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"Simulating media platform mergers"

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Simulating media platform mergers*

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Abstract

The empirical analysis of media platforms economics has often neglected the multi-homing behaviour of advertisers. Assuming away the cross-substitutability and/or complementarity between the advertising slots of different platforms could damage the quality and the robustness of counterfactual analysis. To evaluate the consequence of such an abstraction, we compare the simulation results of hypothetical platform mergers when the demand on the advertising side is derived from a Translog cost model which allows for multi-homing, and when it is approximated by using a simple log-linear inverse demand model that ignores the differentiation among media platforms' advertising slots. Ignoring the existence of substitutes or complements on the advertising side would result in overpredicting the losses of the viewers' surplus and in underpredicting the gains in platforms' revenues.

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

Keywords: Two-sided market, platform merger, advertising, TV market, competition policy

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1 Introduction

Recent studies on equilibrium models of advertising-financed media platforms based on the economics of two-sided markets have contributed to the understanding of the theory of harm raised by mergers in platform industries and the measurement of its effects. Simulating the outcomes of a change in platform ownership given the estimated preferences and costs relies crucially on the precise estimation of the demand patterns of viewers and advertisers.

This paper comments on a practical challenge in the simulation of media platform mergers that arises from the multi-homing behaviour of advertisers. Since the latter decides on how many advertising minutes to buy and often combine the advertising slots of several media platforms to reach the desired amount of audience, their choice of platforms is not discrete. Therefore, we cannot rely on a discrete choice model to estimate the substitutability or complementarity between advertising platforms. As a matter of fact, this issue has been neglected in the literature. Often the demand model of advertisers has been approximated a log-linear model that relates the logarithm of advert prices of a given platform to the logarithm of its own advert quantities and audience. While it is easy to implement, this approach assumes away the substitutability and/or complementarity between the advertising slots of different platforms. Not only such an abstraction is not realistic, but it certainly could deteriorate the quality and the robustness of predictions based on this model, like the outcomes of merger simulation.

Ivaldi and Zhang (2020, IZ2020 in what follows) proposes an alternative framework in which the advertisers' decision program consists in minimizing the total advertising costs to reach a given level of audience. This framework can be implemented by approximating the true cost function of advertisers by a Translog cost function, which allows to explicitly estimate the own- and cross- price elasticities of demand for different advertising platforms. The Translog cost function has two nice features: First, it does not impose any substitution patterns between advertising platforms, which is consistent with the multi-homing behaviour of advertisers. Second, it can be easily estimated even with a large number of competing platforms. Nevertheless, this approach complexifies the procedure to simulate a change of policy such as a platform merger as it requires to solve sequentially two systems of equations. Indeed, a media platform, which raises revenues from selling time slots for advertisements, faces a trade-off between the preferences of viewers and the objectives of advertisers: The advertisers wish to reach a large audience while the viewers could be negatively affected by the amount of advertising. Such a media platform must internalize the network externalities between the viewers and the advertisers in order to maximize its profit. This feature should be taken into account in the merger simulation procedure. It implies in practice to find the profit maximizing level of advertising prices as a function of the corresponding demand for advertising. A simplified model for advertisers' demand ignoring the cross-elasticities of demand on the advertising side allows one to derive directly a closed form solution for a channel's advertising price as a function of its amount of advertisement. However, a more comprehensive model such as the proposed Translog cost function requires to solve a non-linear system of equations in order to obtain the demand for advertising slots of one channel as a function of the advertising prices of all channels of the market.[1]

In this paper, we assess the relevance of such a complex simulation model. Using the same data as in IZ2020, we simulate the outcomes of two hypothetical platform mergers (between two substitutable advertising sales houses (ASHs) and between two complementary ones), when we approximates the demand on the advertising side, first by using the the Translog model proposed in IZ2020, and then by using a simple log-linear inverse demand model. Our results, comparing the simulated merger effects using the two alternative demand models for advertisers, suggest that

[1] The procedure to simulate a platform merger is detailed in IZ2020.

one always over-predict the increase in total amount of advertising (accordingly, under-predict the increase in average advertising prices) when one neglects the substitutability or complementarity between the merging ASHs. In other words, ignoring the existence of substitutes or complements on the advertising side during the simulation of a platform merger would result in over-predicting the loss of the viewers' surplus and in under-predicting the gain in platforms' revenues. The magnitude of such discrepancies in the simulated merger effects is more important when it concerns a merger between two substitutable ASHs.

