Estimating Demand with Multi-Homing in Two-Sided Markets*

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Abstract

We investigate empirically the impact of multi-homing in two-sided markets. We first build a micro-founded structural econometric model, which encompasses demand for differentiated products and allows for multi-homing on both sides of the market. We then use an original dataset on the Italian daily newspaper market that includes information on double-readership of newspapers to estimate demand. We estimate the model above and compare the estimation results obtained in the presence of information on multi-homing to those obtained in its absence. Finally, we discuss to what extent disregarding multi-homing information may bias policy decisions.

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1 Introduction

Two-sided markets are markets in which firms sell two products or services to two different types of consumers taking into account that the two demands are linked by indirect network effects. Examples of such markets are the newspaper market, where the demand for advertising is related to the number of readers, and the market for online social networks, where advertising demand depends on the number of users.

A media firm typically operates in a two-sided market as it sells content to readers/viewers and advertising space to advertisers. Moreover, it knows that the number (and possibly the characteristics) of the audience influence the demand for advertising space while vice versa the amount (or concentration) of advertising might influence the audience's demand. In other words, a media company recognizes the existence of indirect network effects between the two sides of the market when taking its strategic decisions. Newspaper publishers are just one of the first and most typical examples of two-sided markets.

With the emergence of digital technologies, multi-homing has become a widespread phenomenon in media markets. In fact, the cost of multi-homing for consumers of media content has dramatically dropped. For instance, readers of newspapers can now access multiple online news outlets with just a few more clicks, without the need to buy and carry a bunch of different newspapers and physically leafing through them. Similarly, TV viewers have now access to many more digital channels. And so on and so forth. As a result, consumers effectively multi-home more.

Hence, advertisers are now able to reach consumers on a greater number of outlets during their preferred time period (whether a day, a week or a month). This has implications for the willingness to pay of advertisers for reaching consumers. For instance, considering the extreme case in which an advertiser wishes to reach its target consumers only once, the value of second impressions would be zero. A merger between newspapers read by two distinct set of readers (i.e. whose readers single-home) could thus have very different effects on prices charged to advertisers than a merger among newspapers that have perfectly overlapping readers (i.e. whose readers multi-home). In turn, due to two-sidedness, also cover prices may be affected.

Allowing for multi-homing is therefore crucial to devise the best policy decisions, whether in assessing mergers among media outlets, in regulating cross-ownership of media or in setting advertising limits.

We study the role of multi-homing in the newspaper market. We first build a micro-founded structural econometric model, which encompasses the demand for differentiated products on both sides of the market and allows for multi-homing on each side of the market. We then estimate the model above alternatively taking into account and not taking into account information on multi-homing by readers. We show that not accounting for multi-homing leads to a substantial bias in the estimation of own- and cross-price elasticities on the readers' side of the market. We also show that, on the advertising side of the market, own price elasticities depend also on the amount of captive readers while cross-price elasticities depend on the amount of overlapping readers. Hence, disregarding multi-homing is likely to bias the conclusions of exercises such as market definition or merger evaluation, in which own- and cross-price elasticities play a crucial role.

We finally discuss to what extent disregarding multi-homing information may bias policy decisions, particularly in the field of competition policy. In particular, we look at the Italian market for national daily newspapers and run counterfactual policy simulations (such as testing the traditional market definition distinguishing generalist, financial and sport newspapers) that are potentially affected by the use of information on multi-homing. [TO BE COMPLETED]

Our paper contributes to the economic literature on two-sided markets, in which empirical work accounting for multi-homing is still quite scarce (see next section for a discussion). Moreover, our contribution allows a better understanding of the implications of multi-homing and can therefore be useful to competition and regulation authorities to improve their quantitative assessment in cases involving two-sided platforms.

The paper proceeds as follows. Section 2 discusses the literature on multi-homing in two-sided markets. Section 3 provides an overview of the market for daily newspapers in Italy and the data we use. Section 4 presents a two-sided model of demand, while we discuss estimation results in section 5. Section 6 highlights the importance of accounting for multi-homing when drawing conclusions from the estimates. Section 7 concludes.

2 Multi-Homing in Two-Sided Markets

Following the seminal works by Caillaud and Jullien (2001, 2003), Rochet and Tirole (2002, 2003, 2006), Parker and van Alstyne (2005) and Armstrong (2006), a growing number of papers have dealt with the theoretical aspects of two-sided markets, such as for example Anderson and Gabszewicz (2006) on media markets. Some of them, such as Evans (2003), Wright (2004), Evans and Schmalensee (2007), Filistrucchi, Klein, and Michielsen (2012) and Filistrucchi, Geradin, Van Damme, and Affeldt (2014) have focused on competition policy in two-sided markets.

So far most of the theoretical literature on two-sided markets has assumed single-homing on at least one side of the market, most often on the readers'/viewers' side in media markets. In this context, the competitive bottleneck problem of Armstrong (2006) arises, whereby each media outlet is a monopolist over its exclusive audience and advertisers therefore have to patronize all of them in order to reach all consumers. Only recently, as discussed in Anderson and Jullien (2015), the theoretical literature has started filling this gap, e.g. Ambrus, Calvano, and Reisinger (2016), Anderson, Foros, and Kind (2018) and Athey, Calvano, and Gans (2016). The fact that a fraction of consumers patronizes more than one platform changes the model predictions quite dramatically. In particular, it turns out that "each platform is able to price to advertisers only the value of its exclusive consumers plus the incremental value associated with multi-homing (shared) consumers" (Anderson, Foros, and Kind (2018), p.35). This so-called 'principle of incremental pricing' has important implications for platforms' strategies in terms of pricing, reaction to mergers and content provision.

