument is common to the one used in Hausman and Leonard (2002) and Nevo (2000a, b).¹⁷

2.4.2 Demand of Advertisers

ξ_{jt}^A includes mainly the unobserved demographic characteristics of TV viewers. It could be, for instance, the channels’ prediction on viewers’ demographics that I don’t have in my data. As the TV channels may consider their predicted audience composition when determining the lengths of the advertising breaks, variable $\log A_{jt}$ is endogenous in Equation 2.12. y_{jt} is therefore also endogenous by the demand function of TV viewers: the viewership of a TV channel y_{jt} depends on its advertising level A_{jt} . y_{jt} is correlated with ξ_{jt}^A as long as A_{jt} is correlated to ξ_{jt}^A .

I use two sets of instruments: “the broadcasting lengths of different programs” and “the programs of the other TV channels within the same hour” to correct the endogeneity bias. Both of the two sets of instruments vary with channels and with times. For each hour period of observation, the length of advertising messages on channel j , A_{jt} , is equal to 60 minutes minus the total lengths of programs within the same hour on channel j . “The broadcasting lengths of different programs” are correlated with variable $\log A_{jt}$. The programs are predetermined by TV channels and cannot be correlated with identity (purchasing power) of the advertisers, ξ_{jt}^A . As shown in the reduced-form analysis, the programs of the other channels do have an impact on the viewership of channel j , y_{jt} , through competition. Intuitively, viewers are more likely to watch a movie on channel j when there is not another channel broadcasting movie at the same time. I generate variables indicating if there is another channel broadcasting the same genres of programs (and how many if yes) within the same clock hour, to correct the endogeneity bias of $\log y_{jt}$. Similar to the first set of instrument, programs on the other TV channels are predetermined by those channels and are not correlated with identity (purchasing power) of advertisers of channel j , ξ_{jt}^A .

2.4.3 Supply of TV Channels

The expression of marginal cost c_{jt} can be derived from the previously established first order condition (Equation 2.14):

$$c_{jt} = \Omega_{jt} - \lambda_{jt}, \quad (2.15)$$

where $\Omega_{jt} = P_{jt} + A_{jt} \frac{\partial P_{jt}}{\partial A_{jt}} + A_{jt} \frac{\partial P_{jt}}{\partial y_{jt}} \frac{\partial y_{jt}}{\partial A_{jt}} + \sum_{i \neq j, it \in G_{kt}} A_{it} \frac{\partial P_{it}}{\partial y_{it}} \frac{\partial y_{it}}{\partial A_{jt}}$. λ_{jt} measures the shadow prices of the regulation constrains, which is unobserved and need to identify.

If I observe c_{jt} , the identification of λ_{jt} could be achieved easily. By Equation 2.15, c_{jt} is a known function of λ_{jt} , depending on the demand parameters, advertising prices and quantities,

¹⁷One may think about another set of instrumental variables: “broadcasting contents of the other TV channels”. Instruments of this type (observed characteristics of the competitors) have been successfully used in the study of many industries, including automobiles, computers, and pharmaceutical drugs. However, their use in my case can be problematic. In broadcast TV industry, time required to change the observed characteristics (broadcasting contents) is relatively short. (The TV programs are fixed and published only one month prior to the broadcasting time.) Therefore, the change in broadcasting contents could be reacting to same shocks as lengths of advertising breaks A_{jt} . Where that is the case, the necessary condition that “the broadcasting contents of the other TV channels” are uncorrelated with the unobserved demand factors for channel j (ξ_{jt}), required for instrumental variables, is not valid. (See Nevo, 2000.)

and market shares of different TV channels. For any given value of the marginal cost c_0 , there exists always a λ_{jt} such that $c_{jt}(\lambda_{jt}) = c_0$, using $\lambda_{jt} = \Omega_{jt} - c_0$.

In the absence of direct information about the discount rates, the identification of λ_{jt} is possible if there exists some time periods during which the regulation caps for certain channels are not binding. Such identification can be achieved by using variables shifting the marginal costs of different TV channels during different periods of time.

In my data, the restrictions on per hour level of advertising minutes are binding for some hours but not always. According to the Kuhn-Tucker condition for constrained optimization, any binding constraint $\bar{A}_{jt} - A_{jt} > 0$ implies that the associated Lagrange multiplier λ_{jt} is equal to 0.

Define S_{ub} the subset of jt pairs for which the regulation caps are not binding, i.e. $\forall jt \in S_{ub}, A_{jt} < \bar{A}_{jt}$, and S_b the subset of jt pairs for which the regulation caps are binding, i.e. $\forall jt' \in S_b, A_{jt'} = \bar{A}_{jt'}$. For any $jt \in S_{ub} \cap G_{kt}$,

$$c_{jt} = \Omega_{jt}, \quad (2.16)$$

and for any $jt' \in S_b \cap G_{kt}$,

$$c_{jt'} = \Omega_{jt'} - \lambda_{jt'}. \quad (2.17)$$

Let \mathbf{Z} be a vector of variables shifting the channels' marginal cost of advertising during different time periods. The difference in marginal costs between any two observations $jt' \in S_b$ and $jt \in S_{ub}$ can then be modeled as to be linearly dependent on their observed difference $\mathbf{z}_{jt} - \mathbf{z}_{jt'}$ and on the unobserved channel-specific and time-specific additive shocks ω_{jt} :

$$c_{jt} - c_{jt'} = (\mathbf{z}_{jt} - \mathbf{z}_{jt'})' \rho + \omega_{jt} \quad (2.18)$$

with

$$E(\omega_{jt} | \mathbf{z}_{jt} - \mathbf{z}_{jt'}) = 0. \quad (2.19)$$

The non-zero shadow prices $\lambda_{jt'} \in S_b$ can be identified one by one using the moment condition across all the unconstrained $jt \in S_{ub}$ ¹⁸

$$E(\omega_{jt}(\rho, \lambda_{jt'})) = 0. \quad (2.20)$$

That is,

$$\Omega_{jt} - \Omega_{jt'} = -\lambda_{jt'} + (\mathbf{z}_{jt} - \mathbf{z}_{jt'})' \rho + \omega_{jt}. \quad (2.21)$$

2.5 Results

2.5.1 Demand of TV Viewers and Advertising Elasticity of Audience

Estimates on demand of TV viewers are reported in Table 2.3. The estimation is based on simulated method of moments, using 630 normalized Halton draws (Train, 2003), tight tolerance levels for the nested fixed point algorithm and up to 10000 starting values (Knittel and Metaxoglou, 2014). Heterogeneity is controlled for with a normally distributed random coefficient on the advertising quantities and on all the program categories.

All the estimated coefficients are statistically significant, except the mean preference for genre "variety entertainments". As follows from the estimates of standard deviations, the

¹⁸See Dubois and Lasio (2015) for details on the regularity conditions required for such type of identification.

Table 2.3 – Demand of TV viewers (No. obs: 75374)

	Mean		St. Dev.	
	coef.	s.e.	coef.	s.e.
Length of advertising breaks(α)	-3.046***	(0.251)	1.304***	(0.016)
National (or regional) news(β_1)	0.261***	(0.014)	0.201***	(0.011)
Political news(β_2)	1.108***	(0.033)	0.193***	(0.003)
News Magazines(β_3)	-0.066***	(0.014)	0.411***	(0.011)
Other magazines(β_4)	-0.067***	(0.007)	0.781***	(0.008)
Weather forecasts(β_5)	-0.042	(0.012)	0.101***	(0.011)
Documentaries(β_6)	-0.124***	(0.014)	0.032***	(0.003)
Long movies(β_7)	-0.121***	(0.019)	0.641***	(0.045)
Short movies(β_8)	-0.449***	(0.116)	0.396***	(0.044)
TV series(β_9)	0.023***	(0.007)	0.167***	(0.010)
Animated programs(β_{10})	0.078***	(0.013)	0.289**	(0.012)
Cultural entertainments(β_{11})	-0.014	(0.023)	0.310***	(0.008)
TV comedies(β_{12})	-0.212***	(0.025)	0.552***	(0.064)
TV games(β_{13})	-0.143***	(0.011)	0.196***	(0.002)
Music video-clips(β_{14})	0.041***	(0.013)	0.148***	(0.012)
Concerts(β_{15})	-0.320***	(0.023)	0.060***	(0.001)
Sports(β_{16})	0.121***	(0.017)	0.770***	(0.007)
TV shopping(β_{17})	-1.060***	(0.026)	0.370***	(0.009)
Previews of new programs(β_{18})	-0.154***	(0.007)	1.194***	(0.018)
Inventive programs(β_{19})	-0.065***	(0.015)	0.467***	(0.013)
Micro programs(β_{20})	-1.318***	(0.011)	2.150***	(0.011)
Channel FE	Yes			
Hour FE	Yes			
Day of the week FE	Yes			
Month FE	Yes			

Note: The column “Mean” reports the estimated mean preferences of TV viewers. The column “St. Dev.” reports the normally distributed random coefficients capturing heterogeneity in individual tastes for the variables it refers to. Estimates of different fixed effects are not reported, but are available upon request. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

preference of TV viewers are highly heterogeneous, with the tastes for program genres having less wider dispersion than the sensitivity to advertising. On average, the TV viewers are ad-adverse; “National news”, “Political news”, “TV series”, “Animated programs”, “Music video-clips” and “Sports” are commonly appreciated program genres.

I provide estimation results under several alternative specifications in Appendix as robustness checks. In Table 2.13, I report results for “OLS-type” estimation (GMM second stage), where the variable “advertising lengths (A_{jt})” is not instrumented. This robustness check allows to verify if the used instrument is helpful in fixing the endogeneity bias. Without using instrument, a channel’s choice of “advertising lengths” reflect its quality, and is estimated to having a positive effect on viewership of the TV channel. The dis-utility of advertising breaks can be isolated from the channel’s quality only if the endogeneity bias is properly controlled for. In Table 2.14, I report estimation results using simple logit model, ignoring the individual heterogeneity. The instrumental variable used here is the same as in Table 2.3. Comparing Table 2.14 to Table 2.3, we can see clearly that, without controlling the individual tastes, the estimated mean preferences are either upward or downward. For instance, the TV viewers are estimated to be less ad-adverse on average than they are in practice, due to some uncontrolled ad-neutral or ad-lover individuals. The first stage regression is not reported due to the important number of regressors, but is available upon request. All the coefficients of the first stage regression are statistically significant.

The estimates reported in Table 2.3 are used to compute the own- and cross- advertising elasticities of viewers’ demand. These estimates have averaged the own-advertising elasticity of demand to -0.414 across all channels and periods, with some dispersion: the 25th percentile equals to -0.506 , the 50th percentile equals to 0.300 , and the 75th percentile equals to -0.174 . In Table 2.15 - 2.17 (see Appendix), I report the detailed estimates of elasticities by channel, hour and month. Table 2.15 is to be read as the percentage increase in viewership that the channel in column benefits from the channel in row’s raise in advertising quantity by 1%. The results suggest that some channels’ viewers are more sensitive to ads than the others. On average, the own-advertising elasticities of audience are stable overtime, but there are 4 hours during which the viewers are particularly sensitive to ads: 12:00-13:00, 13:00-14:00, 19:00-20:00 and 20:00-21:00. The substitution patterns indicate that the channels are highly differentiated. The channels the less substitutable in the eyes of viewers are CH7, CH9, CH11, and CH12. The estimated cross-advertising elasticities are stable in time.

2.5.2 Demand of Advertisers and Advertising Price Flexibility

Estimates on demand of advertisers are reported in Table 2.4. The signs of IV estimates are in line with expectation. The join effect of “business stealing” and “decreasing return to scale of advertising” is negative on the advertising prices. The willingness to pay of advertisers is increasing in the viewership of TV channels.

As for the demand of TV viewers, I compare the results of OLS estimation to the results of IV estimation in Table 2.4. I find that the OLS estimates of $\hat{\theta}$ are biased upward and the OLS estimates of $\hat{\gamma}$ are biased downward. Without controlling the endogeneity bias, the quantity of advertising reflects the quality of TV channel, and is estimated to have a positive effect on the willingness to pay of advertisers. $\ln(y_{jt})$ is negatively correlated with ξ_{jt}^A . The quality (composition) of audience ξ_{jt}^A acts positively on the value of A_{jt} , and therefore affects negatively the value of (y_{jt}) . Similarly, I do not report the first stage regression due to the important number of regressors, but the results are available upon request. All the coefficients of the

Table 2.4 – Demand of advertisers (No. obs: 75374)

	OLS		IV	
	coef.	s.e.	coef.	s.e.
Log(Quantity of advertising)(θ)	0.078*	(0.043)	-0.059***	(0.012)
Log(Audience)(γ)	0.638***	(0.082)	0.999***	(0.010)
Channel FE	Yes		Yes	
Hour FE	Yes		Yes	
Month FE	Yes		Yes	
Day of the week FE	Yes		Yes	
R-Squared	0.742		0.684	

Note: The robustness correction is applied to both estimation so that the standard errors are robust to the presence of arbitrary heteroskedasticity. The estimates of different fixed effects are not reported but are available upon request. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

first stage regression are statistically significant.

As pointed out in Crawford *et al.* (2012), by estimating the inverse demand of advertisers instead of a direct demand equation, the model estimates the *flexibility of advertising prices*, rather than the elasticity.¹⁹ Even though the elasticity of demand is theoretically given by the inverse of the price flexibility, the same is not true for the estimates.²⁰ The ad-price flexibilities with respect to the viewership and the advertising quantities can be computed respectively according to the following formulas: $\partial \ln P_{jt} / \partial \ln y_{jt} = \gamma$; $\partial \ln P_{jt} / \partial \ln A_{jt} = \theta$. (See Equation 2.12.) It is estimated that 1% increase in viewership of a TV channel increases 0.999% of its average advertising prices, while 1% increase in the length of advertising message decreases on average the advertising prices by 0.059%.

2.5.3 Shadow Prices of Regulation Caps on Advertising

Identification of the shadow prices of regulation constraints is proceeded by using Equation 2.21. The vector of variables shifting the value of marginal costs (\mathbf{Z}) includes dummies of channels, hours of the day, days of the week, and months of the year.

There are in total 2251 shadow prices λ_{jt} that are associated to a binding advertising cap to identify. The value of λ_{jt} measures at what price a TV channel is willing to sell an additional minutes of advertising at hour t , without regulation. Only the advertising spaces more valuable than this price are profitable to the TV channel. The estimated values of λ_{jt} are higher for the private TV channels than for the public channels. In other words, the infinitesimal change in profit from an infinitesimal change in the constraint on advertising minutes is more important for the private broadcasters than for the public broadcasters. The average value

¹⁹“Price flexibility is the percentage change in the price of a commodity associated with a one percent increase in the quantity demand of that commodity or a related variable, all else remaining constant.” (See Houck, 1965.)

²⁰Huang (2007) shows that the estimated own-price elasticity will be less elastic than that implied by the inverse of the estimated by the inverse of the estimated own-price flexibility because the projection of a variable Y on a variable X (as in *OLS*) is not the inverse of a projection of X on Y .

of λ_{jt} is estimated to be EUR 2200 for a public TV station. It means that, on average, a public broadcaster is willing to give up EUR 2200 of subsidy for relaxing an additional minute of constraint on advertising. Due to confidentiality reason, I would not report more detailed euro values of the estimated λ_{jt} . However, I can compute the ratio of “shadow price” to “per minute price of advertising”. The average value of the ratio $\frac{\lambda_{jt}}{P_{jt}}$ is estimated to be equal to 0.7. This ratio is enough to shed light on the impact of regulation. In fact, 95% of the binding observations are associated to an advertising space more valuable than the estimated value of λ_{jt} . In other words, it is profitable for the TV channels to raise their advertise level for 95% of the constrained cases without regulation. It remains to determine weather the advertising level increases significantly if we remove the regulatory constraints.

The value of marginal costs c_{jt} can be recovered from the estimated λ_{jt} by Equation 2.21. As previously discussed, the marginal cost related to an additional minute of advertising includes mainly the discount that a channel has promised to pay back to its advertisers. The value of $\frac{c_{jt}}{P_{jt}}$ measures approximately the value of discount rates of channel j during hour t . My result suggests that this rate is very channel specific, vary from 32.35% to 69.80%. Especially, the estimated discounts of public TV channels are much higher than the discounts of private channels.

2.6 (Short-run) welfare effects of regulation

In this section, I conduct two counterfactual experiments to calibrate the short-run welfare implications of the regulation. In the first counterfactual, I simulate the current French market equilibrium without regulation. In the second counterfactual, I simulate the market equilibrium with and without regulation when the different TV broadcasters collude on their advertising provision.

Counterfactual 1: Regulating Advertising Time on a Competitive Market

At equilibrium, each TV channel plays strategically, taking into account the strategic reactions of the other TV channels. It is expected that the strategic decisions of all the TV channels change after the repeal of the regulation. Even the channels which initially advertise below the caps could choose their advertising levels differently, as strategic replies to the actions of their competitors.