2 Data

We use data on the French digital TV market to perform the merger simulations. Our sample is the same as the one that has been used in IZ2020. The reader is referred to that paper for more details on the construction of dataset.

Different to IZ2020 in which we perform merger evaluation using post-merger data between 2011 and 2013, herein, we use data between 2008 and 2010 to simulate the outcome of two hypothetical mergers. Our goal is to highlight the consequence of ignoring the advertisers' cross-elasticities of demand when simulating the potential impacts of a merger, and comment on how the results differ depending on whether the merging platforms are complements or substitutes for the advertisers. We observe a significant change in broadcasting quality of some TV channels after 2010, which could interfere with the simulated merger effects. Therefore, we prefer to restrict our simulation sample to data before Jan. 2010.

3 Demand primitives and merger simulation

On the audience side, we use directly the model of preferences of TV viewers estimated in IZ2020. The viewers' demand is approximated by a nested-logit model, which classifies the choices of the TV viewers into g groups of TV channels and an additional group for the outside goods. The TV viewers' demand function to be estimated is given by $\ln s_{jt} - \ln s_{0t} = \alpha A_{jt} + \sigma \ln s_{jt/g} + X_{jt}\beta + \xi_{jt}$, where s_{jt} denotes the market share of channel j on audience side, $s_{jt/g}$ denotes the market share of channel j within its group and s_{0t} denotes the market shares of the outside goods. X_{jt} is a matrix of variables including observed content characteristics, channel-fixed effects, as well as month- and year-fixed effects. A_{jt} refers to the amount of advertising on channel j during period t. The estimate of parameter α, which measures the utility of advertising for viewers, is negative, suggesting that the advertisers generate negative cross-side externalities for viewers.

On the advertising side, we keep the choice model of advertisers based on the estimation of a Translog cost function presented in IZ2020. The cost share equations to be estimated is $S^A_{jt} = \gamma_j + \sum_i^J \gamma_{ij}(\ln p_{it}) + \theta_j(\ln Y_t) + \xi^A_{jt}$, where S^A_{jt} denotes the advertising cost share of channel j in period t, p_{jt} denotes the per minute advertising price and $Y_t = \sum_j^J y_{jt}$ is the total number of TV viewers with y_{jt} refering to audience of channel j. The parameter γ_{ij} measures the Allen partial elasticities of substitution between different input factors (i.e, the advertising slots of different channels).

For comparaison, we also estimate a simplified demand model for advertisers. We will refer to this later model as the inverse demand function in what follows. It ignores the cross-elasticities of demand of advertisers as it tries to explain the advertising price of a media platform j by its own amount of advertising and its own viewership, controlling for some exogeneous variables. It is specified as $\ln p_{jt} = \gamma \ln A_{jt} + \theta \ln y_{jt} + X^A_{jt}B^A + \xi^A_{jt}$, where the vector X^A_{jt} includes channel-, month- and year- fixed effects.[2]

We estimate this inverse demand function model using the two-stage least squares estimator, since both the logarithm of advert quantities $\ln A_{jt}$ and the logarithm of audience $\ln y_{jt}$ could be endogenous. Indeed, the error term ξ^A_{jt} is likely to include unobserved programming quality which might be correlated with both $\ln A_{jt}$ and $\ln y_{jt}$.