Empirical work has however lagged behind in accounting for multi-homing. Starting from the seminal papers of Rysman (2004) on the market for yellow pages and of Kaiser and Wright (2006) on the German magazine market, most empirical contributions have assumed single-homing, at least on one side and particularly on the audience side of the market. While Rysman (2007) has shown that multi-homing in adoption, but not in usage, is an important feature of the payment card market, only Fan (2013) moved a step forward by allowing each household to buy up to two newspapers in the econometric model. Yet, Fan (2013) has no information on double-readership of newspapers at the household level, and cannot therefore estimate a model with multi-homing readers. We do have this information at the individual newspaper level and use it to analyse the impact of allowing for multi-homing readers on the empirical results. Gentzkow (2007) develops a methodology that allows for the consumption of two products in order to study competition between print and online newspapers. The same demand model is also applied by Gentzkow, Shapiro, and Sinkinson (2014), which show that advertising competition leads to increased ideological diversity. Unlike Gentzkow (2007), which has individual-level data on readership for a small set of newspapers, we have aggregate data for a larger set of newspapers. We therefore build a nested logit demand model that encompasses readers multi-homing by allowing readers to choose between bundles of newspapers. Also Shi (2015) accounts for readers' multi-homing in the estimation of demand for U.S. magazines, and finds that advertising prices are related to the share of exclusive versus overlapping readers. However, he has data on readers' multi-homing just for one period, while we have much richer survey data including bi-annual information over the years 1992-2006. Finally, a recent paper by Liu (2018) estimates the effect of consumer multi-homing on prices in the online advertising market.

This paper builds on Argentesi and Filistrucchi (2007), where the authors test for market power in the national daily newspaper market in Italy. That paper however, lacking information on multi-homing, assumed that readers do not multi-home, i.e. that they read only one newspaper. Both the structural econometric model and the estimation were conducted under this assumption. Moreover, the analysis was conducted on a smaller sample of newspapers (i.e. only the national generalist newspapers) and on a shorter time period of data. Finally, the dataset on the advertising side of the market was much less detailed than the one we use in this paper.

Also Filistrucchi, Klein, and Michielsen (2012) and Affeldt, Filistrucchi, and Klein (2013), while using data on the Dutch daily newspaper market to simulate the unilateral effects of mergers, do not allow for multi-homing; similarly for Filistrucchi and Klein (2013). More recently, Ivaldi and Muller-Vibes (2018) estimate a two-sided nested logit model of demand for the printed media industry in France but do not have information on readers' multi-homing behaviour.

3 Data

The dataset contains information on seven national daily Italian newspapers, belonging to three different categories: general interest, financial and sport newspapers.[1] The four general interest newspapers are *Corriere della Sera*, *La Repubblica*, *La Stampa* and *Il Giornale*. The two sports newspapers are *Corriere dello Sport* and *Gazzetta dello Sport*. The financial newspaper is *Il Sole 24 ore*. In December 2006, these seven newspapers accounted for more than 40% of overall circulation of daily newspapers in Italy. In particular, in the sub-market of general interest newspapers, *Corriere della Sera* and *La Repubblica* were, and still are, the largest players in terms of circulation. Other newspapers are not included in our dataset because their circulation is mainly regional (e.g. *Il Messaggero* or *QN*) or much smaller than those in our sample (e.g. *Avvenire*). As for sport newspapers, *Gazzetta dello Sport* and *Corriere dello Sport* are the largest outlets, with more than 80% of copies in this segment. Finally, *Il Sole 24 ore* is by

[1] This segmentation of the newspaper market has been adopted in several antitrust decisions, both in Italy and in Europe. See for instance the Italian case 3354/95 *Ballarino vs. Grandi Quotidiani* or the European Commission's decisions M.3817 and M.1401.

far the main financial paper, holding more than 80% of the market in terms of sold copies.

For the readers' side, the dataset features monthly observations for each newspaper in each different day of the week from 1992 to 2006. Market-level data on circulation come from those collected for advertising purposes by Accertamenti Diffusione Stampa (ADS).[2] In particular, we use monthly average printed copies for each day of the week as a proxy for circulation, since information on the number of copies sold in each day of the week is not available in this dataset. It is indeed important to have information disaggregated by day of the week because some weekly supplements are bundled with the newspapers only on some days of the week and cover prices vary by day of the week. We collected information from newspaper publishers on the cover prices of the newspapers and on content characteristics such as the dates regular supplements were introduced, the changes of editors, the presence of local news sections and the dates of the opening of the newspapers' websites.

Information on multi-homing by readers (i.e. on how many readers of a given newspaper also read each of the other newspapers) was collected, for advertising purposes, by Audipress bi-annual surveys.[3] In particular, the survey asks readers which newspapers they read on an average day. Then for each newspaper it computes the number of readers that read only that newspaper as well as the number of readers that also read each of the other newspapers. However, we do not know whether readers of that newspaper, who also read another newspaper, overlap with readers double-homing on a third newspaper. We will hence speak about double-homing in the following as we cannot identify those readers who read more than two newspapers from the data.[4]

Table 1 shows, by newspaper, the percentage of single- and double-homing readers. Depending on the newspaper, on average between 25% and 62% of the readers single-home, i.e. only buy this particular newspaper. Whether readers single-home or double-home also seems to depend on the type of newspaper: while many readers single-home on a general interest newspaper, only 25% of the readers of the financial newspaper Il Sole single-home. The table also shows on which newspapers readers double-home. Thus, the second line shows that, on average, 14.9% and 14.8% of Corriere's readers also buy Gazzetta dello Sport and Repubblica respectively. The sixth line shows that 21% of Il Sole readers also read Corriere della Sera or La Repubblica respectively. Figure 1 represents the information on the percentage of readers single- and double-homing graphically. There is one column for each

[2]See http://www.adsnotizie.it/.