A channel which advertises below the regulation cap may increase its advertising quantity following deregulation, if the other channels initially constrained by regulation raise up their advertising levels. Given the ownership structure of the market, some channels may also reduce their advertising levels following deregulation. This can be the case, for instance, a small channel and a big channel belong to the same TV group; the advertising level of the big channel is initially constrained by the regulation. The small channel has incentive to reduce its advertising spaces as long as its advertisers switch onto the big channel of its group, and that the big channel is able to charge more the advertisers than the small channel.

The surplus of TV viewers can be computed by the formula below (McFadden, 1991 and Small and Rosen, 1979):

$$CS = \int -\frac{1}{\alpha_i} \ln[1 + \sum_j \exp(\delta_{jt} + \mu_{jt})] \varphi(V_i) dV_i, \quad (2.22)$$

where δ_{jt} and μ_{jt} are defined as in section 3.1. Its value decreases with the market equilibrium level of advertising.

The TV stations' profit (net advertising revenue) matters since it determines their capacity to invest on broadcasting content. The individual profit of a channel can either increase or decrease, depending on the advertising levels of all the channels of the market. Formally, let r denotes the equilibrium results under regulation. For any channel j during period t , the variation in profit following deregulation can be decomposed as follows:

$$\begin{aligned} & \Pi_{jt} - \Pi_{jt}^r \\ &= (P_{jt} - c_{jt})A_{jt} - (P_{jt}^r - c_{jt})A_{jt}^r \\ &= (P_{jt} - c_{jt})(A_{jt} - A_{jt}^r) + (P_{jt} - P_{jt}^r)A_{jt}^r \end{aligned}$$

Channel j benefit from deregulation during period t ($\Pi_{jt} \geq \Pi_{jt}^r$) if:

- (i) $A_{jt} \geq A_{jt}^r$ and $P_{jt} \geq P_{jt}^r$; or
- (ii) $A_{jt} \geq A_{jt}^r$, $P_{jt} \leq P_{jt}^r$, and $|(P_{jt} - c_{jt})(A_{jt} - A_{jt}^r)| \geq |A_{jt}^r(P_{jt} - P_{jt}^r)|$; or
- (iii) $A_{jt} \leq A_{jt}^r$, $P_{jt} \geq P_{jt}^r$, and $|(P_{jt} - c_{jt})(A_{jt} - A_{jt}^r)| \leq |A_{jt}^r(P_{jt} - P_{jt}^r)|$.

In contrast, channel j loss from deregulation during period t ($\Pi_{jt} \leq \Pi_{jt}^r$) if:

- (i) $A_{jt} \leq A_{jt}^r$ and $P_{jt} \leq P_{jt}^r$; or
- (ii) $A_{jt} \geq A_{jt}^r$, $P_{jt} \leq P_{jt}^r$, and $|(P_{jt} - c_{jt})(A_{jt} - A_{jt}^r)| \leq |A_{jt}^r(P_{jt} - P_{jt}^r)|$; or
- (iii) $A_{jt} \leq A_{jt}^r$, $P_{jt} \geq P_{jt}^r$, and $|(P_{jt} - c_{jt})(A_{jt} - A_{jt}^r)| \geq |A_{jt}^r(P_{jt} - P_{jt}^r)|$.

Both of the two scenarios are possible in theory. A counterfactual simulation allows to determine the exact decisions of different channels at equilibrium. The simulation can proceed by using the method illustrated in section 3.3, combined with estimates of demand, marginal costs and the first order conditions.

My simulation results suggest that, in sum, the market equilibrium level of advertising is higher under "laissez-faire policy" than under regulation. Yet, the market equilibrium level of advertising would remain reasonable without regulation. On average, a TV channel would broadcast 15 seconds more of ads per hour. The deregulation could drive up the *average* advertising level of public TV channels from 4.261 minutes to 4.369 minutes per hour, and the *average* advertising level of private TV channels from 8.451 minutes to 8.704 minutes per hour.

It seems never optimal for a public (private) TV channel to broadcast more than 8 (12) minutes of ads per hour, even without regulation. We observe clearly a stronger demand for the advertising spaces of private channels than for the advertising spaces of public channels. The regulation on daily average level of advertising means that a public (private) TV channel disposes of 6 (9) minutes of advertising time per hour on average. According to my simulation, the demand for advertising spaces of public TV channels is higher than 6 minutes within hour 17:00-18:00; the demand for advertising spaces of private TV channels is higher than 9 minutes per hour within hours 11:00-16:00 and 17:00-21:00. Overall, the impact of regulation is different from one channel to another, depending on the advertising sensitivity of their respective audience. (See Figure 2.13- 2.15 in Appendix.)

The feedback loop between TV viewers and advertisers is such that an increase in advertising quantities of a TV channel decreases the prices of advertising spots of the channel *directly* by the standard price response to the quantity supplied; and *indirectly*, by affecting negatively

the viewership of the TV channels. Formally, the price response to an increase in advertising quantity of a TV channel is given by $\frac{\partial P_{jt}}{\partial A_{jt}} + \frac{\partial P_{jt}}{\partial y_{jt}} \frac{\partial y_{jt}}{\partial A_{jt}}$. Given the strong “network externalities” between TV viewers and advertisers, it is optimal for the TV channels to not broadcast too much ads, but gain from the higher willingness to pay of advertisers.

The impact of regulation on surplus of TV viewers can be evaluated from Equation 3.2. My result suggests that the regulation increases the averaged viewers’ surplus by 0.19%. In Figure 2.5, I report the desegregate variation in consumer surplus due to regulation. I notice that the regulation mainly protects the welfare of viewers who watch TV in the morning and of viewers who watch TV from 8 p.m to 9 p.m. TV stations have clearly substituted some of the constrained advertising spaces (in the morning and from 8 p.m to 9 p.m) by other advertising spaces (from 1 p.m to 2 p.m, from 4 p.m to 5 p.m and from 6 p.m to 8 p.m), resulting transfers of welfare between TV viewers.

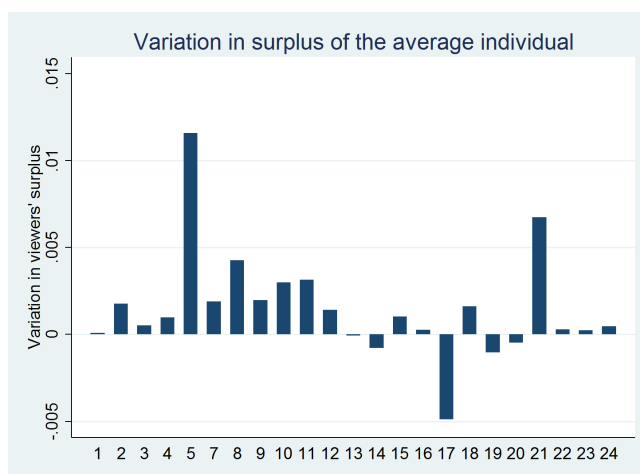


Figure 2.5 – Desegregate variations in consumer surplus

Interestingly, I find that the regulation—which limits the advertising lengths of all the TV stations—increases the total profit (the total net advertising revenue) of the industry. In fact, the laissez-faire policy benefits few channels: five channels over the twelve in my sample realise more profits without regulation; but the other seven channels make less profit under laissez-faire, due to competition. We have such result because the channels are horizontally differentiated. Channels broadcasting non-substitutable programs absorb the consumers and profits of the channels that broadcast substitutable programs.

Counterfactual 2: Regulating Advertising Time on a Concentrated Market

Above counterfactual shows the impact of regulation in a competitive market. The small variation in consumer surplus and industry’s profit suggests that the regulation is unnecessary when the market is competitive. To gain an insight on to what extend the regulation could affect the market equilibrium in a highly concentrated market, I simulate the advertising quantities and prices with and without regulation in a scenario where all the TV broadcasts collude in advertising provision (i.e. choose lengths of advertising breaks which maximize their joint profits).

In this case, the first order condition of a channel’s constrained profit maximization problem

becomes:

$$(P_{jt} - c_{jt}) + A_{jt} \frac{\partial P_{jt}}{\partial A_{jt}} + A_{jt} \frac{\partial P_{jt}}{\partial y_{jt}} \frac{\partial y_{jt}}{\partial A_{jt}} + \sum_{i \neq j, i \in \mathbf{J}} A_{it} \frac{\partial P_{it}}{\partial y_{it}} \frac{\partial y_{it}}{\partial A_{jt}} = \lambda_{jt}, \forall j \in \mathbf{J}. \quad (2.23)$$

Compare expression (13) to expression (22), the value of λ_{jt} depends not only on the advertising level of other channels of its own group, but on advertising levels of all the other channels of the market. The value of λ_{jt} increases with the value of the term $\sum_{i \neq j, i \in \mathbf{J}} A_{it} \frac{\partial P_{it}}{\partial y_{it}} \frac{\partial y_{it}}{\partial A_{jt}}$. In other words, holding the two-sided network effect $(\frac{\partial P_{jt}}{\partial A_{jt}} + \frac{\partial P_{jt}}{\partial y_{jt}} \frac{\partial y_{jt}}{\partial A_{jt}})$ fixed, the impact of the regulation is all the more important when the market becomes concentrated.

My simulation results suggest that, in this collusive context, the average level of advertising provision is 7.67 minutes per hour without regulation, and 9.42 minutes per hour under regulation. The regulation could improve up to 5.75% of consumer surplus, but decrease until 4.8% of the industry's profit.

A comparison on the two counterfactual results is provided in Table 2.5 below.

Table 2.5 – Impact of regulation

Counterfactual	% Δ Ad-Qty	% Δ CS	% Δ Profit
In Competitive Market	-10.34%	0.19%	0.8%
In Concentrated Market	-22.82%	5.75%	-4.80%

2.7 Conclusion and Discussion

This paper investigates the welfare effects of the regulation of TV advertising quantity. It is motivated by the opposite viewpoints between EU/UK and US regulators and by the recent revision of the European Audiovisual Media Services Directive (AVMSD) regarding this regulation policy. On the one hand, TV viewers disappreciate excessive advertising. On the other, TV broadcasts continuously call for more freedom in allocating their advertising spaces. Regulation generates positive shadow prices when the demand for advertising is higher than the maximum level defined by the law. This paper provides a framework to estimate the shadow costs related to the restriction on TV advertising quantity.

In this framework, I first estimate the preference of TV viewers and of advertisers which allows me to account for the two-sidedness of the market in the supply decision of TV stations. My results suggest that the TV viewers are indeed ad-adverse, and the advertisers are highly sensitive to the viewership of TV channels. The identified substitution pattern indicates that the channels are horizontally differentiated. In other words, the French broadcast TV market is competitive.

I specify the broadcast TV stations as two-sided market platforms which supply TV programs and advertising spaces taking into account the feedback loop between viewers and advertisers. The TV channels supply advertising spaces subject to regulation constraints. The regulation generates positive shadow prices whenever the observed advertising supply binds the regulation constraints. The model allows me to identify the value of shadow prices related to each channel-period pair of observations from the marginal cost equations of TV channels. I find that the infinitesimal change in profit from an infinitesimal change in the constraint on

advertising minutes is more important for the private broadcasters than for the public broadcasters. It is estimated that, on average, a public broadcaster is willing to give up EUR 2200 of subsidy for relaxing an additional minute of constraint on advertising.

Based on these results, I conduct two counterfactual simulations to calibrate the welfare effect of the regulation. My results suggest that regulating advertising quantity is unnecessary on a competitive market, given the two-sided market structure of the broadcast TV industry. However, if TV broadcasters collude on their advertising supply, the regulation can improve upto 5.75% of consumer surplus, but decrease until 4.8% of the industry's profit.

Long-run effect of regulation

In the long-run, regulating advertising time which affects the TV stations' revenues may finally alter the broadcast TV programs. Figure 2.6 shows the relationship between the TV channels' advertising revenues and their programs' qualities (in terms of viewers attractiveness). The programs' qualities are directly estimated from the TV viewers' demand model.²¹ Not surprisingly, we observe a positive correlation between the two variables.

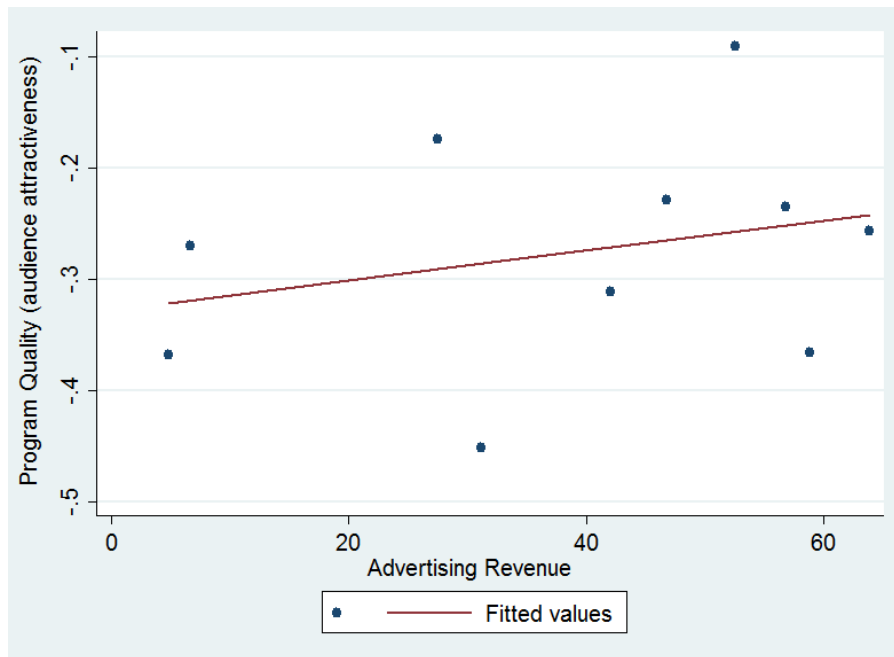


Figure 2.6 – Channels' advertising revenues against their programs' qualities

I have mentioned in section 2.3 that the public TV stations broadcast on a very small frequency during the hours of commercial advertising bans (from 8 p.m. to 6 a.m). Moreover, the public TV channels attain usually a smaller audience share during the commercial advertising bans even when they broadcast: the public TV channels average an audience share of 4.4% from 8 p.m to 6 a.m, but of 7.3% from 6 a.m to 8 p.m. These observations provide also evidence on the positive correlation between TV channels' advertising revenues and their programs' quality

²¹Let q_{jt} denotes the programs' quality (in terms of viewers attractiveness) of channel j during time period t , q_{jt} includes both the observed and unobserved quality which affect the viewers' utility U_{ijt} . Namely, $q_{jt} = G_{jt}\beta_i + \xi_{jt}$. (See Equation 2.1.)

in terms of viewers attractiveness.

Study the long-run effect of regulation requires knowledge on the TV stations' investment strategy and data for a long period of time, which is out of the scope of this paper. This issue is left for the future research.²²

²²Waldfoegel *et al.* (2017) investigates whether the ad blocking poses a threat to site revenue. Their results suggest that ad blocking poses a substantial threat to the ad-supported web.

2.8 Appendix: Additional Tables and Figures

Table 2.6 – List of program categories

Index	Program categories
01	National (regional) news
02	Political news
03	News Magazines
04	Other magazines
05	Weather forecasts
06	Documentaries
07	Long movies
08	Short movies
09	TV series
10	Animated programs
11	Cultural entertainments
12	TV comedies
13	TV games
14	Music video-clips
15	Concerts
16	Sports
17	TV shopping
18	Previews of new programs
19	Inventive program*
20	Micro programs*

* Genre 19 and 20 are short programs of less than five minutes. Genre 19 is a different program on each TV channel; it is “inventive” in the sense that it does not belong to the standard TV programs listed above; each “inventive program” has its loyal audience. The Micro programs are used to complete the daily broadcasting schedules of different channels; its content varies all the time; it does not have loyal audience.

