Complement or substitute? The Internet as an Advertising Channel, Evidence on Advertisers on the Italian Market, 2005-2009[1]

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Abstract

During the last decade the internet has been the fastest growing segment in advertising. Exploiting Nielsen data, we analyze the advertising pattern displayed by the population of organizations (i.e. companies, non-profit institutions and public entities) that were active on the Italian national market during the period 2005-2009. Some reduced form evidence shows that – during this time period – smaller firms increased their ads investment on newspapers, magazines and cinema comparatively more than larger firms. Radio and the internet display

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an opposite pattern, whereas are larger firms increasing their expenses more than smaller firms. In the lack of firm-specific output data, we also estimate a homothetic advertising cost function for different subsets of the sample. We find that media segments are (loose) substitutes, in that the estimated cross price elasticities are positive but decidedly less than one.

JEL Classification:

L2; L82; L86

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Advertising, Internet, Media Substitution

1. Introduction

The last decade has witnessed the exponential growth of the internet as a revolutionary communication platform. From an economic perspective, the internet is another instance of a two-sided (multi-sided?) market, whereas final consumers demand informative and entertainment content, and advertisers are willing to pay for the attention of the former. In fact, the growth in the number of internet connections has been followed by a comparatively rapid increase in the amount of advertising on the internet.

Notwithstanding its relevance, to our knowledge there is little or no systematic evidence on the specific determinants and mechanics of this unprecedented growth. From this point of view, there are several questions one would like to answer, by looking at the data. First, is the growth in internet advertising due to large firms or to a large number of medium and small size firms? And, coming to individual firms, are internet ads simply replacing ads on different media channels – possibly from declining channels like newspapers and magazines – or do they originate from an increase in the overall advertising budget? One would also like to check whether firms belonging to different sectors display a differential propensity to advertise on the internet, and/or to increase it during the most recent years.

In order to tackle these issues, we focus on Italy and study the entire population of national level advertisers during the 2005-2009 period. This data was provided by Nielsen Media Italia. Our set of advertisers includes for-profit companies, non-profit institutions and public entities. For each of these organizations we know the yearly amount of advertisement being purchased on the following media channels: television, radio, newspapers, magazines, cinema, direct mail, out of home, and of course the internet. We also combine this data with yearly information on the GRP price of each media channel, i.e. the channel-specific price to reach a given segment of the population.

We start with some reduced form evidence on the relationship between the yearly change in ads expenses and the overall ads budget. First, firms systematically increase ads expenditure on each media channel as they spend more on total advertising. On the other hand, we find systematic

difference in the advertising behavior of firms as a function of their size, as approximately measured by the overall amount of ads expenses.

In the case of newspapers, magazines and cinema, the change in ads expenses is negatively correlated – at the firm level – with the dimension of the overall advertising budget. In other terms, smaller firms happen to increase their ads expenditure on those media channels comparatively more than larger firms.

An opposite pattern is displayed by radio and the internet, whereas larger firms increase their expenditure significantly more than smaller firms. Finally the change in ads expenditure on television is not significantly correlated with the size of the advertising budget. This is also the case for out of home expenditure.

From a methodological viewpoint, in order to estimate the degree of substitutability and complementarity among advertising segments we should estimate an advertising cost function. Under the assumption that firms use a two stage budgeting procedure, first deciding how much to allocate to advertising, and then – conditionally on this amount – choose how to distribute it across media channels, this is a sensible approach, which has been explored – among others – by Seldon et al. (2000) and Silk et al. (2001). However, differently from the previous literature, we must deal with the lack of firm-specific data on output and overall revenue. In fact, as discussed by Mellander (1992), one can estimate a translog cost function in the lack of output data under the assumption that the cost function itself is homothetic.

This is clearly a restrictive hypothesis which is not consistent with our reduced-form finding that the yearly change in ads expenditure on various channels is significantly correlated with firm size, as proxied by total ads expenditure. However, although homotheticity is not a reasonable assumption when focusing on the entire range of firms in the population, it might be a (more) sensible assumption when dealing with narrower subsets of the population itself.