[3]See http://www.audipress.it/.

[4]Note that, to the extent that they do not carry out additional surveys themselves, this information comprises all that advertisers know about single-homing or multi-homing by readers.

newspaper. The dark-blue area at the bottom of each column represents the percentage of single-homing readers, while all coloured areas above it represent the percentage of multi-homing of readers of the given newspapers on each of the other newspapers.

Finally, information on the total population above 14 years of age (considered traditionally as the set of potential readers of newspapers) was obtained from ISTAT, the Italian Statistical Office. We used this to calculate newspapers' market shares

Table 1: Percentage of Readers Single- and Double-Homing by Newspaper

Newspaper	Single-Homing	DH Corriere	DH Corriere Sport	DH Gazzetta Sport	DH Giornale	DH Repubblica	DH Il Sole	DH Stampa
Corriere	45.8	.	4.4	14.9	5.8	14.8	10.2	4.1
Corriere Sport	41.5	7.8	.	29.5	3	10.8	4.5	3.1
Gazzetta Sport	50.1	13.1	14.7	.	3.5	8.7	5	4.9
Giornale	29	20.4	5.9	13.8	.	12	12	6.9
Repubblica	51.4	14.6	6.1	9.7	3.3	.	9.7	5.3
Il Sole	25	21.4	5.3	11.9	7.1	20.6	.	8.6
Stampa	61.6	6.9	2.9	9.5	3.3	8.9	6.9	.

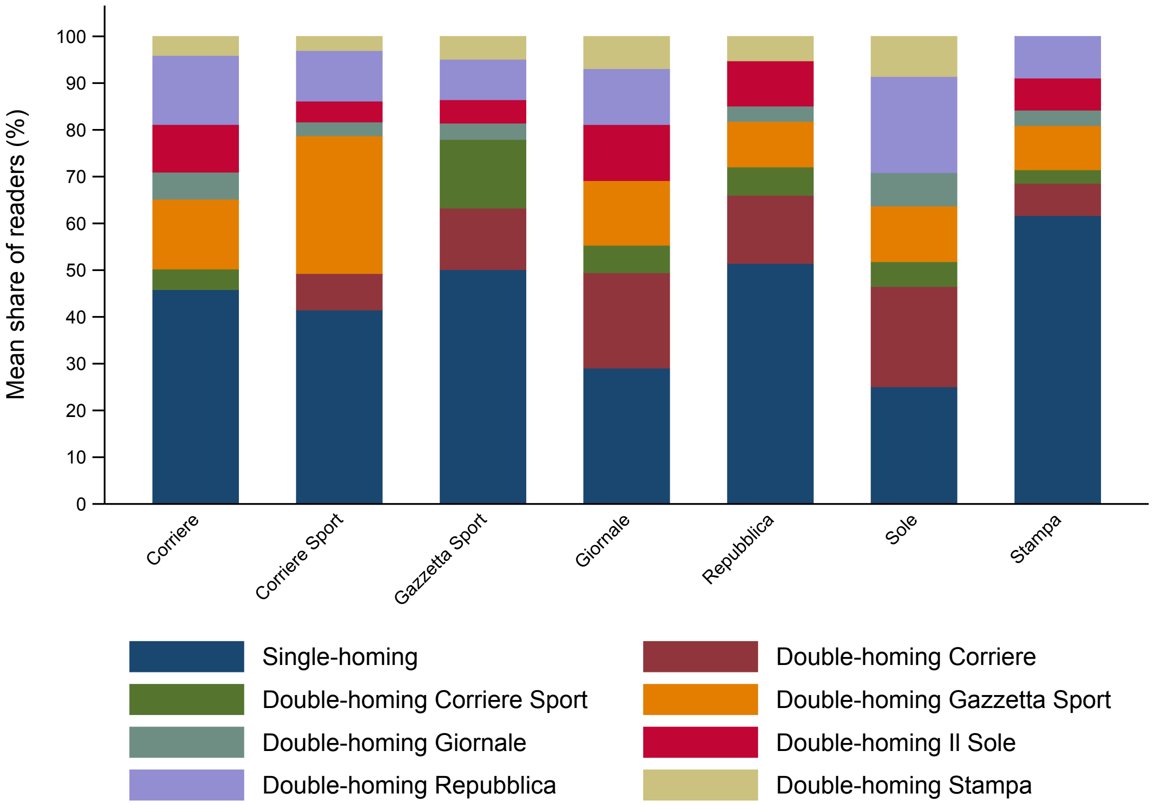
We report the mean percentage of readers single-homing and double-homing over the years 1992-2006.

On the advertisers' side of the market, the dataset contains market-level data on advertising quantity, prices and readers' characteristics of those same newspapers, with monthly observations for each different day of the week from 1992 to 2006. Data on advertising quantities and advertising prices net of estimated discounts come from the database of Nielsen Media Research, while data on readers' demographics come from those collected by Audipress. The latter data are collected bi-annually. However, to the extent that they do not carry out additional surveys themselves, advertisers for half a year can be expected to base their advertising decisions on this demographic information.