Table 2.7 – Active hours by channel by clock hour

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8	CH9	CH10	CH11	CH12	Total
00:00-00:59	364	65	11	364	0	349	365	353	42	353	252	361	2879
01:00-01:59	364	16	0	362	0	355	365	356	5	358	14	341	2536
02:00-02:59	355	23	0	295	0	318	360	362	1	357	0	252	2323
03:00-03:59	215	0	0	0	0	247	269	363	0	356	0	21	1471
04:00-04:59	33	0	0	0	0	44	25	348	0	328	0	0	778
05:00-05:59	0	0	0	0	0	0	0	0	0	0	0	0	0
06:00-06:59	0	352	271	53	297	0	0	52	160	39	79	8	1311
07:00-07:59	276	361	364	298	37	18	0	155	355	52	357	244	2517
08:00-08:59	358	364	362	329	244	217	0	175	361	155	364	340	3269
09:00-09:59	312	309	358	206	49	363	352	365	303	365	359	363	3704
10:00-10:59	361	305	360	349	360	362	365	365	199	363	357	363	4109
11:00-11:59	364	327	365	364	360	365	365	365	192	363	362	363	4155
12:00-12:59	364	362	365	365	363	365	365	365	281	364	358	364	4281
13:00-13:59	361	327	359	364	354	361	365	365	323	365	364	364	4272
14:00-14:59	364	259	342	365	362	365	365	365	185	365	365	361	4063
15:00-15:59	363	306	236	363	356	343	365	362	247	356	355	358	4010
16:00-16:59	363	328	340	364	359	365	362	363	134	353	363	363	4067
17:00-17:59	361	338	364	359	365	363	365	363	151	363	363	362	4117
18:00-18:59	365	356	365	365	359	363	365	362	247	362	365	365	4239
19:00-19:59	365	363	365	365	365	365	365	363	344	361	365	365	4351
20:00-20:59	361	1	236	365	288	365	365	365	152	365	365	365	3593
21:00-21:59	363	4	2	361	1	362	364	365	4	364	365	362	2917
22:00-22:59	364	51	149	360	245	347	364	358	13	355	360	362	3328
23:00-23:59	363	100	46	358	31	351	364	364	38	359	348	362	3084
Total	7359	4917	5260	6974	4795	6953	6840	7619	3737	7431	6480	7009	75374

Table 2.8 – Variations of audience shares by channel

Channel	Mean	Std.Dev.	Channel	Mean	Std.Dev.
TF1	0.192	0.081	RNJ12	0.019	0.012
FR2	0.154	0.102	NT1	0.019	0.013
FR3	0.073	0.039	FR4	0.016	0.013
M6	0.077	0.038	TMC	0.035	0.019
FR5	0.027	0.019	Gulli	0.020	0.014
D8	0.032	0.017	D17	0.012	0.008

Table 2.9 – Variations of audience shares by hour

Hour	Mean	Std.Dev.	Hour	Mean	Std.Dev.
00:00-00:59	0.060	0.069	12:00-12:59	0.066	0.102
01:00-01:59	0.069	0.076	13:00-13:59	0.051	0.081
02:00-02:59	0.071	0.077	14:00-14:59	0.056	0.063
03:00-03:59	0.060	0.060	15:00-15:59	0.053	0.054
04:00-04:59	0.045	0.038	16:00-16:59	0.054	0.053
			17:00-17:59	0.053	0.050
06:00-06:59	0.092	0.122	18:00-18:59	0.052	0.052
07:00-07:59	0.077	0.119	19:00-19:59	0.055	0.068
08:00-08:59	0.060	0.083	20:00-20:59	0.050	0.077
09:00-09:59	0.046	0.050	21:00-21:59	0.051	0.068
10:00-10:59	0.046	0.034	22:00-22:59	0.050	0.065
11:00-11:59	0.060	0.056	23:00-23:59	0.055	0.069

Table 2.10 – Variations in *per minute price* versus *ad-minutes per hour*

	Ad-price		Ad-minutes	
	Mean	Std.Dev.	Mean	Std.Dev.
00:00-00:59	9.975	12.264	7.653	3.61
01:00-01:59	5.501	6.134	7.622	3.285
02:00-02:59	2.737	2.941	6.41	3.206
03:00-03:59	1.37	1.439	6.656	3.058
04:00-04:59	0.498	0.591	7.255	2.895
06:00-06:59	1.663	2.51	3.204	2.432
07:00-07:59	3.97	5.295	4.756	2.809
08:00-08:59	4.028	4.480	5.353	2.827
09:00-09:59	3.654	3.539	6.576	3.345
10:00-10:59	4.129	3.878	6.891	3.365
11:00-11:59	5.462	5.450	7.972	3.600
12:00-12:59	10.734	14.558	7.886	3.696
13:00-13:59	10.410	16.743	7.703	3.477
14:00-14:59	9.198	12.521	7.947	3.802
15:00-15:59	7.748	9.497	7.503	3.642
16:00-16:59	7.364	9.060	7.428	3.517
17:00-17:59	8.538	9.880	8.041	3.290
18:00-18:59	12.581	16.962	8.206	3.389
19:00-19:59	19.332	25.718	8.893	3.321
20:00-20:59	32.978	52.390	8.739	4.402
21:00-21:59	42.321	58.918	7.208	2.373
22:00-22:59	33.961	50.958	7.269	3.887
23:00-23:59	19.687	28.525	7.977	3.566

The unites of prices are not reports for confidential reason.

Table 2.11 – Viewers' Sensitivity to Ads

Number of TV Viewers		
	coef.	s.e.
Advertising lengths	-202.656***	(50.931)
DM_national (or regional) news	135.844***	(10.406)
DM_political news	56.142*	(23.829)
DM_news magazines	-120.375***	(12.750)
DM_other magazines	-29.116***	(5.593)
DM_weather forecasts	-15.373*	(8.787)
DM_documentaries	-137.531***	(10.292)
DM_long movies	-199.778***	(10.771)
DM_short movies	-242.865***	(104.695)
DM_TV series	-62.863***	(5.810)
DM_animated programs	-0.737	(10.222)
DM_cultural entertainments	128.790***	(20.386)
DM_TV comedies	-31.082***	(7.077)
DM_TV games	-336.704***	(8.596)
DM_music video-clips	-115.017***	(9.886)
DM_concerts	-178.322***	(15.744)
DM_sports	309.696***	(13.599)
DM_TV shopping	-1121.253***	(21.862)
DM_inventive programs	-0.027	(10.957)
DM_preview of new programs	22.063***	(5.476)
DM_micro programs	-9.945	(11.675)
Channel FE	Yes	
Hour FE	Yes	
Day of the week FE	Yes	
Month FE	Yes	
R-Squared	0.315	
No. obs	75374	

Note: DM denotes *dummies*. * p<0.1, ** p<0.05, *** p<0.01

Table 2.12 – Horizontal differentiation and market competition

	Number of TV Viewers	
	coef.	s.e.
Comp_national (regional) news	25.592***	(3.434)
Comp_political news	125.137**	(63.455)
Comp_news magazines	82.242***	(23.044)
Comp_other magazines	2.006	(1.562)
Comp_weather forecasts	34.899***	(2.401)
Comp_documentaries	-66.085***	(9.759)
Comp_long movies	-41.187***	(4.078)
Comp_short movies	279.380	(419.130)
Comp_TV series	-15.800***	(1.272)
Comp_animated programs	-37.762***	(4.370)
Comp_cultral entertainments	-0.759	(61.402)
Comp_TV comedies	-7.929**	(3.920)
Comp_TV games	-153.367***	(3.643)
Comp_music video-clips	-69.967***	(8.434)
Comp_concerts	-113.394***	(25.060)
Comp_sports	206.884***	(15.407)
Comp_TV shopping	-1093.488***	(22.614)
Comp_previews of new programs	-1.516***	(0.805)
Comp_micro programs	-117.168***	(15.177)
Comp_inventive programs	73.924***	(10.755)
Channel FE	Yes	
Hour FE	Yes	
Day of the week FE	Yes	
Month FE	Yes	
R-Squared	0.307	
No. obs	75374	

Note: * p<0.1, ** p<0.05, *** p<0.01

Table 2.13 – OLS-type estimation on demand of TV viewers (No. obs: 75374)

	Mean		St. Dev.	
	coef.	s.e.	coef.	s.e.
length of advertising breaks(α)	1.208***	(0.066)	1.304***	(0.009)
National (regional) news(β_1)	0.201***	(0.013)	0.201***	(0.002)
Political news(β_2)	0.999***	(0.031)	0.193***	(0.002)
News Magazines(β_3)	-0.045***	(0.013)	0.411***	(0.003)
Other magazines(β_4)	-0.066***	(0.007)	0.781***	(0.004)
Weather forecasts(β_5)	-0.059***	(0.011)	0.101***	(0.002)
Documentaries(β_6)	-0.091***	(0.013)	0.032***	(0.001)
Long movies(β_7)	-0.093***	(0.011)	0.641***	(0.004)
Short movies(β_8)	-0.319***	(0.110)	0.396***	(0.042)
TV series(β_9)	0.014**	(0.007)	0.167***	(0.003)
Animated programs(β_{10})	0.107***	(0.013)	0.289***	(0.004)
Cultural entertainments(β_{11})	0.037*	(0.022)	0.310***	(0.005)
TV comedies(β_{12})	-0.199***	(0.008)	0.552***	(0.004)
TV games(β_{13})	-0.153***	(0.010)	0.196***	(0.002)
Music video-clips(β_{14})	0.076***	(0.012)	0.148***	(0.001)
Concerts(β_{15})	-0.230***	(0.021)	0.060***	(0.001)
Sports(β_{16})	0.125***	(0.017)	0.770***	(0.007)
TV shopping(β_{17})	-0.886***	(0.025)	0.370***	(0.006)
Previews of new programs(β_{18})	-0.153***	(0.006)	1.194***	(0.010)
Inventive programs(β_{19})	-0.050***	(0.014)	0.467***	(0.004)
Micro programs(β_{20})	-1.324***	(0.011)	2.150***	(0.010)
Channel FE	Yes			
Hour FE	Yes			
Day of the week FE	Yes			
Month FE	Yes			

Note: The column “Mean” reports the estimated mean preferences of TV viewers. The column “St. Dev.” reports the normally distributed random coefficients capturing heterogeneity in individual tastes for the variables it refers to. Estimates of different fixed effects are not reported, but are available upon request. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2.14 – Simple logit estimation on demand of TV viewers (No. obs: 75374)

	Mean		St. Dev.	
	coef.	s.e.	coef.	s.e.
length of advertising breaks(α)	-2.698 ***	(0.241)	-	-
National (regional) news(β_1)	0.184***	(0.011)	-	-
Political news(β_2)	1.069***	(0.029)	-	-
News Magazines(β_3)	0.022**	(0.013)	-	-
Other magazines(β_4)	0.072***	(0.006)	-	-
Weather forecasts(β_5)	-0.020***	(0.009)	-	-
Documentaries(β_6)	-0.151***	(0.012)	-	-
Long movies(β_7)	0.010	(0.011)	-	-
Short movies(β_8)	-0.335***	(0.126)	-	-
TV series(β_9)	0.009	(0.006)	-	-
Animated programs(β_{10})	0.087***	(0.012)	-	-
Cultural entertainments(β_{11})	0.023	(0.021)	-	-
TV comedies(β_{12})	-0.108***	(0.008)	-	-
TV games(β_{13})	-0.142***	(0.009)	-	-
Music video-clips(β_{14})	0.022**	(0.011)	-	-
Concerts(β_{15})	-0.326***	(0.021)	-	-
Sports(β_{16})	0.239***	(0.015)	-	-
TV shopping(β_{17})	-0.982***	(0.024)	-	-
Previews of new programs(β_{18})	0.021***	(0.006)	-	-
Inventive programs(β_{19})	-0.001	(0.013)	-	-
Micro-programs(β_{20})	-0.066***	(0.012)	-	-
Channel FE	Yes			
Hour FE	Yes			
Day of the week FE	Yes			
Month FE	Yes			

Notes: Estimates of different fixed effects are not reported, but are available upon request.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2.15 – Advertising elasticities of viewers by channels (* **CH** denotes channel)

	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	CH 9	CH 10	CH 11	CH 12
CH 1	-0.336	0.053	0.048	0.078	0.064	0.077	0.081	0.085	0.059	0.075	0.087	0.094
CH 2	0.022	-0.238	0.031	0.033	0.025	0.029	0.023	0.026	0.026	0.021	0.027	0.025
CH 3	0.011	0.012	-0.232	0.014	0.013	0.011	0.012	0.014	0.012	0.011	0.013	0.013
CH 4	0.025	0.023	0.019	-0.459	0.030	0.032	0.031	0.035	0.026	0.030	0.039	0.037
CH 5	0.002	0.003	0.003	0.003	-0.199	0.003	0.003	0.004	0.003	0.003	0.004	0.003
CH 6	0.011	0.008	0.007	0.014	0.011	-0.511	0.016	0.016	0.010	0.013	0.016	0.016
CH 7	0.006	0.005	0.004	0.007	0.006	0.007	-0.571	0.010	0.005	0.007	0.009	0.009
CH 8	0.063	0.005	0.004	0.007	0.007	0.008	0.010	-0.537	0.006	0.008	0.009	0.009
CH 9	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	-0.235	0.001	0.002	0.001
CH 10	0.011	0.009	0.009	0.014	0.012	0.013	0.015	0.017	0.011	-0.491	0.016	0.016
CH 11	0.003	0.003	0.003	0.004	0.004	0.004	0.005	0.005	0.004	0.004	-0.325	0.005
CH 12	0.004	0.003	0.003	0.005	0.004	0.005	0.006	0.005	0.004	0.005	0.006	-0.572

Table 2.16 – Advertising elasticities of audience by hour (***H** denotes hour)

	H 1	H 2	H 3	H 4	H 5	H 6	H 7	H 8	H 9	H 10	H 11	H 12
Own-ad elasticities	-0.366	-0.385	-0.317	-0.363	-0.440		-0.207	-0.257	-0.370	-0.558	-0.356	-0.402
Cross-ad elasticities	0.025	0.021	0.015	0.007	0.002		0.009	0.017	0.022	0.024	0.019	0.028
	H 13	H 14	H 15	H 16	H 17	H 18	H 19	H 20	H 21	H 22	H 23	H 24
Own-ad elasticities	-0.563	-0.533	-0.444	-0.361	-0.336	-0.378	-0.397	-0.509	-0.566	-0.372	-0.340	-0.340
Cross-ad elasticities	0.045	0.026	0.027	0.022	0.020	0.023	0.024	0.033	0.024	0.016	0.016	0.021

Table 2.17 – Advertising elasticities of audience by month (***M** denotes month)

	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 9	M 10	M 11	M 12
Own-ad elasticities	-0.329	-0.378	-0.355	-0.394	-0.389	-0.434	-0.428	-0.373	-0.470	-0.481	-0.450	-0.433
Cross-ad elasticities	0.021	0.022	0.021	0.023	0.023	0.025	0.024	0.022	0.026	0.026	0.026	0.022