We use the total broadcasting hours of news and entertainment of competing channels to instrument the variables $\ln A_{jt}$ and $\ln y_{jt}$. The validity of this set of instruments relies on a timing assumption: Neither ASHs nor advertisers observe the error term ξ^A_{jt} until TV channels have selected the broadcasting content (news and entertainment); the selection of content does not depend on the unobserved characteristics included in ξ^A_{jt}. This assumption is met in the French digital TV market. First, a TV channel obtains the broadcasting right of a content via contract with its producer, many content producers require the TV stations to pre-purchase and to commit on the broadcasting of its content already at the production stage, via a co-financing system. Second, national broadcast TV stations in France have the duty and some obligations to ensure the diversity of content that they offer; these channels need to agree with the sector regulator CSA on the amounts and schedules of news and entertainment content that they plan to offer at the beginning of every year.[3]

The estimated value of parameter $\hat{\gamma}$ is equal to -0.392 and the one of parameter $\hat{\theta}$ is equal to 0.909. Both are significantly different from zero at the 5% level. These estimates are used to perform the merger simulations below. Note that the inverse demand function allow us to derive an analytical expression of advertising price p_{jt} as a function of the amount of advertsing A_{jt} and that of audience y_{jt}, namely, $p_{jt} = (A_{jt})^{\gamma}(y_{jt})^{\theta} exp(X^A_{jt}B^A + \xi^A_{jt})$.

The merger simulations are performed using the first order condition (FOC) associated with the profit maximization program of advertising sales house (ASH) of channel j. At equilibrium, the amount of advertising is the variable which links both sides of the market: It has an impact both on the number of viewers and the advertising prices of the TV channels. An ASH internalizes the network externalities between viewers and advertisers by choosing the amount of advertising A_{jt} which maximizes its profits. Formally, the objective of an ASH $\mathscr{H}$ at equilibrium can be written as: $\max_{\{A_{jt}\}_{j\in\mathscr{H}}} \sum_{j\in\mathscr{H}} \Big[p_{jt}\Big(\mathbf{A}_t, Y_t\big(y_{1t}(\mathbf{A}_t), ..., y_{Jt}(\mathbf{A}_t)\big)\Big) - c_{jt}\Big] A_{jt}$. The FOCs associated with this profit maximization problem are: $(p_{jt} - c_{jt}) + \sum_{k\in\mathscr{H}} A_{kt}(\frac{\partial p_{kt}}{\partial A_{jt}} + \frac{\partial p_{kt}}{\partial y_{jt}} \sum_{i,\forall i} \frac{\partial y_{it}}{\partial A_{jt}}) = 0$ (1), where c_{jt} denotes the estimated marginal cost of selling one minute of advertising, $\mathscr{H}$ is the advertising sales house of channel k.

A merger between channel j and channel k implies a change in the term $\sum_{k\in\mathscr{H}} A_{kt}(\frac{\partial p_{kt}}{\partial A_{jt}} + \frac{\partial p_{kt}}{\partial y_{jt}} \sum_{i,\forall i} \frac{\partial y_{it}}{\partial A_{jt}})$: The ASH of channel j internalizes the impact of the channel j's advertising level on the sales of advertising slots of channel k, after merging with the ASH of channel k. The simulation procedure consists of finding the vector $\mathbf{A}_t = \{A_{1t}, ..., A_{Jt}\}$ which solves the new equilibrium described by the FOC (1).

[2]This model has been used in Rysman (2004) and Fan (2013) to evaluate the impact of platform entry and of merger.

[3]See for instance, the annual contract between different TV broadcasters and the CSA: https://www.csa.fr/Reguler/Espace-juridique/Les-relations-du-CSA-avec-les-editeurs/Convention-des-editeurs/Les-chaines-de-television-privees-hertziennes.