Information on the total number of (advertising and non-advertising) pages per newspaper also comes from Nielsen Media Research, while information on the size of a newspaper was collected browsing on the internet. In combination with information on the price of the paper used to print daily newspapers, collected from Camera di Commercio di Milano, this data allows us to calculate the paper input cost per page and per printed copy.

Table 2 presents summary statistics on the variables we use in the estimation of the readers side of the market. The average daily circulation of the newspapers included in the dataset is about 560,000

Figure 1: Single- and Double-Homing by Newspaper



We report the mean percentage of readers single-homing and double-homing over the years 1992-2006.

copies, while the mean real cover price over the sample period is about 0.96 Euros per copy.

Table 3 presents instead summary statistics for the variables we use in the estimation of the advertising side of the market. While the mean advertising expenditure share is 14%, the average real advertising price is about 180 Euros per advertising slot.

Importantly the variable "captive readers" measures the percentage of single-homing readers for each newspaper. This measure is crucial in order to properly account for multi-homing by readers: the more readers single-home, the higher is the market power of the newspaper on the advertising side of the market as newspapers enjoy monopoly power over providing access to these captive readers (see Armstrong (2006)).

The final datasets both on the reader side as well as on the advertising side of the market hence cover monthly observations for each different day of the week for the seven newspaper from January 1992 to December 2006. Appendix A.1 contains a list of all the variables used in our empirical analyses together with the corresponding data sources.

Table 2: Summary Statistics Reader Side (1992-2006)

	mean	sd	min	max
Average newspaper's prints (10k)	56.76	20.19	21.12	127.43
Market share	0.01	0.00	0.00	0.03
Real cover price (EUR/copy)	0.96	0.12	0.79	1.60
Number of pages	40.43	13.00	16.50	115.00
Number of advertising slots (k)	3.96	2.19	0.19	16.48
Advertising intensity (slots/pages)	95.12	36.59	7.23	249.87
Generalist magazine	0.56	0.50	0.00	1.00
Generalist magazine (day)	0.07	0.26	0.00	1.00
Women magazine	0.21	0.40	0.00	1.00
Women magazine (day)	0.03	0.17	0.00	1.00
Economic insert	0.29	0.45	0.00	1.00
Economic insert (day)	0.04	0.20	0.00	1.00
Local pages	5.45	5.64	0.00	22.00
Website	0.50	0.50	0.00	1.00
Real paper cost (EUR/copy)	0.11	0.04	0.04	0.32
Observations	8795			

Table 3: Summary Statistics Advertiser Side (1992-2006)

	mean	sd	min	max
Advertising expenditure share	0.14	0.10	0.00	0.51
Real advertising slot price (k EUR)	0.18	0.09	0.03	0.59
Percentage of readers between 14 and 17	4.76	2.88	0.84	12.87
Percentage of readers between 18 and 24	13.04	4.23	5.40	21.68
Percentage of readers between 25 and 34	21.52	3.22	15.90	30.40
Percentage of readers between 35 and 44	19.46	2.78	13.70	26.60
Percentage of readers between 45 and 54	17.36	2.59	11.78	23.40
Percentage of readers between 55 and 64	12.56	2.57	7.30	18.83
Percentage of readers above 65	11.30	4.91	3.20	23.60
Percentage of readers in low income group	12.71	7.26	2.90	32.20
Percentage of readers in middle income group	61.35	4.87	49.25	72.20
Percentage of readers in high income group	25.94	9.91	9.03	46.60
Percentage of female readers	31.66	12.26	9.00	46.50
Percentage of captive readers	43.49	12.80	9.49	66.50
Observations	8820			

4 A Model of Demand

The structural econometric model encompasses demand for differentiated products on both sides of the market and allows for multi-homing on each side of the market. We estimate both readers' demand and advertisers' demand taking into account the inter-market network effects that characterize two-sided markets.

On the readers' side of the market, demand derives from random utility maximization by readers and is estimated using a nested logit model, as in Berry (1994). The structure of the nests draws on the traditional classification of national daily newspapers between generalist, financial and sport ones. Hence, readers are assumed to read no newspaper, one generalist newspaper, one financial newspaper or one sport newspaper. On this side of the market, we have information on multi-homing. When taking into account this information, readers are allowed to choose between all possible couples of newspapers and nests are designed accordingly as combinations of newspapers of the same or of different categories.

On the advertisers' side of the market, demand derives from advertisers' choice to allocate a given advertising budget, that changes with the business cycle, across different newspapers. This is similar to consumers allocating a given budget among different types of beers in Hausman, Leonard, and Zona (1994). Product differentiation is interpreted in the spatial sense proposed by Pinkse, Slade, and Brett (2002), as applied parametrically in Slade (2004) and in Pinkse and Slade (2004). Hence, cross-price elasticities among two products (in our case advertising slots in two different newspapers) are assumed to be a function of the distance among the products in characteristic space, so that elasticities would be higher when products are closer to each other in terms of characteristics. In our case, the distance metrics are derived from differences among newspapers in the demographic characteristics of readers. In addition, own-price effects are allowed to depend on characteristics of the newspapers. While our model allows for multi-homing also by advertisers, we do not have, and hence do not use, data on multi-homing by advertisers. However, consistently with the theoretical models of two-sided markets, the information on multi-homing by readers can be used also in the estimation of advertising demand. In particular, we derive distance metrics from the amount of overlapping readers between two newspapers and the amount of captive readers is considered as an additional characteristic of the newspaper from the point of view of advertisers. Finally, in applying the distance metrics model to a two-sided market such as the newspaper market, we allow advertising demand on a newspaper to depend on circulation.