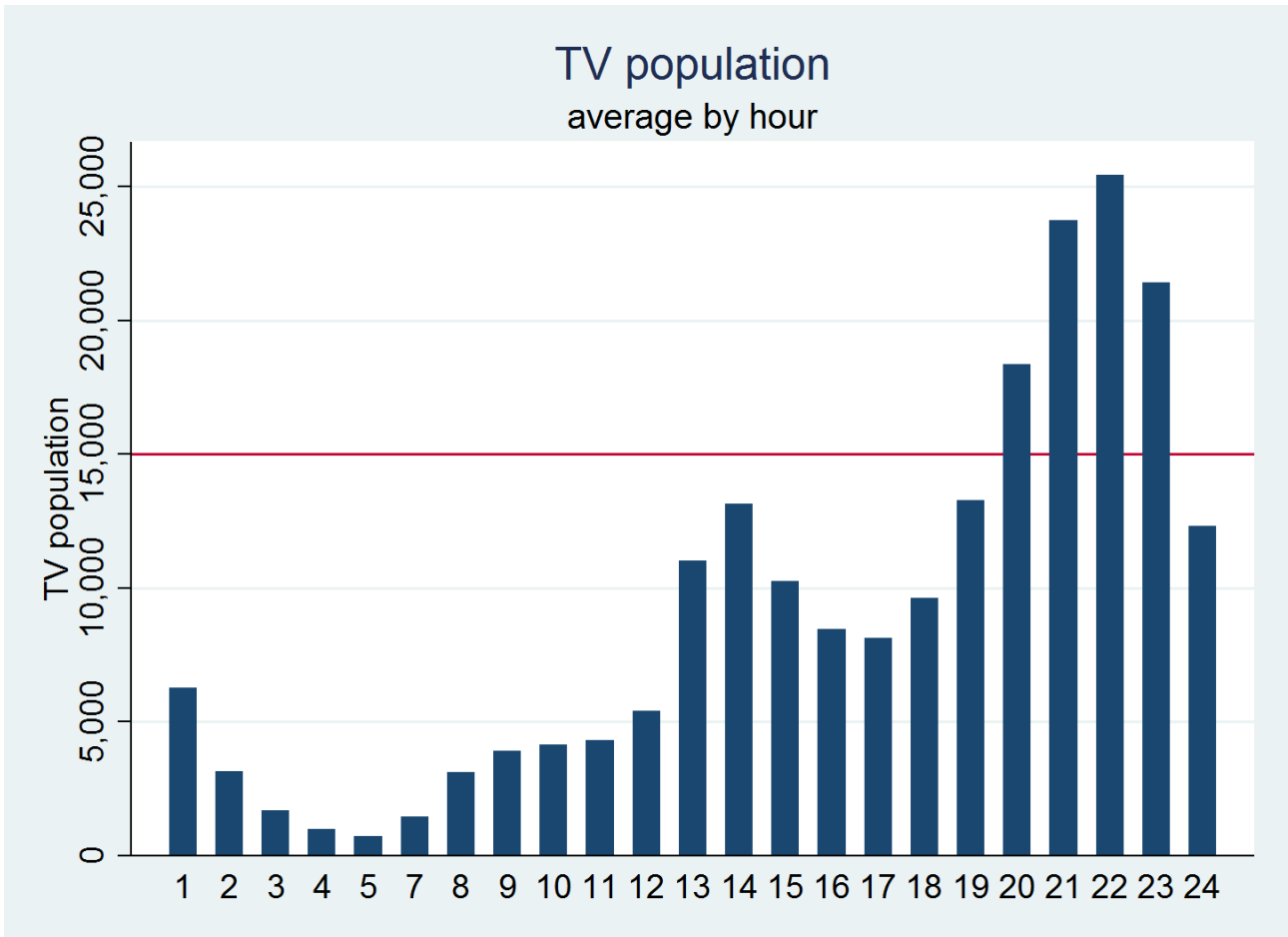


Figure 2.7 – TV population

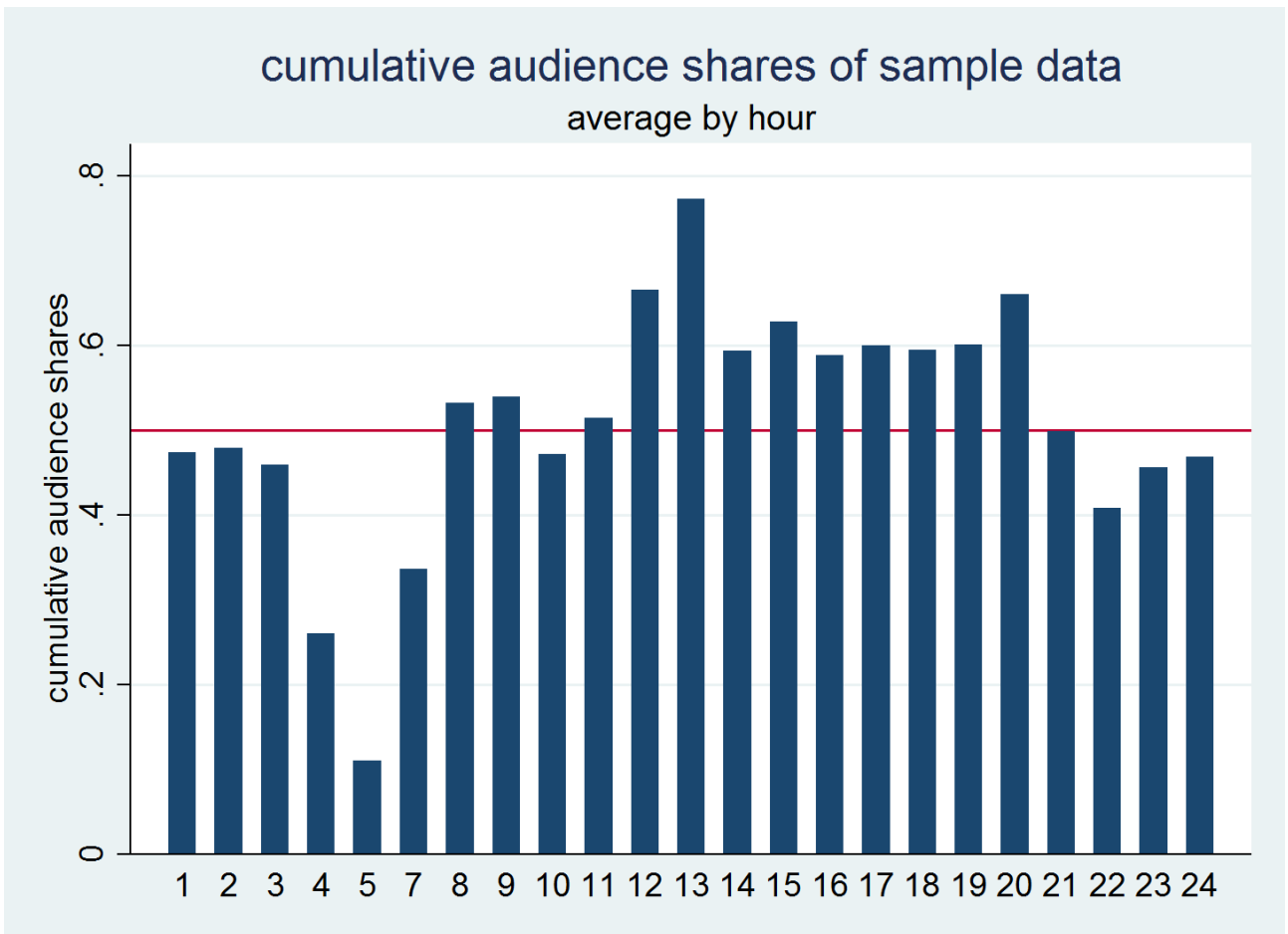


Figure 2.8 – Cumulative audience share

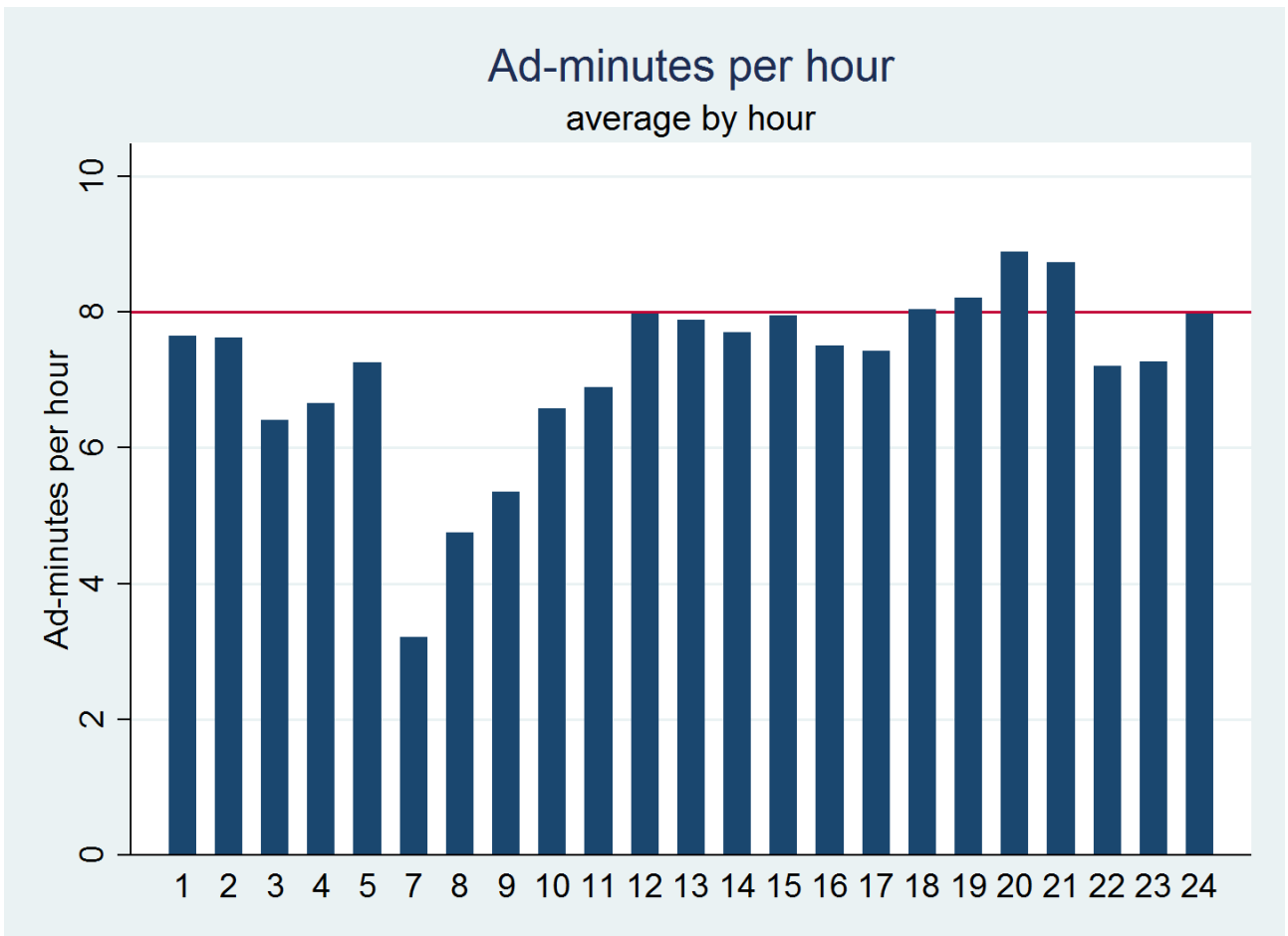


Figure 2.9 – Averaged advertising minutes per hour of the sample

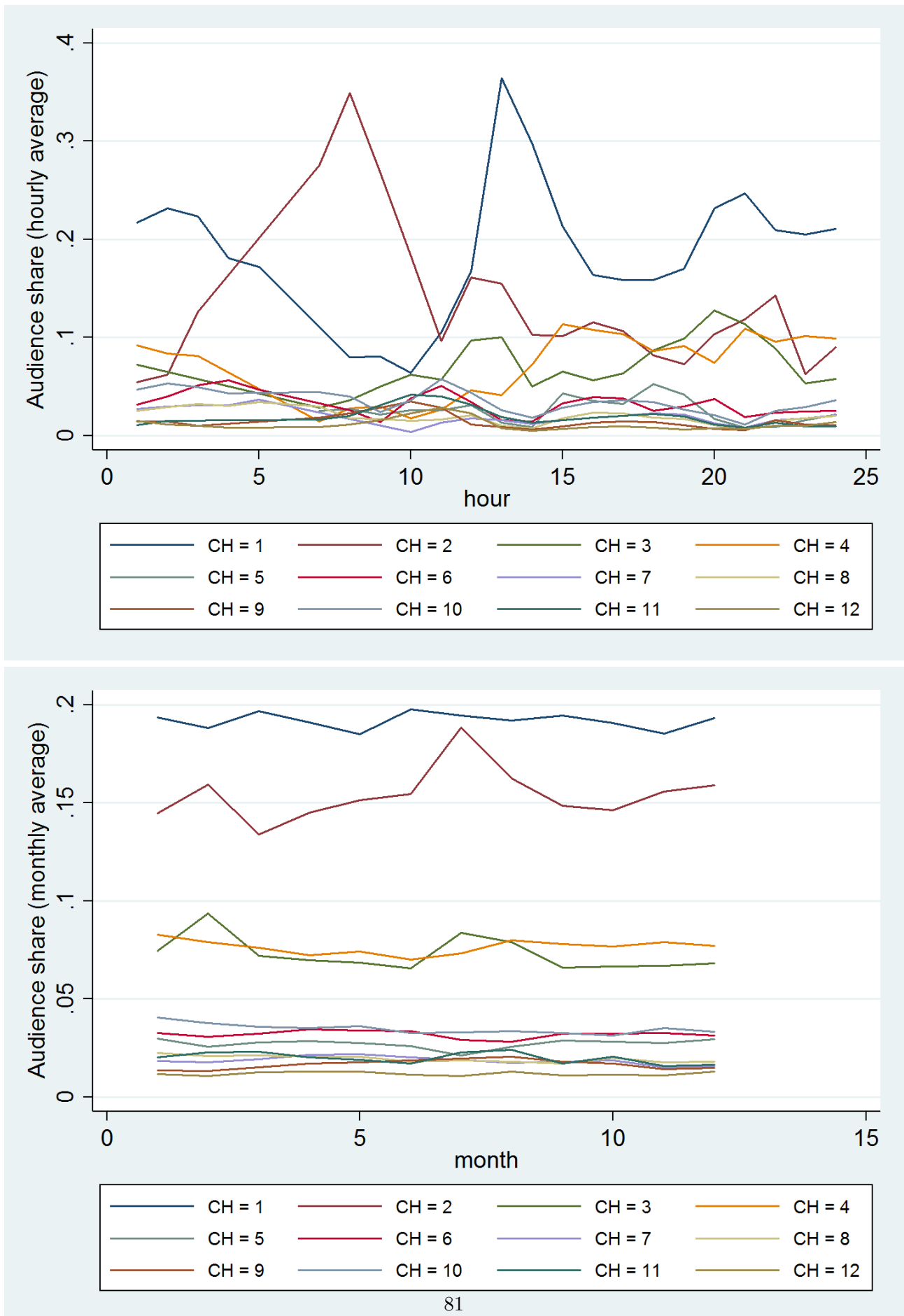


Figure 2.10 – Audience shares (The identity of TV channels are not reported for confidentiality reason)

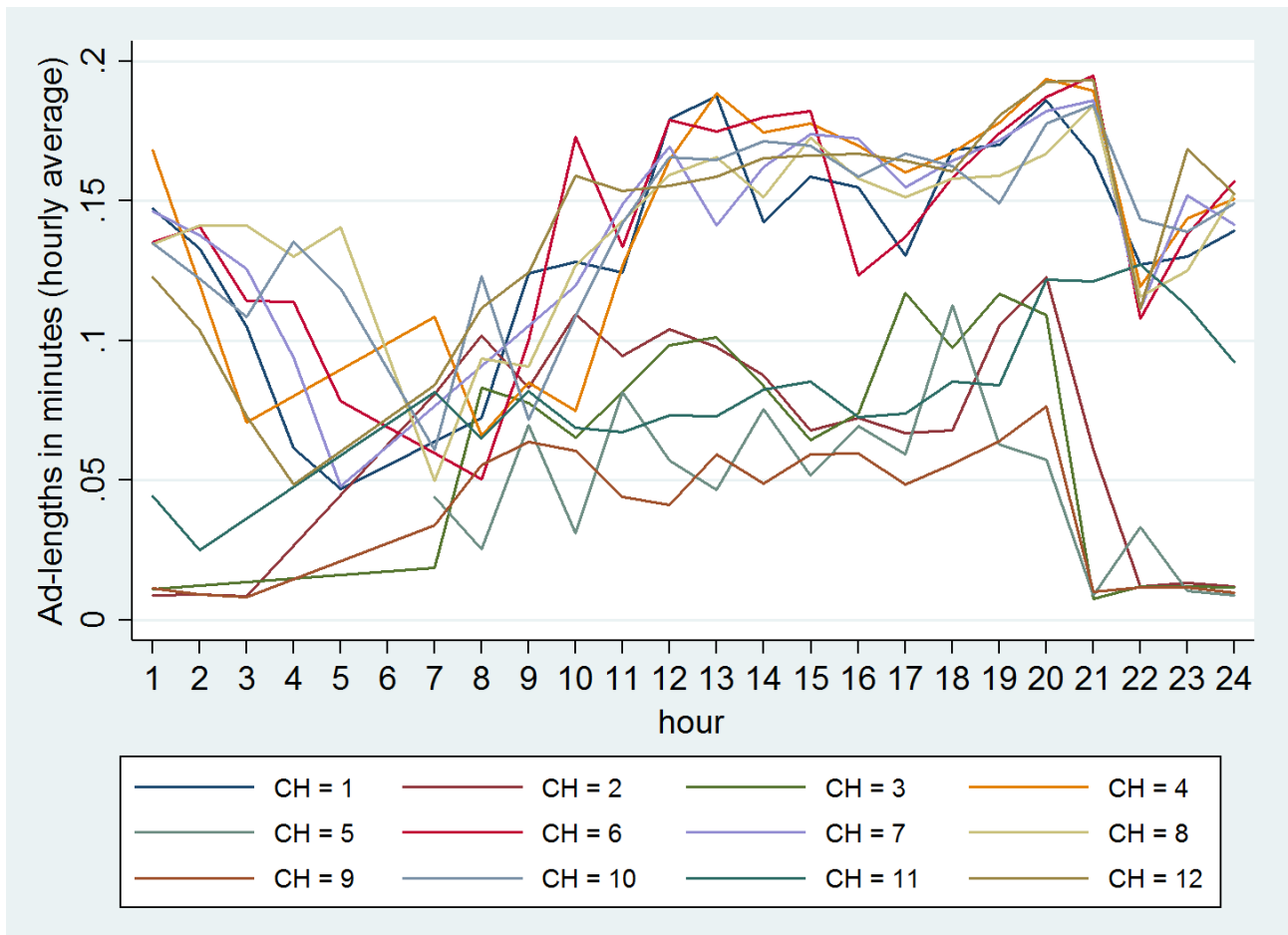


Figure 2.11 – Length of advertising breaks (The identity of TV channels are not reported for confidentiality reason)