Simulation with inverse demand function on the advertising side

A logit type demand model for TV viewers allows one to derive an analytical expression of audience y_{jt} as a function of the vector of advertising levels of different TV channels, namely, $y_{jt} \equiv \mathscr{F}(\mathbf{A}_t)$. Substituting it in the inverse demand function for advertisers, one obtains the following relationship between channel j's advertising price p_{jt} and the advertising levels of different TV channels $\mathbf{A}_t = \{A_{1t}, ..., A_{Jt}\}$: $p_{jt} \equiv \mathscr{G}(A_{jt}, y_{jt}(\mathbf{A}_t))$ (2). One can next substitute this equation (2) into the FOC (1) and find the vector $\mathbf{A}_t = \{A_{1t}, ..., A_{Jt}\}$ which solves the new equilibrium. The simulation procedure implied by this model is straightforward but it assumes away the direct effect of the advertising price of another channel $k \neq j$ on the demand for advertising slot of channel j.

Simulation with Translog cost function on the advertising side

Alternatively, the Translog cost function proposed in IZ2020 implies a more complex relationship between the advertising price of channel j, P_{jt}, and the advertising levels of different TV channels, $\mathbf{A}_t$: $\frac{p_{jt}A_{jt}}{\sum_j p_{jt}A_{jt}} = \gamma_j + \sum_i^J \gamma_{ij} \ln p_{it} + \theta_j(\ln Y_t)$ (3), where $Y_t = \sum_j^J y_{jt}$. This model takes into account the direct effect of the advertising price of channel $k \neq j$ on the demand for advertising slot of channel j, as the advertisers can substitute or complement an advertising slot of channel j by the advertising slot of another channel k. The equilibrium advertising levels of different channels $\mathbf{A}_t$ can be found via a fixed point iteration: $\mathbf{A}_t = \mathscr{N}(\mathbf{p}_t(\mathbf{A}_t), Y_t(\mathbf{A}_t))$, where $\mathbf{p}_t = \{p_{1t}, ..., p_{Jt}\}$.

In practice, finding a vector $\mathbf{A}_t$ which solves the FOC of the profit maximizing problem of an ASH, and satisfies the demand function of advertisers given by their Translog cost function, requires to solve sequentially the two systems of equations given by (1) and (3). This gives one more step of complexification compares to the case where the demand of advertising is modelled according to an inverse demand function.

We compare now the merger simulation outcomes given by the two alternative models of advertisers demand to assess the relevance of a more complex simulation procedure considering explicitly the cross-elasticities of demand of advertisers.

4 Results

We simulate separately the effects of a merger between two substitutable advertising sales houses (ASHs) and between two complementary ones. The simulated merger effects are presented in Table 1 and Table 2.

Table 1 shows the simulated impact of mergers on the equilibrium level of advertising quantities and prices. We first note that the merger between two (either complementary or substitutable) ASHs increases the market equilibrium amount of advertising, which is due to the substitutional effects on the viewers' side. Indeed, the fact that advertisers generate negative cross-side externalities to viewers implies that a merged ASH has incentivize to increase its advertising level, as it internalizes the negative externalities of advertising. The other ASHs increase their amount of advertising as well as a stratergic response to the choice of the merged ones.

Now, without accounting for the advertisers' cross-elasticities of demand (i.e., using the inverse demand function), we predict a decrease in the advertising prices of the merging ASHs, even for the case in which the two merged ASHs are substitutes for advertisers. In fact, the log-linear inverse demand function implies that the advertising prices of a channel j, p_{jt}, decreases in response to the increase in its amount of advertising A_{jt}. However, this result is counterintuitive and contradictory with the basis theory of harm of merger analysis.