Our structural estimates show that media segments are (loose) substitutes one with respect to the other, as cross-price elasticities are positive, significantly different than zero and decidedly less than one. We find that cross-price elasticities with respect to the price of magazines ads are the

largest ones across the various segments. We also find that the cross price elasticities with respect to the price of television ads tend to increase with the average size of the sampled firms, consistently with the primary role of this ads segment for top advertisers. Finally the cross price elasticities with respect to the price of internet ads are the smallest ones across media segments, probably because the share of internet ads on total advertising expenditure is still quite small, at least on average.

2. Data

Summary statistics regarding our advertising data are displayed in Table 1. For each media channel, the firm-specific amount of ads is expressed in thousand of euros. The distribution of ads purchases is strongly skewed to the left, as shown by the large positive difference between the average and the median amount of ads. This is also the case for the total amount of ads. It is interesting to notice that television ads represent the largest expenditure in our sample. To give a comparative perspective on this, the average amount of TV ads is around four times larger than the average amount on the second largest media channel, i.e. magazines.

From the Nielsen data we exclude media intermediaries, i.e. those firms that purchase residual ads slots on the internet and sell them to firms. We do so, since we are not able to attribute those large amounts of ads to final purchasers.

3. Preliminary evidence

We first present some reduced-form evidence at the firm level on the correlates of the yearly change in the amount of ads on each media channel. The output of this preliminary exercise is shown in Table 2, whereas we

control for the total amount of ads being purchased by that firm in the previous year (i.e., on all media channels different from the one under consideration), and the yearly change in this residual amount of ads. To account for macroeconomic changes in the demand for ads on each media channel, we also include year fixed effects. Moreover, in order not to inflate the precision of our estimates in the presence of (possibly) serially correlated error term and explanatory variables, we present results with standard errors that are clustered at the firm level (Bertrand, Duflo and Mullainathan 2004). First, firms systematically increase their investment on each media channel as they spend more on total advertising. This is shown by the positive and strongly significant coefficient on the change in total advertising. On the other hand, we find systematic differences in the advertising behavior of firms as a function of their size, as proxied by the overall amount of ads expenses.

In the case of newspapers, magazines and cinema, the change in ads expenses is negatively correlated – at the firm level – with the dimension of the overall advertising budget. In other terms, smaller firms tend to increase their investment on those media channels more than larger firms.

An opposite pattern is displayed by radio and the internet, whereas are larger firms increasing their expenses more than smaller ones. Finally the change in ads expenditure on television is not significantly correlated with the size of the advertising budget. This is also the case for out of home expenditure.

In Table 3 we focus on ads expenditure at the (firm x sector x year) level, and we analyze the explanatory power of sectoral dummies and total ads expenditure as a proxy of firm size. Again, we separately investigate ads expenditure on each media channel. However, differently from the previous table, the dependent variable here is the share of ads expenditure by firm i on channel j during year t on the total amount of ads expenditure by that firm during that year. In the Nielsen data we have 24 macro sectors; in our regressions we take "food" as the excluded category.

First, we confirm the common wisdom, according to which the share of television ads is increasing with the overall advertising budget. This is also the case for radio, cinema and the internet, with smaller estimated coefficients. On the other hand, the share of ads expenditure on newspapers, magazines and out of home is negatively and significantly correlated with total ads budget.

Regarding the sectoral dummies and focusing on the internet, it is worthwhile to notice that firms in the distribution, finance, computer and telecoms sectors on average devote around 10 percent more of the advertising budget on this channel as compared to food firms. On the other side, firms in the clothing, alcohol and toiletries sectors have a significantly and slightly smaller share of ads being purchased on the internet, again using food as the reference sector.