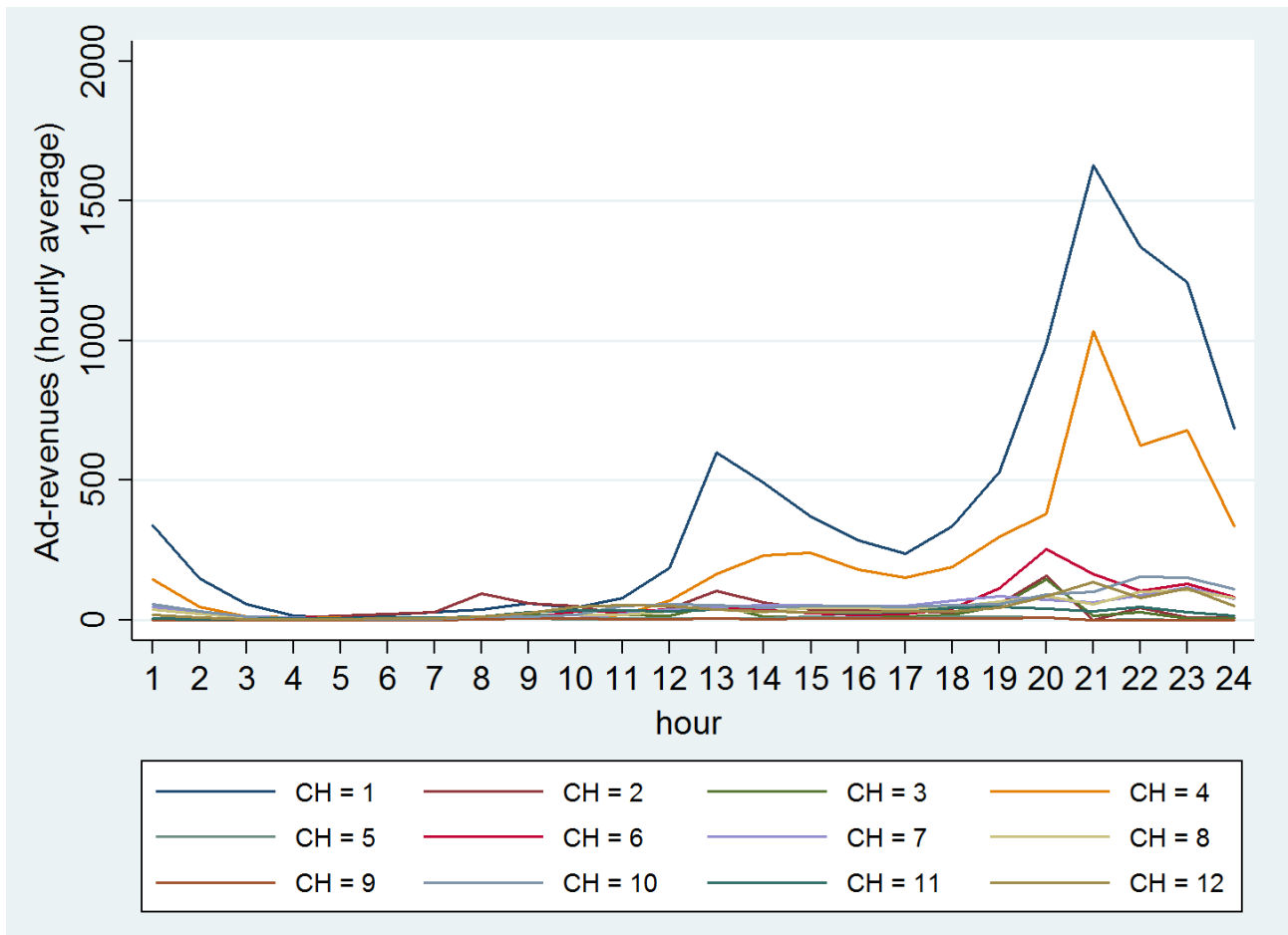


Figure 2.12 – Advertising revenues (The identity of TV channels and the unit of revenues are not reported for confidentiality reason)

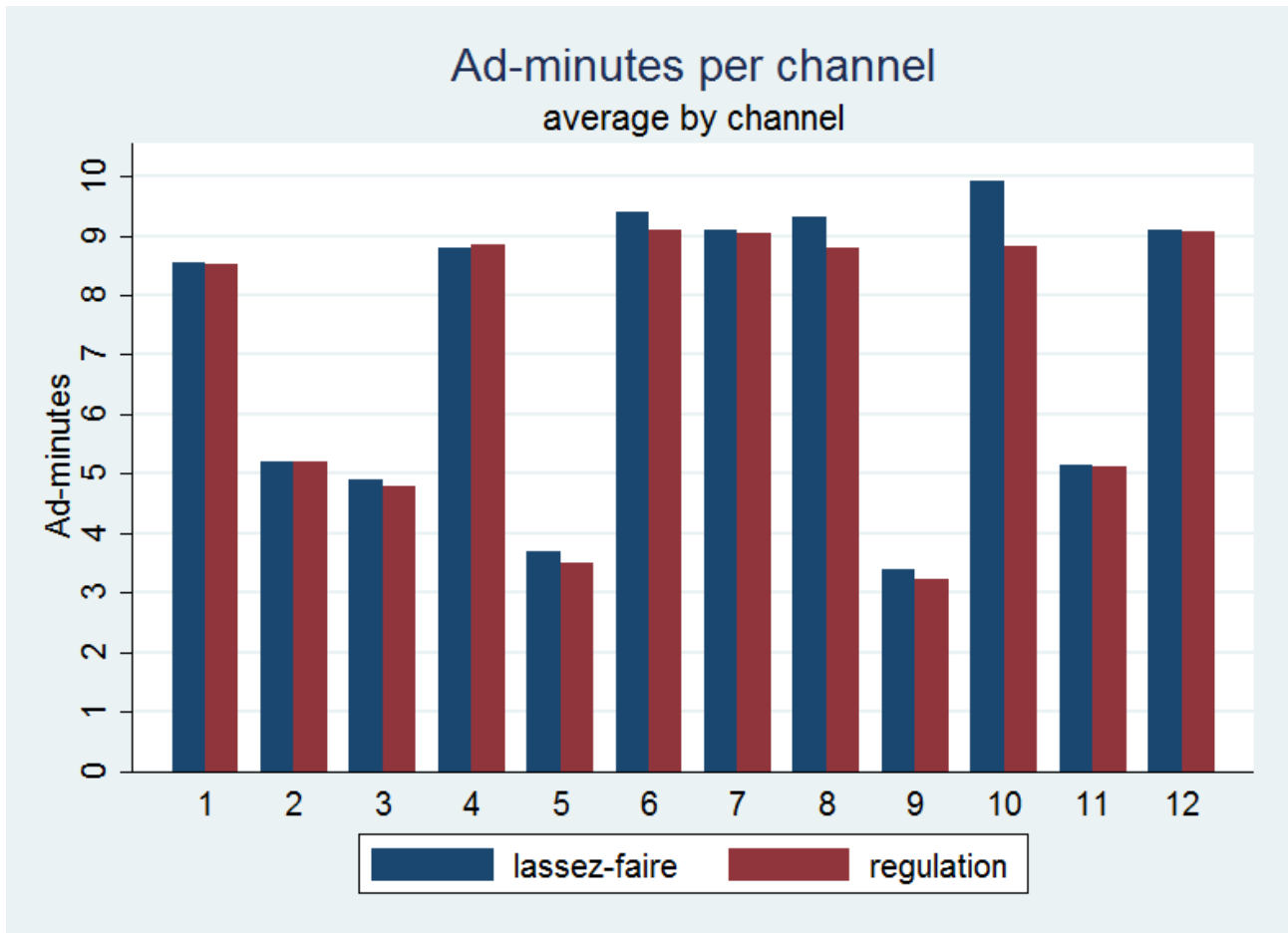


Figure 2.13 – Counterfactual equilibrium level of ad quantities by TV channel (The identity of TV channels are not reported for confidentiality reason)

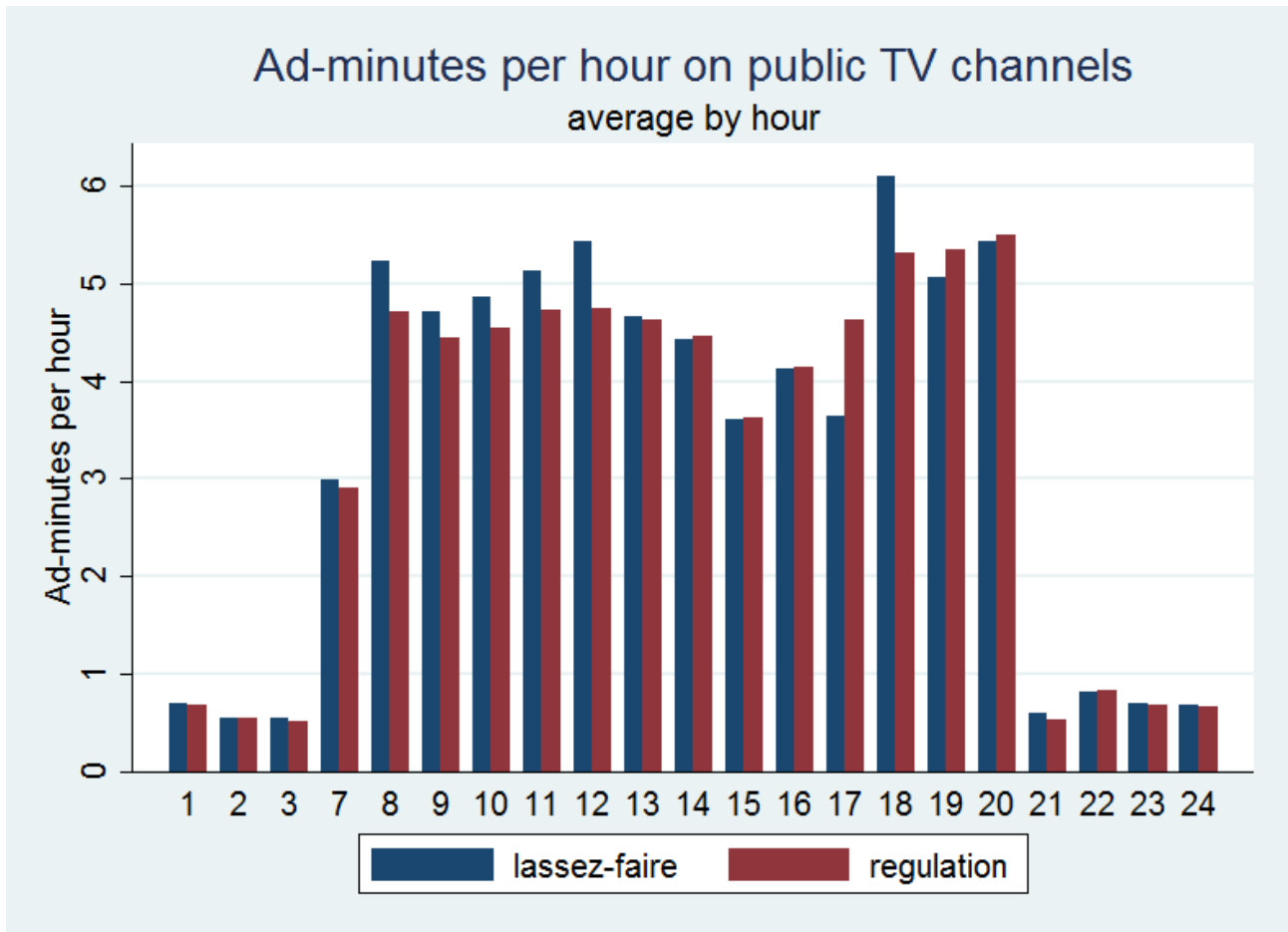


Figure 2.14 – Counterfactual equilibrium level of ad prices by TV channel

Notice that the advertising level of public TV stations during the commercial banning hours (from 8 p.m to 6 a.m) does not increase significantly after the deregulation. This is because that the public TV stations do not broadcast very attractive programs under the commercial bans. The quality of TV programs in terms of audience attractiveness is measured by the term $G_{jt}\beta_i + \xi_{jt}$ in the model of demand of TV viewers. The value of $G_{jt}\beta_i + \xi_{jt}$ averaged over all the public TV stations is equal to -0.467 from 8 p.m to 6 a.m, and is equal to -0.235 from 6 a.m to 8 p.m. This observation sends important message to the policy makers. The commercial advertising bans is introduced in the aim of guaranteeing a higher quality of programs by freeing public TV stations from the interests of advertisers. (See Filistrucchi et al., 2013.) However, we observe in practice that the public TV stations seems to broadcast less attractive programs as a consequence.

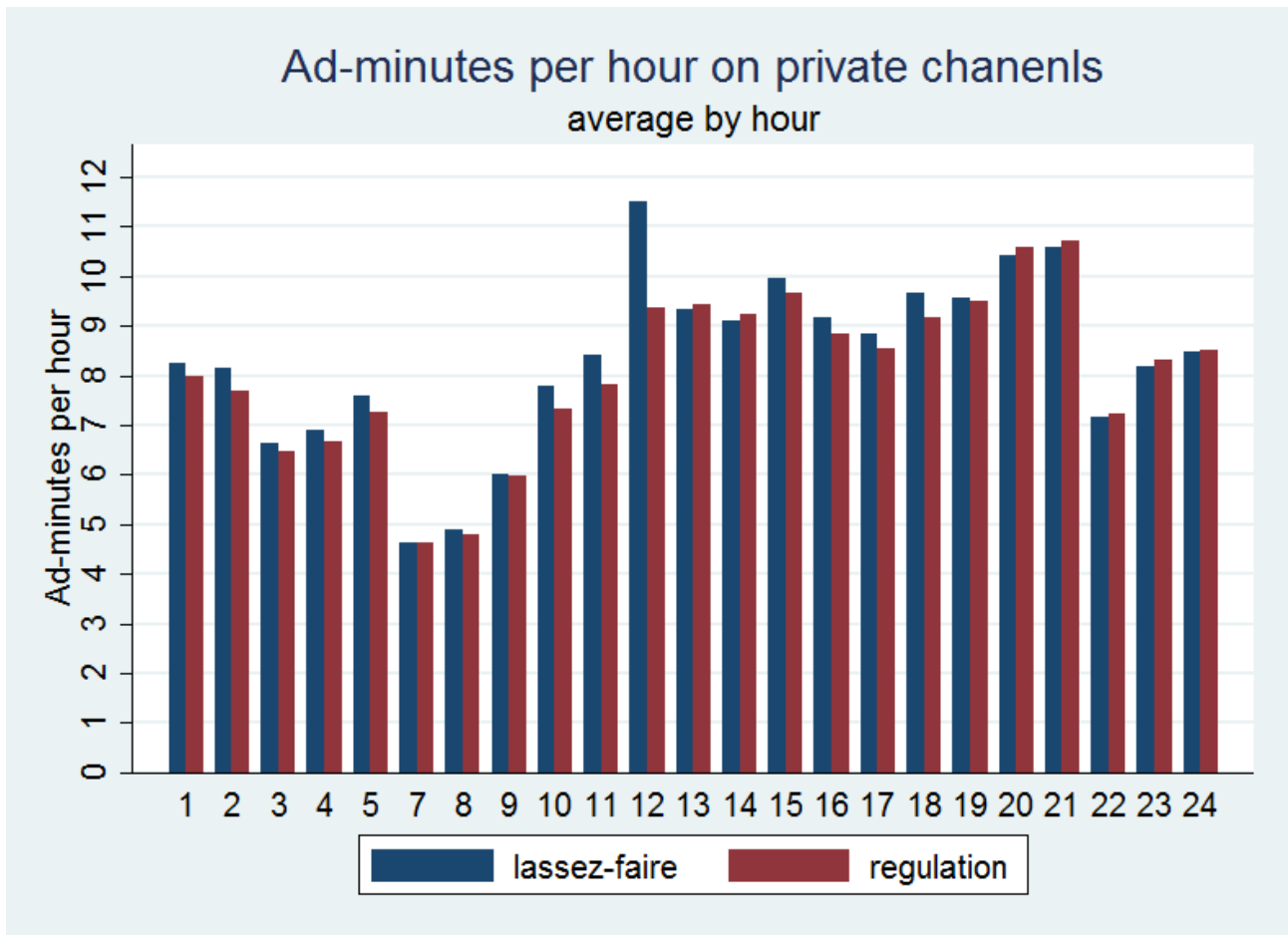


Figure 2.15 – Counterfactual equilibrium level of audience shares by TV channel

Chapter 3

Merger of Advertising Financed Media Platforms

English summary

In this chapter, I use a theoretical model to analyze the competitive behavior of advertising financed media platforms. The platforms are specified to be horizontally differentiated and the market structure is an oligopoly. The first major insight of the model is that the different platforms behave as strategic complements under Cournot competition. In particular, if a platform increases its quantity of advertising, it is optimal for its competitors to raise their respective advertising quantities as well. The model suggests that the merger of advertising sales houses of several platforms increases the advertising offers of all the competing platforms of the market (both the merged and unmerged), holding the quality of platforms unchanged. I further test the theoretical prediction with TV market data and model used in the first chapter, the empirical counterfactual simulation conclude to the same result as the theoretical model.