Table 1: Simulated merger effects on advertising quantities and prices

	% changes in advert quantity		% changes in advert price	
	of merging ASHs	of non-merging ASHs	of merging ASHs	of non-merging ASHs
Merging Two Substitutable ASHs				
Translog cost function	1.14	5.08	40.06	21.99
Inverse demand function	17.31	9.00	−13.99	0.32
Merging Two Complementary ASHs				
Translog cost function	1.92	2.00	−0.42	1.46
Inverse demand function	5.40	1.21	−1.69	0.39

Table 2: Simulated welfare effects of merger

	% changes in viewers surplus	% changes in total advert cost	% changes in total profit of ASHs
Merging Two Substitutable ASHs			
Translog cost function	−0.13	30.65	67.02
Inverse demand function	−3.13	2.85	−21.64
Merging Two Complementary ASHs			
Translog cost function	−0.11	0.70	1.21
Inverse demand function	−0.25	0.41	−1.16

We obtain more intuitive results with the Translog cost specification which considers explicitly the advertisers' cross-elasticities of demand. A merged ASH internalizes not only the substitutional effects on the viewers side but also the substitutional and/or complementary effect on the advertisers' side. Merging two ASHs, which are substitutable for advertisers, intuitively increases the advertising prices, as the merged entity internalizes the pricing externalities. Merging two ASHs, which are complementary for advertisers, has much less significant impact at equilibrium. This is because the complementarity between the merging firms eliminate their pricing externalities. If the merged ASH increases the advertising price of one of its channel j, the marginal advertisers would not switch to another channel under its management which is complementary to channel j, but to the other channels that are substitutes for these channels. The prices for the complementary advertising slots are lower under joint ownership rather than independent ownership.

Accordingly, while ignoring the advertisers' cross-elasticities of demand in the merger simulation, we over-predict the increase in the market equilibrium level of advertising quantities. For the case in which the merged ASHs are substitutes for advertisers, we furthermore miss-predict the impact of merger on the advertising prices without considering the cross-substitutional effects on the advertising side. Hence, using a simplified model which ignores the substitutability or the complementarity of media platform for advertisers when one simulates the effect of mergers between two ASHs is inappropriate, as such a simplified model assumes away an important feature of the two-sided market, namely, the platform internalizes the cross-externalities between the two groups of consumers (viewers and advertisers). Knowing that too much advertising reduces a media platform's audience (because advertisers generate negative externalities to viewers), which will in turn decrease the willingness to pay of advertisers (as viewers generate positive externalities to advertisers), a platform merger should not increase signficiantly the market equilibirum amount of advertising. Especially, for the case in which the merged platforms are substitutes for advertisers, the merged firm has even more incentive to not loss audience with more advertising, since it could charge higher prices to the advertisers. Overall, when it comes to the magnitude of discrepancy between the predicted merger effects using the two alternative models for advertisers' demand, we note that, ignoring the advertisers' cross-elasticities of demand is more problematic when the simulated merger concerns two substitutable ASHs for advertisers than when it deals with two complementary ones.

Table 2 shows the simulated welfare impacts of the mergers. While ignoring the cross-elasticities of demand of advertisers, we over-predict the loss of viewers' surplus due to the over-predicted increase in advertising quantities. In regard to the total advertising costs, we under-predict the loss of advertisers due to the under-predicted increase in advertising prices. Ignoring the advertisers' cross-elasticities of demand impact the magnitude of change in the profits of ASHs as well. Indeed, we would conclude that the total profit of ASHs is lower in a more concentrated advertising market (following a merger between two ASHs). We obtain more intuitive results once taken into account the advertisers' cross-elasticities of demand in the merger simulation, in which case we exhibit an increase in the total profit of ASHs.

5 Conclusion

In this paper, we highlight the consequences of ignoring the existence of substitutes or complementes in one side of the market when evaluating the platform mergers. More specifically, we assess the relevance of taking into account the advertisers' cross-elasticities of demand in the simulation of merger between ASHs. We compare the simulation results using two alternative models of demand of advertisers. We show that ignoring substitutability or complementarity between different ASHs results in over-predicting the loss in the viewers' surplus, and in under-predicting the gains in the total profits of ASHs. The magnitude of discrepancies is more important when simulating a merger between two substitutable ASHs. We believe our results are useful for policy makers seeking to regulate the concentration of platform markets.

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