4.1 Readers' Demand

On the readers' side of the market, demand derives from random utility maximization by readers and is estimated using a nested logit [5] model as in Berry (1994). Hence, reader i at time t in weekday d chooses one unit of newspaper $j \in J$ to maximize utility

$$u_{ijtd} = \alpha p_{jtd} + \beta x_{jtd} + \gamma a_{jtd} + \xi_{jtd} + \zeta_{gtd} + (1-\sigma)\varepsilon_{ijtd}, \tag{1}$$

where p_{jtd} is the cover price of newspaper j at time t in weekday d, x_{jtd} is a set of observed newspaper characteristics, a_{jtd} is the advertising intensity in newspaper j at time t in weekday d, ξ_{jtd} is an unobserved (by the econometrician) product characteristic, ζ_{gtd} represents consumer utility common to all newspapers of nest g at time t in weekday d and ε_{ijtd} is an idiosyncratic error term assumed to be i.i.d. extreme value type 1. σ measures the correlation of utility between newspapers within nests relative to the between ones. As σ approaches one, newspapers within a nest approach being perfect substitutes, if σ is instead equal to zero, we are back to the simple logit case.

The structure of the nests draws on the traditional classification of national daily newspapers in generalist, financial and sport newspapers. As discussed in section 3, we have data on four general interest newspapers, two sport newspapers and one financial newspaper. The resulting baseline estimating equation of the nested logit model is the following:

$$\ln(s_{jtd}) - \ln(s_{0td}) = \alpha p_{jtd} + \beta x_{jtd} + \gamma a_{jtd} + \sigma \ln(s_{jtd|g}) + \phi_{jd} + \tau_{tg} + \nu_{jtd}, \tag{2}$$

where s_{jtd} is the market share of newspaper j at time t in weekday d, s_{0td} is the market share of the outside good, p_{jtd} is the newspaper's cover price, x_{jtd} is a set of observed newspaper characteristics, a_{jtd} is the advertising intensity in newspaper j and $s_{jtd|g}$ is the share of newspaper j within nest g. We split the unobserved product characteristic ξ_{jtd} into the newspaper-weekday fixed effect ϕ_{jd}, the time fixed effects τ_{tg} and the i.i.d. error term ν_{jtd}.

The newspaper-weekday fixed effects capture the unobserved product characteristics that are constant over time. The time fixed effects, specific to each nest, capture variations in time in the relative attractiveness of the outside good with respect to the different categories of newspapers in our sample (for instance because of the appearance of internet, which is here allowed to have differential effects on

[5] We also tried to estimate a random coefficient logit model. However, the random coefficients were not estimated to be significant.

sales of sport and generalist newspapers). The market shares are defined over the total potential market size, which is considered to be the total population in Italy older than 14 years, as is usual in studies on the media market.

The newspaper cover price, the advertising intensity as well as the within nest market share are all endogenous as they are correlated with the unobserved product characteristic ξ_{jtd}. Following Berry, Levinsohn, and Pakes (1995) and Nevo (2000), we use the sum of the characteristics of the other newspapers as instruments for the newspaper cover price . In particular, we use the dummy variables for the weekday when a supplement is bundled to the newspaper, when a women magazine is bundled to the newspaper as well as the number of local pages to construct the BLP instruments for newspaper cover price. The within nest market share is instrumented with the corresponding BLP instruments within a given nest. As described in section 3, we also constructed a marginal cost measure, the real paper cost per copy, that is varying over newspapers and time and is used as an instrument for cover price and advertising intensity. Lastly, we use Italian GDP to instrument advertising intensity, as GDP is a measure of the overall business cycle and advertising expenditures by companies increase with the business cycle, whereas, given the low price for a copy of a newspaper, income effects from the business cycle are not expected to be substantial and affect readers' demand directly.

We aim to investigate the bias that can take place in the estimation of demand parameters, price elasticities and indirect network effects in particular, when neglecting readers' multi-homing. In order to assess the relevance of this bias, we estimate two different specifications of readers' demand. The traditional demand equation (similar to Argentesi and Filistrucchi (2007)) assumes that readers only read one newspaper in each period. We also estimate a second, alternative, demand equation where readers are allowed to read up to two newspapers (which is what we observe in the data). We thus model readers as choosing between all possible couples of newspapers (including single-homing on a newspaper), and nests are accordingly designed at the bundle level. Consistently with the first equation, we hence distinguish six nests, comprising respectively: general interest newspapers bundles, sports newspaper bundles, financial newspaper bundles, general interest/sports bundles, general interest/financial bundles and sports/financial bundles.[6]

Estimating the nested logit discrete choice model at the bundle level relaxes the strong assumption

[6] We thus construct a second dataset based on the data on multi-homing behaviour of readers, in which the level of observation is no longer a newspaper but a bundle of up to two newspapers for a given weekday and month. Appendix A.2 contains a detailed description of how we construct the dataset at the bundle level based on the newspaper level data and on the survey information on multi-homing by readers.

of all newspapers being substitutes. While a discrete choice model at the bundle level of course still assumes that newspaper bundles are substitutes, individual newspapers can be complements rather than substitutes.