Résumé français

Dans ce chapitre, j'utilise un modèle théorique pour analyser le comportement concurrentiel des plateformes médias financées par la publicité. Je démontre que, dans un marché oligopolistique où les plateformes sont différenciées horizontalement, la réaction stratégique des plateformes médias sous une concurrence à la Cournot est complémentaire (i.e. si une plateforme augmente son offre de publicité, ses concurrents ont également intérêt à augmenter la leur). Par conséquent, la fusion des régies publicitaires permet à chaque plateforme du marché d'augmenter sa quantité de publicité. Je teste ensuite empiriquement cette prédiction théorique à l'aide du modèle et des données sur le marché de la télévision utilisés dans le premier chapitre. La simulation contrefactuelle conclut aux mêmes résultats que le modèle théorique.

3.1 Introduction

Advertising financed media platforms include broadcast TV, radio, social networks and different online shops. These platforms are two-sided markets providing contents (or services) free of charge to their users, but earning revenues from advertising sponsors. There are in general several platforms compete on a given market. The competitors compete in the advertising market by selling advertising spaces, however, the demand of advertisers depends on the platforms' performance on the other side (ie. on their userships). Antitrust authorities generally forbid the joint selling of advertising spaces of different platforms to prevent different forms of anti-competitive behaviors.¹ However, the effect of merger of advertising sales houses of media platforms is unclear. This paper investigates the short-run effect of merger (or cooperation) of advertising sales houses (or ad-exchanges) of media platforms. In particular, I am interested in the change in advertising quantities and prices at equilibrium holding the broadcasting contents unaffected.

Holding factors like product characteristics and production costs fixed, the pure price-quantity effects of mergers in a one-sided market are straightforward. Traditional economic theory predicts that the competing firms have incentives to set a low price in order to steal business from the rival, and more so the more prone the consumers are to shift from one firm to the other. If the firms merge (or set prices cooperatively), the owners will internalize these business-stealing effects. Prices will thus unambiguously increase. However, the advertising financed media platforms “sell” userships to the advertisers, while the users of platforms may dislike advertising. Network externalities between the two groups of consumers complicate the strategic reactions of competitions. Moreover, the media platforms dispose of limited advertising spaces, they compete à la Cournot (setting advertising quantities) on the advertising market. These factors make the media platforms substantially different from standard one-sided market. A careful analysis on the strategic behaviors of platforms is required to predict the potential consequence of merger.

The Seminal paper on two-sided markets (Anderson and Coate, 2005) predicts that a merger leads to higher advertising levels and lower per viewer advertising prices if consumers dislike ads. The model of Anderson and Coate (2005) assumes that the consumers visit only one media platform (e.g., watch only one TV channel or read only one newspaper), so-called single-homing. This assumption implies that the advertisers do not make an “either-or” decision to join a TV channel. Rather, keeping the market shares for TV viewers constant, an advertiser makes a decision to join the channel independently from its decision to join the other. Armstrong (2006) terms this phenomenon “competitive bottlenecks”. Several recent papers challenge this assumption and open up for competition for advertisers by allowing consumers to multi-home. (Ambrus et al., 2015; Anderson and Peitz, 2014a,b; Anderson et al., 2015a,b; Athey et al., 2013). Though using different model specification, these papers predict in general that the merger of advertising sales houses of media platforms reduces ad levels and increases per viewer advertising prices, when consumers multi-home.

The logic behind these recent contributions is that the over-lapped consumers are less valuable than the single-homing consumers for advertisers. (See Ambrus et al., 2015; Athey et al., 2013) Though fully rational, this assumption goes beyond the current advertising techniques of the majority of media platforms. Kind et al. (2007) introduces a model based on the representative consumer utility function à la Shubik and Levitan (1980). This model allows the possibility of multi-homing of the both sides of consumers, and imposes a less strict assumption

¹See “Rules and guidance of ITV advertising sales” for the UK regulatory framework, “Décision relative à la prise de contrôle exclusif par le groupe TF1 de la société NT1 et Monte-Carlo Participations” for the French example.

on the market structure. Kind et al. (2007) compares the market provision of advertising to the socially optimum level of ads, but did not analyze the consequence of merger of ad-sales houses of broadcast TV channels.

Empirical literature on two-sided market have studied merger cases in newspaper industry and broadcast radio industry. Chandra and Collard-Wexler (2009) empirically examine the price effects of ownership consolidation, relying on a series of newspaper merger in Canada in the late 1990s. They find that ownership consolidation had no discernible effect on either circulation or advertising prices. Filistrucchi et al.(2012) study a hypothetical merger in the Dutch newspaper industry. Their results suggest that such a merger would not directly affect advertising prices. However, it would raise subscription prices, and the resulting loss of subscribers would reduce advertising demand and would also raise advertising prices per reader; nevertheless, the estimated effects are small. Fan (2013) use a structural model of the newspaper industry to analyze the welfare consequences of newspaper mergers. Her counterfactual simulation results suggest that the newspapers will raise prices post-merger. Brown and Williams (2002) examine the concentration of local radio market in US during the period from 1996 to 2001. They find that increases in local market concentration, are positively correlated with changes in local advertising prices, but that these changes only explain around 5% of the large increase in advertising prices during the period of their data. Chipty (2007) finds no significant relationship between local concentration and her measures of advertising prices. Sweeting (2008) finds no significant effects of changes in local concentration on how many commercials are played. Jeziorski (2014) further examined the impact of local concentration in US radio industry. He estimates an equilibrium model of two-sided market using US data from 1996 to 2006. He finds that the local consolidation led to 17% reductions in the amount of advertising heard by the average listener, with a corresponding 6.5% increase in per-listener advertising prices.

In this chapter, I use firstly the model of Kind et al. (2007) to analyze the potential consequence of merger of advertising financed media platforms. Then, I use data and econometric model of Ivaldi and Zhang (2015) to test the theoretical prediction by conducting a counterfactual simulation on the merger of advertising sales houses of channel TF1 and the advertising sales house of channel TMC and NT1.

The paper is organized as follows. In section 2, I present the theoretical model and prediction. In section 3, I show the empirical results. I conclude in section 4.

3.2 Theoretical Model

Following Kind et al (2007), I use the Shubik-Levitan utility function to model the demand of platform users. Assume there are m ad-financed media platforms operating on the market. These platforms are differentiated one to another from users' point of view. n producers of goods (or services) are interested in advertising their products on the media platforms. They choose advertising spaces to buy based on their their expected benefits from advertising.

The model uses a representative individual to represent the behaviors of platform users. By normalizing his daily time to 1, the fraction of time per day that the representative user spend on platform j represents the platform j 's market share of that day. Denoting the fraction of time per day that the representative user spends on platform j by V_j . $\sum_{j=1}^m V_j$ measures the total fraction of time per day that the representative user spends on the media platform in question, $\sum_{j=1}^m V_j \leq 1$.

The platform user's gross utility is given by the Shubik-Levitan utility function:

$$U = \sum_{j=1}^m V_j - \frac{1}{2} [m(1-s) \sum_{j=1}^m (V_j)^2 + s(\sum_{j=1}^m V_j)^2] \quad (3.1)$$

The parameter $s \in (0, 1)$ measures the degree of horizontal differentiation between the m competing platforms: the higher the s , the closer substitutes are the platforms from the users' point of view. The Shubik-Levitan formulation ensures that the parameter s only captures product differentiation and has no effect on the market size. (See Motta, 2004.)

I am interested in ad-financed media platforms whose users disappreciate (excessive) advertising. This is typically the case of free TV (see Ivaldi and Zhang, 2015 and Wilbur, 2008.), but applies also to broadcast radio and many online platforms. Assume that the users' disutility from advertising is linear and let $\gamma > 0$ represents the nuisance cost per unit of ad, the users' subjective cost of using platform j is thus equal to $\gamma A_j V_j$, where A_j represents the advertising level on platform j (the fraction of time per day or fraction of space per webpage that platform j attributes to advertisements).²

In sum, the users' gross consumption surplus is written as:

$$CS = U - \gamma \sum_{j=1}^m A_j V_j \quad (3.2)$$

In this benchmark model, I assume that the qualities of platforms are exogenous.

Media platforms usually sell advertising spaces via their corresponding advertising sales houses ("ad-exchange" for the online platforms). Denote the platform j 's unit price of advertising by r_j and normalize the marginal cost of TV stations to be 0, the platform j 's profit function is given by:³

$$\Pi_j = r_j A_j, j = 1, \dots, m \quad (3.3)$$

Let A_{jk} denotes the fraction of time per day (ads per webpage) that advertiser k has occupied on channel j . The advertisers' return increase with the number of users of the platform. Under the assumption of increasing return in coverage of advertising message, the advertisers' return is conceptually captured by $A_{jk} V_j$ in this model. Let $A_{jk} V_j$ represent the advertiser k 's gross gain from advertising on platform j , one can write down the advertiser k 's expected profit from advertising as:

$$\pi_k = \left(\sum_{j=1}^m A_{jk} V_j \right) - \left(\sum_{j=1}^m r_j A_{jk} \right) = \sum_{j=1}^m A_{jk} (V_j - r_j), k = 1, \dots, n \quad (3.4)$$

By construction, we have the advertising level of platform j to be equal to the sum of advertising slots of all the advertisers of platform j , i.e. $A_j = \sum_{k=1}^n A_{jk}$. To determine the equilibrium outcomes, I consider the following three-stage game:

- Stage 1: The platforms set their respective advertising level through advertising sales houses (ad-exchanges): A_j ;

²The interpretation of this model impose the value of γ to belong to interval $(0.5, 1)$ later on. In particular, normalizing the time and space dimension to 1 requires $\sum_{j=1}^m V_j \in [0, 1]$, $A_j \in [0, 1]$, therefore, $A_j V_j \in [0, 1]$.

³In media industry, we distinguish two type of advertising prices: *cost per view (click)*, which corresponds to the price of each platform user who has seen (react) on the ad, is specified before the advertising; *unit price of advertising*, which measures the price of each individual advertising slot, is realized ex-post and is equal to *cost per view (click)* times number of views (clicks).

- Stage 2: The advertisers determine their demand for advertising: A_{jk} ;
- Stage 3: The platform users decide on which platform(s) to join and on to spend how long time: V_j .

Solving the game by backward induction. At stage 3, given the advertising level of each platform A_j , the TV viewer makes his consumption choice (time spent on each platform V_j) by maximizing his gross consumption surplus CS . This results:

$$V_j = \frac{1}{m} \left[1 - \gamma A_j - \frac{\gamma s}{1-s} (A_j - \bar{A}) \right], j = 1, \dots, m, \quad (3.5)$$

where $\bar{A} = \frac{1}{m} \sum_{j=1}^m A_j$ is the average level of advertising on the m platforms.

One can interpret the advertising as an indirect price that platforms charge to the TV viewer on this market. Advertising level of a platform affects the users' demand through its leeway from the market average level. Precisely, the attractiveness of the platform decreases with its advertising level, holding everything else equal: $\frac{dV_j}{dA_j} < 0$. Moreover, the attractiveness of platform j decreases as quickly as its advertising level departs from the average advertising level of the market: $\frac{dV_j}{d(A_j - \bar{A})} < 0, \forall A_j > \bar{A}$.⁴

At stage 2, advertisers choose advertising spaces according their expected users of the platform V_j . Replacing Expression 3.5 into Expression 3.4 and solving $\frac{\partial \pi_k}{\partial A_{jk}} = 0$ simultaneously for n advertisers. Using the fact that $A_j = \sum_{k=1}^n A_{jk}$, one can finally derive the aggregate demand of advertising (i.e. the advertising level of channel j) as:

$$A_j = \frac{1}{\gamma} \frac{n}{n+1} [1 - m(1-s)r_j - ms\bar{r}], j = 1, \dots, m, \quad (3.6)$$

where $\bar{r} = \frac{1}{m} \sum_{j=1}^m r_j$ represents the average unique price of advertising of the m media platforms.

Thereby, the inverse aggregate demand of advertiser is:

$$r_j = \frac{1}{m} \left(1 - \gamma \frac{n+1}{n} \frac{A_j - s\bar{A}}{1-s} \right), j = 1, \dots, m \quad (3.7)$$

- $\frac{dr_j}{dA_j} < 0$: the willingness to pay of advertisers decrease with the total advertising quantity of platform i .
- $\frac{dr_j}{dA_i} > 0, \forall i \neq j$: the willingness to pay of advertisers for the advertising spaces of platform j increases with advertising level of the other platforms.

⁴Expression (3.5) can be rewritten as:

$$A_j - \bar{A} = \frac{1-s}{\gamma s} [1 - \gamma A_j - mV_j], j = 1, \dots, m$$

As $s \rightarrow 1$, the right-hand side goes to zero. As the competing platforms tend toward perfect substitutes, there is less and less leeway for the advertising level of any platform to deviate from the market average level.

- $\frac{d(\frac{dr_j}{dA_j})}{ds} > 0$; $\frac{d(\frac{dr_j}{dA_i})}{ds} > 0$: more (horizontally) substitutable the platforms, more dependent the willingness to pay of advertisers to the total advertising level of the market. Since the risk of losing users due to advertising is higher when the competing platforms are less (horizontally) differentiated.

At stage 1, media platforms determine the advertising level which maximize their respective profits based on their expected demand of advertisers and of platform users. The equilibrium outcomes depend on the game played between the platforms.

Non-cooperative equilibrium:

Let's consider firstly the case where the m platforms compete non-cooperatively and derive their market equilibrium before merger.

Solving $\max_{A_j} \Pi_j = r_j(A_1, \dots, A_j, \dots, A_m)A_j$, the non-cooperative equilibrium level of advertising is such that:

$$A_j^c = \frac{1}{\gamma} \frac{n}{n+1} \frac{m(1-s)}{2m - ms - s}, j = 1, \dots, m \quad (3.8)$$

Inserting Expression 3.8 into Expressions 3.7 and Expressions 3.3, the equilibrium pricing and profit of each platform under non-cooperative competition are given by:

$$r_j^c = \frac{m-s}{m(2m - ms - s)}, j = 1, \dots, m \quad (3.9)$$

$$\Pi_j^c = \frac{1}{\gamma} \frac{n}{n+1} \frac{(m-s)(1-s)}{(2m - ms - s)^2}, j = 1, \dots, m \quad (3.10)$$

As expected, both the equilibrium advertising level and profit of the platforms are decreasing with respect to the nuisance cost of advertising: $\frac{\partial A_j^c}{\partial \gamma} < 0$, $\frac{\partial \Pi_j^c}{\partial \gamma} < 0$. The equilibrium level of advertising increases with the degree of horizontal differentiation of the market (decreases with the value of s): $\frac{\partial A_j^c}{\partial s} < 0$. Since users can easily switch from high advertising level platforms to the low advertising level platforms when the platforms are substitutable one to another, the platforms' profit decreases with the degree of substitutability between the competitors as well: $\frac{\partial \Pi_j^c}{\partial s} < 0$.

Proposition 1: *On the advertising market, the reactions of media platforms are **strategic complements** under Cournot competition: when one platform raises its advertising level, it is optimal for its rivals to increase their advertising level as well, i.e. $\frac{\partial A_j}{\partial A_i} > 0$.* (See Appendix 1 for proof.)

The traditional theory of industrial organization argues that the reactions of firms are *strategic substitutes* under Cournot competition but are *strategic complements* under Bertrand competition. However, the business structure of the ad-financed media platforms differs in the sense that there are two groups of consumers generating opposite externalities to each other.

(Advertisers consider platform users as potential customers of their advertised products and they pay to reach these potential buyers; platform users exert positive externalities to the advertisers. Users are sensitive to ads; advertisers exert negative externalities to advertisers.) The nuisance of ads is an indirect tariff that the platforms charge to the users in exchange of free media contents. The advertising quantity plays the role of price on the users' side as in the analysis of one-sided market theory. When one platform increases its advertising quantity, part of its users may switch onto the other platforms which increases the advertisers' demand for the other platforms; by consequence, the other platforms have incentive to increase their advertising quantities as well.

Merger effect:

Consider now that the advertising sales houses (ad-exchanges) of l ($2 \leq l < m$) media platforms merge. The merger allows the merged platforms to communicate and determine jointly their offers on the advertising market.