4. An advertising cost function approach: theory

A non-negligible literature within the IO field borrows the empirical tools originally devoted to the estimation of production functions in order to analyse the advertising costs incurred by firms. Of course, those ads expenses are just another component of the costs firms incur to produce and sell their output. To the extent that the proper production part and the advertising part of the costs are additively separable, one can legitimately focus on the advertising part of it, and explore its properties (see Seldon et al. 2000). The *advertising cost function* $C(\boldsymbol{P};Q)$ denotes the minimum cost for advertising a firm has to incur to sell a quantity Q of output, when the vector of prices for the various media channels is $\boldsymbol{P}$.Again following the broader literature on production function, the standard specification for the advertising function is the translog one, whereas we impose additional constraints that are implied by the cost minimization problem.

Note that our dataset, although it covers a much larger set of firms (the entire population of advertisers on the Italian national market), does not include information on the overall sales of each firm. Thus we cannot directly estimate a fully-fledged translog model. To the extent that the advertising cost function is homothetic, we can concentrate on the cost share equations, as derived from the translog model:

$$S_{f,i,t} = \alpha_i + \sum_j \beta_{ij} (\ln P_{j,t}) + u_{f,I,t}$$

where Sf, i, t is the share of advertising spent by firm f on medium i at time t, Pj, t is the price of a message on medium i at time t, and u f, I, t is the error term[2]. This equation exactly corresponds to equation (2) in Seldon et al. under the assumption of homotheticity. From an econometric viewpoint, we must estimate a SUR (seemingly unrelated regression) system of equations, with the following linear constraints:

$$\sum_j \alpha_I = 1 \quad \text{and} \quad \sum_i \beta_{ij} = \sum_j \beta_{ij} = 0$$

Since cost shares sum to one, we estimate the share equations for n-1 media channels, and recover the parameter estimates for the n-th channel by exploiting the linear constraints laid out above. Moreover, since the regressors are the same in each share equation, we can directly estimate the model by OLS.

Homotheticity is of course an important restriction, whose statistical relevance must be assessed against the actual data. At a minimum, it would imply that a given change in the relative price of advertising on two media channels ought to have the same effect on ads shares irrespective of the quantity of output being sold by the firm. We do not have information on firm output, but it is not unreasonable to assume that – maybe conditionally on the sector where a firm is active – total output is positively related with total advertising expenses.

From this point of view, the reduced form evidence shown in Tables 2 and 3 is inconsistent with the advertising cost function being homothetic, at least if one focuses on the entire range of firms belonging to the population.

Moreover, a large number of firms in the sample – especially the small ones – display an erratic advertising behaviour. For example, they might invest on a given channel only for one year and then switch back to zero advertising. Typically, this is not a problem for empirical studies done at the sectorial level, or for firm-level studies that focus on large enough firms, such as the beer producers examined by Seldon et al. (2000)[3].

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[2] Thus, we depart here from Seldon et al. and follow Mellander (1993).

[3] See Moss (2000) for a discussion of different methods to deal with zero inputs in the case of a Cobb Douglas agricultural production function.

The homotheticity argument suggests us to apply the cost function approach separately to different subsets of the population. Conversely, the zero input argument implies that we should mainly focus – at least in this preliminary stage of the analysis – on the larger firms in the sample.

5. Results

We focus on own-price and cross-price elasticities of the derived demand for inputs. The starting point is the Allen partial elasticities of substitution, which can be written as:

$$\sigma_{ii}^{A} = \frac{(\beta_{ii} + S_i^2 - S_i)}{S_i^2}$$

for the own-Allen and

$$\sigma_{ij}^{A} = \frac{(\beta_{ii} + S_i S_j)}{S_i S_j} \quad \text{if} \quad i \neq j$$

for the cross-Allen elasticity. The own-price and cross-price elasticities are then computed as follows:

$$\epsilon_{ij} = S_j \sigma_{ij}$$

The estimated price elasticities are displayed in Table 4, for various subsets of firms. Since we have ads price data (GRP: gross rating point) only for five media channels, i.e. television, radio, newspapers, magazines and the internet, we restrict our analysis to those channels. In the estimation we exclude the radio share equation, whose parameters are then computed on the basis of the parameter restrictions.