The own-price elasticity of demand η_{jj} in the nested logit model is given by (for $\alpha > 0$):

$$\eta_{jj} = \frac{\partial s_{jt}}{\partial p_{jt}} \frac{p_{jt}}{s_{jt}} = -\frac{\alpha}{1-\sigma} p_{jt}[1-(1-\sigma)s_{jt} - \sigma s_{jt|g}] \tag{3}$$

The cross-price elasticities of demand η_{jk} are instead given by (for $\alpha > 0$):

$$\eta_{jk} = \frac{\partial s_{jt}}{\partial p_{kt}} \frac{p_{kt}}{s_{jt}} = \begin{cases} \alpha p_{kt}[s_{kt} + \frac{\sigma}{1-\sigma} s_{kt|g}] & \text{if } k \neq j \text{ and } k \in g \\ \alpha p_{kt} s_{kt} & \text{if } k \neq j \text{ and } k \notin g \end{cases} \tag{4}$$

Note that, when readers' demand is estimated at the bundle level, this implies that the above elasticity formulas give the own-price and cross-price elasticities at the bundle rather than at the newspaper level. However, we are ultimately interested in the elasticities at the newspaper level. When computing elasticities, we hence first compute the marginal effects at the bundle level, sum up all the relevant marginal effects at the bundle level to get to the marginal effects at the newspaper level and then multiply these marginal effects with the respective newspaper price (own or cross) and divide by the newspaper's market share to get to the elasticities at the newspaper level.

4.2 Advertisers' Demand

On the advertisers' side of the market, demand derives from advertisers' choice to allocate a given budget, which changes with the business cycle, across different media outlets. This approach follows Hausman, Leonard, and Zona (1994) who model consumer choices among different brands of beer. Product differentiation is interpreted in the spatial sense proposed by Pinkse, Slade, and Brett (2002), as applied parametrically in Slade (2004) and in Pinkse and Slade (2004). The basic idea is that cross-price elasticities among two products (in our case advertising slots in two different newspapers) should be a function of the distance among the products in characteristic space. One would then expect higher cross-price elasticities when products are closer to each other in terms of characteristics. In addition, own-price effects are allowed to depend on characteristics of the newspapers. In our case, the distance metrics are derived from differences among newspapers in the demographic characteristics of readers (e.g. age, gender, income) and from the amount of overlapping readers between the two newspapers, while the own price elasticities are allowed to depend on the amount of captive readers. As required by two-sidedness of the media market, we allow advertising demand on a newspaper to depend on the circulation. In the demand specification, the circulation of the newspapers is treated as product advertising is treated in Rojas (2008) and Rojas and Peterson (2008).

Following Hausman, Leonard, and Zona (1994), advertising demand is estimated using demand equations at different levels. At the top level, advertisers decide on the budget to spend on advertising on national print newspapers (relative to advertising via other channels). The estimation equation of overall demand for advertising space on national newspapers is the following:

$$\ln(q_{td}) = \beta_0 + \beta_1 \ln(y_t) + \beta_2 \ln(P_{td}) + \phi Z_{td} + \varepsilon_{td}, \tag{5}$$

where q_{td} is total advertising quantity (measured in advertising slots) at time t in weekday d, y_t is GDP at time t, P_{td} is a deflated price index for advertising in newspapers at time t in weekday d (see explanation on the price index below), Z_{td} is a set of time and seasonal controls, potentially different by weekday, and ε_{td} is an i.i.d. error term varying across time and weekday. The coefficient β_2 on the price index for advertising in newspapers is hence the overall price elasticity of advertising demand in these seven newspapers relative to other media outlets.

The endogenous advertising price index P_{td} is instrumented by printing cost shifters, in particular the average real paper cost per page (averaged across the seven newspapers), an electricity price index for industrial consumers [7] and an hourly wage index for the printed media sector.

At the newspaper level, advertisers decide in a second step on how to allocate the newspaper advertising budget chosen at the top level across the seven newspapers. Advertisers are hence allowed to multi-home and can potentially decide to buy (different amounts of) advertising space in all of the seven newspapers at the same time.

Following Rojas (2008) and Rojas and Peterson (2008), we use a linear approximation of the Almost Ideal Demand System by Deaton and Muellbauer (1980) to model newspaper level advertising demand. The estimation equation of demand for advertising space in a particular newspaper is then the following:

$$w_{jtd} = a_{jtd} + \sum_{k=1}^{J} b_{jk} \ln(p_{ktd}) + \sum_{k=1}^{J} c_{jk} \ln(circ_{ktd}) + d_j \ln(\frac{x_{td}}{P_{td}}) + \varepsilon_{jtd}, \tag{6}$$

where w_{jtd} is the advertising sales share of newspaper j at time t in weekday d (i.e. $w_{jtd} = \frac{p_{jtd}q_{jtd}}{x_{td}}$),

[7] series nrg_pc_205_h, consumption band Ie from Eurostat.