Let Π_G , A_g and r_g denote respectively the profit, advertising quantity and price of the merged platforms, Π_i , A_i and r_i denote respectively the profit, advertising quantity and price of the $m - l$ independent platforms:

$$\Pi_G = \sum_{g=1}^l r_g A_g = \sum_{g=1}^l \frac{1}{m} A_g \left[1 - \frac{\gamma}{(1-s)} \frac{n+1}{n} \left((1 - \frac{s}{m}) A_g - \frac{s}{m} \left(\sum_{j=1, j \neq g}^l A_j + \sum_{i=l+1}^m A_i \right) \right) \right]; \quad (3.11)$$

$$\Pi_i = r_i A_i = \frac{1}{m} A_i \left[1 - \frac{\gamma}{(1-s)} \frac{n+1}{n} \left((1 - \frac{s}{m}) A_i - \frac{s}{m} \left(\sum_{g=1}^l A_g + \sum_{j=l+1, j \neq i}^m A_j \right) \right) \right] \quad (3.12)$$

The equilibrium outcomes can be derived by solving $\max_{A_g} \Pi_G$ and $\max_{A_i} \Pi_i, i = m - l, \dots, m$ simultaneously. (See Appendix 2 for computation details.)

In order to compare the equilibrium outcomes after merger of the advertising sales houses (ad-exchanges) to the non-cooperative equilibrium derived before, I assume from now on that $m = 3, l = 2$. Therefore, the change in advertising level of merged (non-merged) media platforms after the merger is given by:

$$A_g - A_j^c = \frac{1}{\gamma} \frac{n}{n+1} AGC(s) \quad (3.13)$$

$$A_i - A_j^c = \frac{1}{\gamma} \frac{n}{n+1} AIC(s) \quad (3.14)$$

where $AGC(s) = \frac{s^2 - 7s + 6}{2(s^2 - 6s + 6)} - \frac{3(1-s)}{6-4s}$ and $AIC(s) = \frac{s^2 - 4s + 3}{s^2 - 6s + 6} - \frac{3(1-s)}{6-4s}$. $AGC(s) > 0$, $AIC(s) > 0, \forall s \in (0, 1)$.

The change in unit price of advertising of merged (non-merged) platforms after the merger is given by:

$$r_g - r_j^c = \frac{2s^2 - 15s + 18}{18s^2 - 108s + 108} - \frac{m-s}{m(2m - ms - s)} \quad (3.15)$$

$$r_i - r_j^c = \frac{2s^2 - 12s + 18}{18s^2 - 108s + 108} - \frac{3-s}{3(6-4s)} \quad (3.16)$$

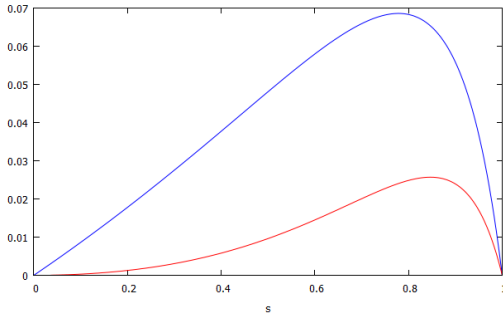


Figure 3.1 – The blue line represents AGC, the red line represents AIC.

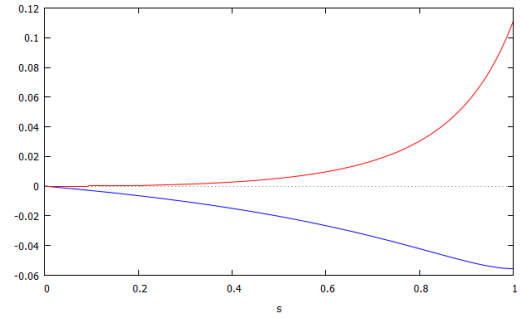


Figure 3.2 – The blue line represents rgc , the red line represents ric .

Denote $r_g - r_j^c$ by $rgc(s)$ and $r_i - r_j^c$ by $ric(s)$. The value of AGC and AIC as function of s is presented in Figure , the value of rgc and ric as function of s is presented in Figure 3.2.

Proposition 2: *Merger of advertising sales houses (ad-exchanges) of media platforms increases the advertising levels of both merged and non-merged platforms. The advertising prices of the merged platforms decrease, while the advertising prices of the non-merged platforms increase. The merger effect is more important with low degree of substitutability between competing platforms at equilibrium.*

Platform users are direct consumers of the platforms, while the platforms compete on the advertising market by selling their shares of users. Under strong competition, platforms choose low advertising level to avoid losing users. Merger allows the merged platforms to internalize their competition, thereby increases their advertising level.⁵ Since the reaction of platforms are **strategic complements**, when the merged platforms increase their level of advertising, it is optimal for the non-merged platforms to increase jointly their advertising level as well.

The model also predicts that the advertising prices of the merged media platforms decrease, but the advertising prices of the non-merged platforms increase. The increase in advertising levels of the merged platforms are much more important than the increase in advertising levels of the non-merged platforms. As a consequence, the negative response of the advertisers' willingness to pay to the increase in advertising quantities of the merged platforms overweights its positive response to the increase in advertising quantities on the non-merged platforms. The prices of advertising spaces of the merged platforms decrease. By the same logic, the positive response of the advertisers' willingness to pay to the increase in advertising quantities on the merged platforms overweight its negative response to the increase in advertising quantities on the non-merged platforms. The prices of advertising spaces of the non-merged platforms increase.

The surplus of media platforms can be computed by inserting the value of advertising quantities of different platforms A_1, \dots, A_m into Expression 3.2. The model predict that the

⁵To simplify the reasoning, imagine there are two cplatforms A and B competing on the market. When users of platform A switch onto platform B due to advertising, the willingness to pay of advertisers for platform A decreases, and to some extent, the profit of platform A decreases as well. As a matter of fact, platform A has no incentive to set a high level of advertising. The same logic applies to platform B. Now that platform A and B merge, they share profits within the new entity. The users' switch between the two platforms due to advertising is no more profit harming, thereby giving incentive to the merged platforms to increase their advertising levels.

merger harms the surplus of platform users since it increases the market equilibrium level of advertising.

3.3 Empirical Counterfactual Simulation on the French Merger Case

To test prediction of the theoretical model, in this section, I use the data and econometric model used in Ivaldi and Zhang (2015) to simulate the merger of advertising sales houses of three French broadcast TV channels: TF1, TMC and NT1. This merger simulation is in line with a decision of the French antitrust authority in 2010 which authorize the acquisition of channels TMC and NT1 by the TF1 TV group under the preservation of separation in advertising offers of TF1 on the one hand, and of TMC and NT1 on the other. The main worry of the French antitrust authority about this acquisition is the dominant position of TF1 Group on the TV advertising market: the group holds more than 50% of market share in 2009 and the acquisition can even strengthen the group's position. However, the TF1 group provided good argument on the efficiency gain related to this acquisition: for instance, some of the programs in storage at TF1 Group can be broadcast on the two other channels without additional cost. Therefore, the antitrust authority finally approved the acquisition subject to separation in advertising offers of the three channels. This context provided an excellent environment to test the prediction of the theoretical model. By using data after the acquisition (from 2010 to 2013), I actually control for the potential change in quality of broadcasting networks following the acquisition. My simulation shows the effect of merger on the advertising market controlling for potential efficiency gains on the broadcasting market.

Data

The dataset covers detailed monthly information on 21 free TV channels in France from March 2008 to December 2013 and is provided by the CSA.

The broadcasting 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. The Médiamétrie survey gathers information of the audience shares, the total population having access to TV services (all reception modes together) in metropolitan France, and the average watching time per day per individual. The average watching time per day per individual is at aggregate level, I do not have detailed per channel data for this variable.

The advertising data are measured by Kantar Media. I have access to the number of advertising minutes and the gross advertising revenues per month of different TV channels. From these data, I construct the number of advertising spots and their corresponding prices. The number of advertising spots is obtained by dividing the number of advertising minutes by the standard length of an advertising spot, which lasts for 30 seconds. The price of an advertising spot is calculated by dividing the gross advertising revenues by their corresponding numbers of advertising spots. The prices calculated in such a way correspond to the equilibrium prices established on the market on the basis of the channels' audience performance and quantities of advertising supply.

In addition to the dataset provided by CSA, I collected complementary information from published reports of the Centre national du cinéma et de l'image animée (CNC), Kantar Media and different TV channels. The list of variables include the total amount of advertising investment in the cinema market, the total quantity of advertising on radio, the total number of hours of French audiovisual programs broadcast during the year, the number of movies

broadcast during the prime time (20:30 - 22:20), the amount of subsidies allocated to the public broadcasters, the financial participation of each channel in the production of movies and French audiovisual programs, and the total number of employees of each TV group.⁶ These data either serve as instrumental variables or as components of cost equations at the estimation stage.

Econometric Specification

Demand of TV viewers is specified by the nested-logit model (Berry, 1994). The TV viewers' demand function to be estimated is given by:

$$\ln(s_{jt}) - \ln(s_{0t}) = \alpha A_{jt} + \sigma \ln(\bar{s}_{jt/g}) + X_{jt}\beta + \xi_{jt}, \quad (3.17)$$

where s_{jt} measures the market share of channel j , s_{0t} measures the market share of the outside goods, A_{jt} denotes the number of advertising spots on channel j during period t , $\bar{s}_{jt/g}$ represents the market share of channel j within its own category (incumbent or new channels),⁷ X_{jt} is specified as a linear combination of dummies of channels, of months and of years, ξ_{jt} is a random term capturing the effect of unobserved factors of channel j at time t on the mean utility of TV viewers.

Demand of advertisers is specified by the inverse demand function:

$$\ln(p_{jt}) = \theta \ln(A_{jt}) + \nu \ln(y_{jt}) + X_{jt}^A \beta^A + \xi_{jt}^A, \quad (3.18)$$

where p_{jt} denotes the per minute price of advertising of channel j , y_{jt} measures the number of TV viewers of channel j during period t ($s_{jt} = (y_{jt}/Y_t)$, where Y_t denotes the size of the French population at period t), X_{jt}^A and ξ_{jt}^A represent, respectively, the observable and unobservable characteristics of channel j at time t that impact the demand of advertisers. X_{jt}^A is specified as a linear combination of dummies to identify channel, monthly, and annual fixed effects.

Broadcast TV stations sell advertising spaces on the TV advertising market. Demand of advertisers depend on the viewership of TV channels. TV viewers' choice in channel(s) depends on the broadcasting contents but also on their advertising levels.

The J free-broadcast TV channels belong to K different media groups on the French market. Each media group owns or cooperates with a private advertising sales house through which its channels exchange with the advertisers. Channels within the same media group maximize jointly their profits taking account of the strategic reactions of other groups.

The profit function of a media group G_k , $k = \{1, \dots, K\}$ from selling advertising spaces is given by

$$\Pi_{G_k} = \sum_{j \in G_k} \Pi_j = \sum_{j \in G_k} [(p_j - c_j) A_j - F_j], \quad (3.19)$$

where c_j and F_j are the marginal and fixed costs of channel j , respectively. TV stations broadcast their programs free-to-air but mainly cover their programming costs from advertising revenues. The fixed cost F_j measures the sunk investment of channel j on the acquisition of its programs' broadcasting right. The variable costs of advertising include mainly the management cost of advertising and fixed discounts proposed by the TV channels to the advertisers.

⁶ Many channels in our sample share a common ownership, i.e., belong to the same media group. It is impossible to distinguish the number of employees of different channels in the same media group.

⁷As explained in Ivaldi and Zhang (2015), the French household differentiate between watching an incumbent and a newly launched channel. The implementation of DTTV service has been achieved region by region, and the newly launched DTTV channels were made accessible to the French households progressively during the entire period of our observation. Those who get used to watching the incumbent channels do not switch to the new channels immediately, as the latter lack notoriety. To account for the difference in notoriety between the incumbent and entrant channels, the model classifies them into two separate nests.

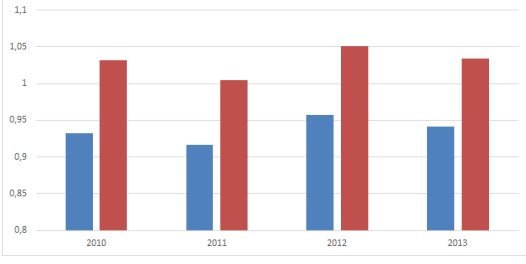


Figure 3.3 – Comparison on advertising quantities of the non-merged TV channels before and after the merger

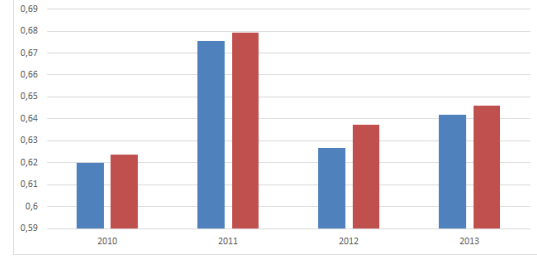


Figure 3.4 – Comparison on advertising quantities of the merged TV channels before and after the merger

Channels compete à la Cournot on the advertising market. (See Ivaldi and Zhang, 2015.) Each group G_k determines the optimal advertising quantities of channels within the group $(A_{jk}, j \in G_k)$, taking the advertising quantities of other groups as given, namely,

$$\max_{A_{jk}:j \in G_k} \{\Pi_{G_k} | A_{-j}\} = \max_{A_{jk}:j \in G_k} \sum_{j \in G_k} \{[p_j [A_j, y_j(A)] - c_j] A_j | A_{-j}\}, \quad (3.20)$$

where $p_j [A_j, y_j(A)]$ is the inverse-demand curve of advertisers and A_{-j} is the set of strategic advertising decisions of all channels other than j . The associated first-order condition is obtained as

$$(p_j - c_j) + A_j \frac{\partial p_j}{\partial A_j} + A_j \frac{\partial p_j}{\partial y_j} \frac{\partial y_j}{\partial A_j} + \sum_{i \neq j, j \in G_k} A_i \frac{\partial p_i}{\partial y_i} \frac{\partial y_i}{\partial A_j} = 0, \forall j \in G_k. \quad (3.21)$$

Counterfactual Simulation

I use the estimated demand and supply side parameters $(\hat{\alpha}, \hat{\sigma}, \hat{\beta}, \hat{\xi}_{jt}, \hat{\theta}, \hat{\nu}, \hat{\beta}^A, \hat{\xi}_{jt}^A, \hat{c}_{jt})$ to simulate the equilibrium outcomes when the advertising sales house of channel TF1 merge with the advertising sales house of channel TMC and NT1 at the moment of acquisition.

Equation 3.21 can be written in matrix notation as:

$$(1 - \theta)\mathbf{p}(\mathbf{A}) - \mathbf{c} - \alpha\gamma_3(\mathbf{O}(\mathbf{A}) \cdot \mathbf{Q}(\mathbf{A})) = 0 \quad (3.22)$$

where $\mathbf{A} = (A_1, \dots, A_J)'$; $\mathbf{c} = (c_1, \dots, c_J)'$; $\mathbf{p}(\mathbf{A})$ is vector of prices as function of \mathbf{A} , derived from Equation 3.18 and nested-logit expression of s_j ($s_{jt} = (y_{jt}/Y_t)$); $\mathbf{Q} = (Q_1, \dots, Q_J)'$ with $Q_j = A_j p_j(\mathbf{A})$; $\mathbf{O}(\mathbf{A})$ is a matrix depending on $s_j(\mathbf{A})$, $\bar{s}_{j/g}(\mathbf{A})$, and the ownership of TV channels.⁸

Comparison on the average advertising quantities and prices of merged and non-merged TV channels are presented in Figure 3.3-Figure 3.6. The blue bars show the equilibrium outcomes (advertising quantities and prices) before merger; the red bars show the equilibrium outcomes after merger.

The counterfactual simulation suggests the same results as the theoretical model. The merger of advertising sales houses increases the advertising quantities of both merged and non-merged TV channels. It increases the prices of advertising spaces of non-merged TV channels, but decreases the prices of advertising spaces of merged channels.

⁸See Appendix 3 for details.