The table is divided in four panels: In Panel A) we focus on firms whose average total spending on advertising on those five media channels is above the

median. In Panel B) we restrict our attention to the tenth decile in the distribution of mean ads expenditure, while in Panel C) we only consider firms that on average spent more than one million euros in advertising on those channels. Finally, in Panel D) we display results for an even more restricted sample, i.e. those firms that in each year on each media channel always spent non-negative amounts.

Each table is organized as follows: in row i and column j we report the price elasticity of ads purchases on channel i with respect the GRP price on channel j. Below each elasticity we report the estimated standard error, which is computed according to Anderson and Thursby (1986).

We start from own price elasticities. Across the panels there are interesting patterns to observe. First the own price elasticity for television is close to one in Panel A) and drops considerably when moving to smaller samples of larger firms, i.e. to Panels B), C) and D). In the last panel this elasticity is close to one third. On the other hand, the elasticity for radio and internet is close to one across all 4 panels, even though it slightly drops for radio in Panel D). Finally, the elasticity for newspapers and magazines is decidedly smaller than one and pretty stable across panels, with the exception of magazines in Panel D), where the elasticity is close to one.

Regarding cross-price elasticities, it must be noticed that the elasticities with respect to the GRP price on a given media channel are pretty similar across affected media channels. This is clearly due to the fact that -in the computation of these elasticities- the common share factor has an overwhelming influence on the computed elasticity, given small values of the estimated Allen elasticity of substitution.

Generally speaking, the media channels we focus on are (loose) substitutes one for the other, as witnessed by the positive (and relatively small) values of all cross-price elasticities in the four panels. Within this common thread, there are remarkable patterns to observe: the elasticities with respect to the price of television ads is between 0.04 and 0.03 in Panel A), while it is more than tenfold in Panels C) and D) (around 0.5 and 0.6 respectively). The elasticities with respect to the price of radio ads are comparable to the television ones in the first two panels, while they increase in the latter two panels, but at a much slower pace: in panel D) these elasticity is close to 0.1.

The elasticities with respect to the price of newspaper ads are very stable across panels, since they are around 0.15, with a small spike of 0.2 in

Panel B). The elasticities with respect to the price of magazine ads are the largest in Panel A) and Panel B) – around 0.3 and 0.4 respectively – while they drop to 0.2 and 0.06 in the last two panels.

Finally, the elasticities vis a vis the price of internet ads are very small (between 0.025 and 0.045) and stable across the four panels. In this paper we have presented some reduced form and structural evidence on the firm-level advertising behavior of a large sample of organizations that are active on the Italian market.

The reduced form evidence shows that – in the case of newspapers, magazines and cinema – the change in ads expenses is negatively and significantly correlated with the dimension of the overall advertising budget. An opposite pattern is displayed by radio and the internet, whereas larger firms increase their expenditure significantly more than smaller firms.

Since we lack firm-level data on total output and revenue, we then estimate a homothetic, translog advertising cost function. Since the homotheticity assumption is unlikely to be true for the entire range of firms in the population, we separately estimate those cost functions on narrower subsets of the population itself.

Our estimates show that media segments are (loose) substitutes one with respect to the other, as cross-price elasticities are positive, significantly different than zero and decidedly less than one. We find that cross-price elasticities with respect to the price of magazines ads are the largest ones across the various segments. Consistently with its crucial role for top advertisers, we find evidence that the cross price elasticities with respect to the price of television ads tend to increase with the average size of the sampled firms. Finally the cross price elasticities with respect to the price of internet ads are the smallest ones across media segments.

Starting from these results, there are interesting research pathways to explore in the future. First, we plan to analyze in greater depth the differences among sectors in the degree of substitutability of different media channels. Taking an orthogonal route, we also plan to look a sector-specific aggregates of ads expenditure on the various media segments, and match them with sectorial- level output data. This would allow us – at least at a more aggregate level- to dispense with the homotheticity assumption we have adopted here.

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