p_{ktd} is the real price per slot of advertising in newspaper k at time t in weekday d , $circ_{ktd}$ is the circulation of newspaper k at time t in weekday d, x_{td} is total advertising expenditures at time t in weekday d (i.e. $x_{td} = \sum_{j=1}^{J} p_{jtd} q_{jtd}$) and P_{td} is an overall advertising price index. Rojas and Peterson (2008) use a Laspeyres index for the overall advertising price index defined as $\ln(P_{td}^{L}) = \sum_{j=1}^{J} w_j^0 \ln(p_{jtd})$, with w_j^0 being the base share of newspaper j, defined as $w_j^0 = \frac{1}{7T} \sum_{t=1}^{T} \sum_{d=1}^{7} w_{jtd}$. However, in our dataset, some of the newspapers are not available on all weekdays in the earlier years of the data. Using the base share w_j^0 of newspapers to compute the overall advertising price index would therefore artifically understate the price index for those weekday observations where not all seven newspapers are available. We thus use the Stone price index to measure the overall advertising price instead, defined as $\ln(P_{td}) = \sum_{j=1}^{J} w_{jtd} \ln(p_{jtd})$, as has been proposed already by Deaton and Muellbauer (1980) and was often applied in practice. The term a_{jtd} can incorporate time and newspaper dummy variables, newspaper characteristics and market specific variables such as demographics. The term $\ln(\frac{x_{td}}{P_{td}})$ enters the estimation equation as the advertising sales shares are conditional on the total advertising expenditures x_{td} set at the top level.

Following Slade (2004) and Pinkse and Slade (2004), we model the cross-price and cross-circulation coefficients b_{jk} and c_{jk} as linear functions of distance measures between newspapers j and k. In particular, how close substitutes two newspapers are in the eyes of advertisers depends on how close these two newspapers are in characteristics space. The closeness metrics are derived from differences among newspapers in the demographic characteristics of readers (age, gender, income) and the amount of overlapping readers between the two newspapers.

The estimation equation thus becomes:

$$w_{jtd} = a_{jtd} + b_{jj} \ln(p_{jtd}) + c_{jj} \ln(circ_{jtd}) + \sum_{k \neq j}^{J} g(\delta_{jk}) \ln(p_{ktd}) + \sum_{k \neq j}^{J} h(\mu_{jk}) \ln(circ_{ktd}) + d_j \ln(\frac{x_{td}}{P_{td}}) + \varepsilon_{jtd}, \tag{7}$$

with

$$b_{jk} = g(\delta_{jk}) = \sum_{l=1}^{L} \lambda_l \delta_{jk}^{l} \tag{8}$$

$$c_{jk} = h(\mu_{jk}) = \sum_{m=1}^{M} \tau_m \mu_{jk}^{m} \tag{9}$$

Where δ_{jk} and μ_{jk} are the L and M closeness measures that determine the cross-price and cross-circulation effects respectively and λ_l and τ_m are parameters to be estimated.

Substituting (8) and (9) into (7) and regrouping terms, the estimation equation is given by:

$$w_{jtd} = a_{jtd} + b_{jj}\ln(p_{jtd}) + c_{jj}\ln(circ_{jtd}) + \sum_{l=1}^{L}\lambda_l \sum_{k\neq j}^{J}\delta_{jk}^{l}\ln(p_{ktd}) + \sum_{m=1}^{M}\tau_m \sum_{k\neq j}^{J}\mu_{jk}^{m}\ln(circ_{ktd}) + d_j\ln(\frac{x_{td}}{P_{td}}) + \varepsilon_{jtd} \tag{10}$$

The closeness measures between newspapers for continuous product characteristics use an inverse measure of Euclidean distance.[8] These closeness measures between two newspapers vary between zero and one, so that a one implies that the two newspapers are at the same location in characteristic space. For discrete closeness measures (for example the type of newspaper: generalist, sport, financial), the closeness between two newspapers is equal to one if they belong to the same group (i.e. are of the same type) and zero otherwise. The cross-price and cross-circulation coefficients b_{jk} and c_{jk} are then recovered by replacing the estimated coefficients λ_l and τ_m and the closeness measures δ_{jk} and μ_{jk} into (8) and (9) respectively.

Note that also the own price and own circulation coefficients b_{jj} and c_{jj} can be modelled as functions of newspaper j's own product characteristics. For example using the percentage of female readers as the relevant product characteristic, the own-price coefficient in (8) would be defined as $b_{jj} = b_1 + b_2 femalereaders_j$, where $femalereaders_j$ is the percentage of female readers of newspaper j.

Since we aim in particular to investigate the effect of reader multi-homing on the estimation of demand parameters on both sides of the market, we model the own-price effects as a function of the percentage of captive readers a newspaper has and the cross-price effects as a function of the overlap in readers between two newspapers. Similarly to the estimation of readers' demand we estimate two specifications, one disregarding multi-homing information, such as the percentage of captive readers or the percentage of overlapping readers, and one using this information. The objective is, as in the estimation of readers' demand, to compare estimates of own- and cross-price effects and own- and cross-circulation effects when information on multi-homing is disregarded or used.

Advertising prices as well as newspaper circulation (both own and cross terms) are endogenous and need to be instrumented for in the estimation. Following Slade (2004), we use product characteristics of competing newspapers as instrument for price (i.e. BLP instruments). In particular, we use the sum across competitors of the percentage of female readers to instrument for own advertising price. In addition, we use the cost shifter real paper cost per page to instrument own advertising price. Newspaper

[8] In particular, the closeness between newspapers j and k in terms of product characteristic x is defined as $\frac{1}{1+2\sqrt{(x_j-x_k)^2}}$.

circulation is instrumented with the real paper cost per issue as well as the dummy for the day of the week when a magazine of general information is bundled to the newspaper. Increases in the printing costs should increase the newspaper price and hence decrease reader demand, while adding a magazine to the newspaper increases reader demand (see estimation results on readers' demand in section 5). Using the dummy for a magazine of general information as instrument for circulation relies on the assumption that the presence of the magazine does not directly influence the demand for advertising space *on the newspaper* (other than through its effect on newspaper circulation). Also the interaction terms between cross-prices and cross-circulation and the closeness measures are endogenous and need to be instrumented in the estimation. Based on the instruments for price and circulation, the corresponding interaction terms between instruments and closeness measures are constructed. Lastly, as total advertising expenditures x_{td} are constructed from prices and quantity variables, they are also treated as endogenous and instrumented with GDP.