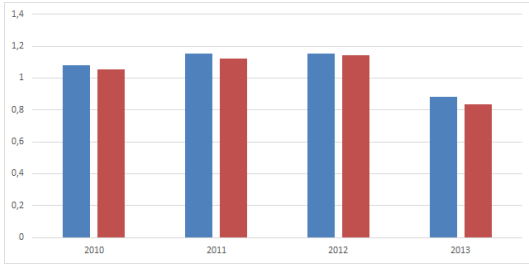


Figure 3.5 – Comparison on advertising prices of the non-merged TV channels before and after the merger

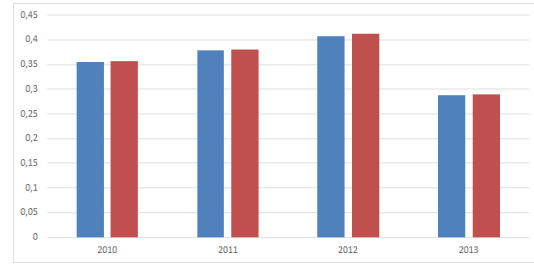


Figure 3.6 – Comparison on advertising prices of the merged TV channels before and after the merger

By the nested-logit specification on the demand of TV viewers, the surplus of TV viewers can be computed according to the formula below (Williams, 1977 and Small and Rosen, 1981):

$$CS_{viewers} = -\frac{1}{\alpha} \ln \left[1 + \sum_g \left[\sum_{j \in C_g} \exp\left(\frac{\delta_{jt}}{1-\sigma}\right) \right]^{(1-\sigma)} \right]. \quad (3.23)$$

The surplus of TV viewers is higher when the advertising spaces of channel TF1 are sold independently of the advertising spaces of the channel TMC and NT1. (See Figure 3.7.)

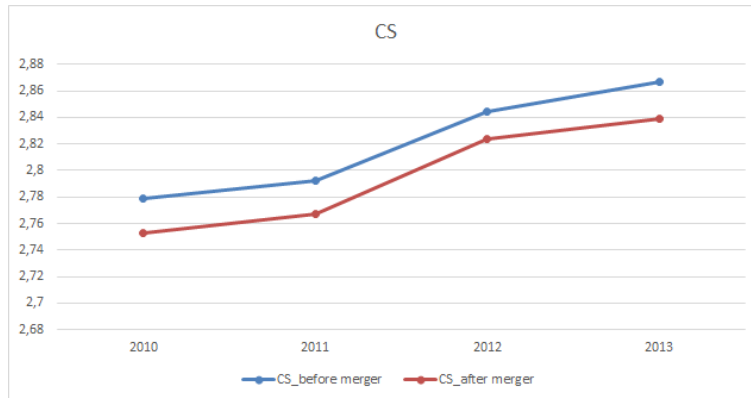


Figure 3.7 – Comparison on advertising prices of the merged TV channels before and after the merger

3.4 Conclusion

This chapter studies the short-run effect of merger (or cooperation) of advertising sales houses (or ad-exchanges) of media platforms. Both the theoretical model and the empirical simulation suggest that the merger increases the advertising levels of both merged and non-merged media platforms. The advertising prices of the merged platforms decrease, but that of the non-merged platforms increase. The merger reduces the surplus of platform users. The specific feature of the advertising financed media platforms implies that the advertising is an indirect tariff that the platforms charge to its users. The merger internalizes the competition among the merged advertising sales houses, thereby allow them to set higher level of advertising. Since the reactions of the media platforms are *strategic complements*, the non-merged platforms increase their offer of advertising spaces as well. The advertisers' willingness to pay for the advertising spaces of a media platform decreases in its total quantity of advertising offers, but

increases in the total quantity of advertising offers the other platforms of the market. Since the increase in advertising quantities of the merged platforms are much more important than the increase in advertising quantities of the non-merged platforms, the advertising prices of the merged platforms decrease, but that of the non-merged platforms increase.

3.5 Appendix

Appendix 1: Prof of Proposition 1

$$\max_{A_j} \Pi_j = r_j(A_1, \dots, A_j, \dots, A_m)A_j = \frac{1}{m} \left(1 - \gamma \frac{n+1}{n} \frac{A_j - s\bar{A}}{1-s}\right) \quad (3.24)$$

$$\frac{\partial \Pi_j}{\partial A_j} = \frac{1}{m} \left[1 - \frac{\gamma}{(1-s)} \frac{(n+1)}{n} (A_j - s\bar{A}) - \frac{\gamma}{(1-s)} \frac{(n+1)}{n} \left(1 - \frac{s}{m}\right) A_j\right] = 0 \quad (3.25)$$

\Leftrightarrow

$$\frac{mn(1-s)}{\gamma(n+1)} - 2(m-s)A_i + s \sum_{i, i \neq j}^m A_i = 0 \quad (3.26)$$

\Leftrightarrow

$$A_i = \frac{s}{2(m-s)} \sum_{j, j \neq i}^m A_j + \frac{mn(1-s)}{2\gamma(n+1)(m-s)} \quad (3.27)$$

\Rightarrow

$$\frac{\partial A_j}{\partial A_i} = \frac{s}{2(m-s)} > 0, \forall i \neq j \quad (3.28)$$

Appendix 2: Merger effects

$$\max_{A_g} \Pi_G = \sum_{g=1}^l r_g A_g = \sum_{g=1}^l \frac{1}{m} A_g \left[1 - \frac{\gamma}{(1-s)} \frac{n+1}{n} \left((1 - \frac{s}{m}) A_g - \frac{s}{m} \left(\sum_{j=1, j \neq g}^l A_j + \sum_{i=l+1}^m A_i \right) \right) \right]; \quad (3.29)$$

$$\frac{\partial \Pi_G}{\partial A_g} = \frac{1}{m} \left[1 - \frac{2\gamma}{(1-s)} \frac{(n+1)}{n} A_g + \frac{\gamma s}{(1-s)} \frac{(n+1)}{mn} \left(\sum_{g=1}^l A_g + \sum_{i=l+1}^m A_i \right) + \frac{\gamma s}{(1-s)} \frac{(n+1)}{mn} \sum_{g=1}^l A_g \right] = 0 \quad (3.30)$$

$$\max_{A_i} \Pi_I = r_i A_i = \frac{1}{m} A_i \left[1 - \frac{\gamma}{(1-s)} \frac{n+1}{n} \left((1 - \frac{s}{m}) A_i - \frac{s}{m} \left(\sum_{g=1}^l A_g + \sum_{j=l+1, j \neq i}^m A_j \right) \right) \right] \quad (3.31)$$

$$\frac{\partial \Pi_I}{\partial A_i} = \frac{1}{m} \left[1 - \frac{2\gamma}{(1-s)} \frac{(n+1)}{n} A_i + \frac{\gamma s}{(1-s)} \frac{(n+1)}{mn} \left(\sum_{g=1}^l A_g + \sum_{i=l+1}^m A_i \right) + \frac{\gamma s}{(1-s)} \frac{(n+1)}{mn} A_i \right] = 0 \quad (3.32)$$

Imposing symmetry on the advertising level of merged channels ($A_j = A_g$ for $j = 1, \dots, G$) and of the independent channels ($A_j = A_i$ for $j = l + 1, \dots, m$), expression (25) implies:

$$\frac{mn(1-s)}{\gamma(n+1)} + 2(ls-m)A_g + s(m-l)A_i = 0 \quad (3.33)$$

Expression (27) implies:

$$\frac{mn(1-s)}{\gamma(n+1)} + s l A_g + [-2m + s(m-l) + s] A_i = 0 \quad (3.34)$$

The equilibrium level of advertising can be obtained by solving the system: $\begin{cases} (28) \\ (29) \end{cases}$

For $m = 3, l = 2$,

$$A_g = \frac{(ns^2 - 7ns + 6n)}{((2an + 2a)s^2 + (-12an - 12a)s + 12an + 12a)} \quad (3.35)$$

$$A_i = \frac{(ns^2 - 4ns + 3n)}{((an + a)s^2 + (-6an - 6a)s + 6an + 6a)} \quad (3.36)$$

Substituting (33) and (34) into expression (7),

$$r_g = \frac{(2s^2 - 15s + 18)}{(18s^2 - 108s + 108)} \quad (3.37)$$

$$r_i = \frac{(2s^2 - 12s + 18)}{(18s^2 - 108s + 108)} \quad (3.38)$$

Appendix 3: Counterfactual Simulation

Inserting the value of $\frac{\partial p_j}{\partial A_j}$, $\frac{\partial p_j}{\partial y_j}$, $\frac{\partial y_j}{\partial A_j}$, $\frac{\partial y_i}{\partial A_j}$ into Equation 3.21, we obtain

$$(1 + \theta)p_j - c_j - \alpha\gamma(d + s_j + e\bar{s}_{j/g})A_jp_j - \alpha\gamma \sum_{i \neq j, j \in G_k} (s_j + e\bar{s}_{j/g}A_i p_i) = 0, \quad (3.39)$$

where $d = \frac{1}{(\sigma - 1)}$, $e = \frac{\sigma}{(1 - \sigma)}$.

Rewriting above expression in matrix notation:

$$(1 - \theta)\mathbf{p}(\mathbf{A}) - \mathbf{c} - \alpha\gamma_3(\mathbf{O}(\mathbf{A}) \cdot \mathbf{Q}(\mathbf{A})) = 0, \quad (3.40)$$

$\mathbf{p} = (p_1, \dots, p_J)'$, and $p_j = (A_j)^\theta (s_j)^{\gamma_3} (T)^{\gamma_3} \exp(X_j^A \beta^A + \xi_j^A)$;

$\mathbf{Q} = (Q_1, \dots, Q_J)'$, and $Q_j = (A_j)^{(1+\theta)} (s_j)^{\gamma_3} (T)^{\gamma_3} \exp(X_j^A \beta^A + \xi_j^A)$;

$$\mathbf{O} = \begin{pmatrix} O_1^1 & O_1^2 & O_1^3 & O_1^2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ O_2^1 & O_2^2 & O_2^3 & O_2^2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ O_3^1 & O_3^2 & O_3^3 & O_3^2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ O_4^1 & O_4^2 & O_4^3 & O_4^2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & O_5^1 & O_5^3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_{33}^3 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & O_6^3 & O_6^1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_{33}^3 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & O_7^1 & O_7^2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & O_8^2 & O_8^1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_9^1 & O_9^2 & 0 & O_9^2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_{10}^2 & O_{10}^1 & 0 & O_{10}^2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_{11}^1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_{11}^3 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_{12}^2 & O_{12}^2 & 0 & O_{12}^1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_{13}^1 & 0 & 0 & 0 & 0 & 0 & O_{13}^2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_{14}^1 & 0 & 0 & O_{14}^2 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_{15}^1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & O_{16}^3 & O_{16}^2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_{16}^1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_{17}^2 & 0 & 0 & O_{17}^1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_{18}^3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_{18}^1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_{19}^1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_{20}^2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & O_{20}^1 & 0 \\ 0 & O_{21}^1 \end{pmatrix},$$

$O_j^1 = d + s_j + es_{j/g}$, $O_j^2 = s_j + es_{j/g}$, and $O_j^3 = s_j$. Each line j of matrix \mathbf{O} corresponds to one TV channel. The matrix \mathbf{O} depends on the TV channels' ownership and changes with the way by which one orders the different channels.⁹

⁹Here, the 21 TV channels are ordered as: F2, F3, F4, F5, M6, W9, TMC, NT1, D17, D8, TF1, Itele, BFM, NRJ, Gulli, 6ter, cherie 25, HD1, Numero23, RMC, Equipe21.

By Equation 3.17 and following Berry(1994), s_j and $s_{j/g}$ are functions of \mathbf{A} , $\mathbf{A} = (A_1, \dots, A_J)'$.

Solving Equation 3.40, one refinds the equilibrium level of advertising $\mathbf{A} = (A_1, \dots, A_J)'$ that we observe.

In case where the advertising agency of channels TMC and NT1 merges with that of TF1, the lines 7, 8, 11 of matrix \mathbf{O} , which correspond separately to these three channels, become:

$$\mathbf{O}_{7,j} = (0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ O_7^1 \ O_7^2 \ 0 \ 0 \ O_7^3 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ O_7^2 \ 0 \ 0 \ 0);$$

$$\mathbf{O}_{8,j} = (0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ O_8^2 \ O_8^1 \ 0 \ 0 \ O_8^3 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ O_8^2 \ 0 \ 0 \ 0);$$

$$\mathbf{O}_{11,j} = (0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ O_{11}^3 \ O_{11}^3 \ 0 \ 0 \ O_{11}^1 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ O_{11}^3 \ 0 \ 0 \ 0).$$

Resolving Equation 3.40 with the modified matrix \mathbf{O} , one obtains the equilibrium level of adverting in case of merger $\mathbf{A}' = (A'_1, \dots, A'_J)'$. The equilibrium level of advertising prices $\mathbf{p}' = (p'_1, \dots, p'_J)'$ and audience shares $\mathbf{s}' = (s'_1, \dots, s'_J)'$ can be derived from the corresponding level of advertising quantities.

All the simulations are conducted by Matlab.

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Abstract

Résumé

Chapitre 1 étudie la situation concurrentielle du marché de la télévision en clair. A l'aide d'un modèle de concurrence oligopolistique, nous identifions la nature et l'ampleur des externalités entre téléspectateurs et annonceurs publicitaires. Nous contribuons à la littérature en mettant en œuvre une procédure simple permettant de tester le type de comportement des entreprises sur un marché. Nous démontrons que la nature de la concurrence sur le marché publicitaire de la télévision est de type Cournot. En outre, nos estimations nous permettent de conclure que, sur un marché biface, des taux de marge élevés sur une des faces du marché ne signifient pas une absence de concurrence. Chapitre 2 analyse l'effet de la régulation par plafonnement des volumes publicitaires sur les chaînes de télévision en clair. J'exploite une nouvelle base de données par tranche horaire sur 12 chaînes de télévision en France pendant un an (2014). J'estime d'abord la demande des téléspectateurs et des annonceurs, ce qui me permet de tenir compte de la nature biface du marché dans la spécification de la décision stratégique des chaînes. J'identifie ensuite les «prix fictifs» de la régulation à partir des contraintes observées. Enfin, je conduis deux simulations contrefactuelles pour calibrer les effets de la régulation. Mes résultats suggèrent que la régulation n'est pas nécessaire sur un marché concurrentiel, compte tenu de la structure biface de cette industrie. Cependant, si les chaînes de télévision s'entendent sur leur offre publicitaire, la régulation peut augmenter jusqu'à 5,75% le surplus des consommateurs, mais diminuer jusqu'à 4,8% le profit de l'industrie. Chapitre 3 utilise un modèle théorique pour analyser le comportement concurrentiel des plateformes médias financées par la publicité. Je démontre que, dans un marché oligopolistique où les plateformes sont différenciées horizontalement, la réaction stratégique des chaînes de télévision sous une concurrence à la Cournot est complémentaire (i.e. si une chaîne augmente son offre de publicité, ses concurrents ont également intérêt à augmenter la leur). Par conséquent, la fusion des régies publicitaires permet à chaque chaîne du marché d'augmenter sa quantité de publicité. Je teste ensuite empiriquement cette prédiction théorique à l'aide du modèle et des données utilisés dans le premier chapitre. La simulation contrefactuelle conclut aux mêmes résultats que le modèle théorique.

Mots Clés

Marché biface, publicité, externalités, économétrie structurelle, concurrence, régulation.

Chapter 1 empirically investigates the advertising competition in the French broadcast television industry within a two-sided market framework. We use a unique dataset on the French broadcast television market including audience, prices, and quantities of advertising of twenty-one TV channels from March 2008 to December 2013. We specify a structural model of oligopoly competition and identify the shape and magnitude of the feedback loop between TV viewers and advertisers. We also implement a simple procedure to identify the conduct of firms on the market. We find that the nature of competition in the French TV advertising market is of the Cournot type. Further, we provide empirical evidence that the price-cost margin is not a good indicator of the market power of firms operating on two-sided markets. Chapter 2 studies the welfare implications of the widespread regulation on TV advertising quantity. To my knowledge, it is the first paper which structurally investigates this issue within a two-sided market framework. The paper exploits a novel dataset of per hour data on 12 broadcast TV channels in France during one year (2014). I first estimate the demand of TV viewers and of advertisers, which allows me to account for the two-sidedness of the market in the supply decision of TV stations. I identify the shadow prices of regulation based on the observed regulatory constraints. Finally, I conduct two counterfactual experiments to calibrate the welfare effects of the regulation. My results suggest that regulating advertising quantity is unnecessary on a competitive market, given the two-sided market structure of the broadcast TV industry. However, if TV broadcasters collude on their advertising supply, the regulation can improve upto 5.75% of consumer surplus, but decrease until 4.8% of the industry's profit. In chapter 3, I use a theoretical model to analyze the competitive behavior of advertising financed media platforms. The platforms are specified to be horizontally differentiated and the market structure is an oligopoly. The first major insight of the model is that the different platforms behave as strategic complements under Cournot competition. In particular, if a platform increases its quantity of advertising, it is optimal for its competitors to raise their respective advertising quantities as well. The model suggests that the merger of advertising sales houses of several platforms increases the advertising offers of all the competing platforms of the market (both the merged and unmerged), holding the quality of platforms unchanged. I further test the theoretical prediction with TV market data and model used in the first chapter, the empirical counterfactual simulation conclude to the same result as the theoretical model.

Keywords

Two-sided market, advertising, externalities, empirical structural IO, competition, regulation.