The price elasticities of advertising demand $\tilde{\eta}_{jk}$ *conditional on total advertising expenditures* x_{td} are given by:

$$\tilde{\eta}_{jk} = \begin{cases} -1 + \frac{b_{jj}}{w_{jt}} - d_j & \text{if } k = j \\ \frac{b_{jk}}{w_{jt}} - d_j \frac{w_{kt}}{w_{jt}} & \text{if } k \neq j \end{cases} \tag{11}$$

with b_{jj} potentially being a function of own product characteristics and b_{jk} being a function of the closeness measures.

Unconditional advertising price elasticities however also need to take into account how advertising price increases by one newspaper change the overall price index for advertising in newspapers, how this in turn then changes the overall demand for advertising in print newspapers at the top level (relative to other media outlets) and how this change in total advertising expenditures x_{td} then affects the advertising quantity demanded on newspaper j. The *unconditional* price-elasticities for advertising demand η_{jk} take these effects into account and are given by:

$$\eta_{jk} = \begin{cases} \tilde{\eta}_{jj} + (1 + \frac{d_j}{w_{jt}})(\beta_2 + 1) w_{jt} & \text{if } k = j \\ \tilde{\eta}_{jk} + (1 + \frac{d_j}{w_{jt}})(\beta_2 + 1) w_{kt} & \text{if } k \neq j \end{cases} \tag{12}$$

where β_2 is the overall price elasticity of advertising demand in the seven newspapers relative to other media outlets estimated at the top level.

The circulation elasticities of advertising demand ρ_{jk}, which do not depend on total advertising expenditures x_{td}, are given by:

$$\rho_{jk} = \begin{cases} \frac{c_{jj}}{w_{jt}} & \text{if } k = j \\ \frac{c_{jk}}{w_{jt}} & \text{if } k \neq j \end{cases} \tag{13}$$

with c_{jj} potentially being a function of own product characteristics and c_{jk} being a function of the closeness measures.

Appendix A.3 contains the derivation of both the conditional and the unconditional price as well as the circulation elasticities.

5 Estimation Results

5.1 Estimation Results Readers' Demand

We present here the results on the estimation of readers' demand, once under the assumption of single-homing readers and once under the assumption of double-homing readers.

Table 4 shows results for readers' demand assuming single-homing by readers. Both specifications contain nest-specific (i.e. newspaper type or bundle type) year fixed effects to account for the time trend as well as month fixed effects to account for seasonality. While the first specification contains month fixed effects that are common across nests, the second specification allows seasonality to differ across nests by including nest-specific month fixed effects.

The price coefficient is negative and statistically significant at the 1% significance level in both specifications and varies between -0.86 and -1.32 depending on how we model seasonality. The advertising intensity coefficient is positive and significant. This result may seem counter-intuitive at first as Argentesi and Filistrucchi (2007) have found insignificant effects of advertising quantity on reader demand with similar data. However, the positive effect of advertising intensity on reader demand is very small. It may hence be that those who are not interested in ads in the newspaper can easily skip them while those who are interested can enjoy them, so that overall demand is affected little but positively.

The estimated σ is positive and statistically significant at the 1% significance level, thus showing that the chosen nesting structure matters.

The other coefficients have the expected signs and are mostly consistent with Argentesi and Filistrucchi (2007): both the coefficients for the dummy variables for the day of issue of a magazine of general information or the day of issue of a women magazine are positive and statistically significant at the 1% level. The coefficient for the dummy variable for the day of issue of an economic insert has a negative but mostly statistically insignificant effect. The number of local pages in a newspaper also impacts readers' demand negatively in the two specifications. For the website dummy variables interacted with internet penetration rate, that account for the launch of a website by a given newspaper, the coefficients are often statistically insignificant but mostly negative in the cases where they are statistically significant. Thus, the introduction of websites seems to have a negative impact on printed newspaper demand, as in Filistrucchi (2005). We also include a set of editor dummy variables in the estimation. Standard errors are heteroskedasticity robust and corrected for autocorrelation of order 1. The Kleibergen-Paap test statistic for weak instruments indicates that there is no problem of weak instruments in the first stages.

Table 5 shows instead the estimation results for readers' demand accounting for double-homing by readers. The two specifications are analogous to the two specifications in the estimations assuming single-homing by readers. The structure of the nests is however richer. Since demand is now modelled as demand for bundles of one or two newspapers, in addition to the outside good, there are now not only the nests of generalist, of sport and of financial newspapers but also the nests of generalists and sport, of generalist and financial and of sport and financial.

The estimated price coefficient is negative and significant at the 1% significance level and varies between -1.08 and -1.34 depending on how we account for seasonality. The magnitude of the price coefficient is slightly larger than in the estimations under the assumption of single-homing by readers. The advertising intensity coefficient is now negative and significant in specification (2), where we allow seasonality to differ across nests. In any case, the impact of advertising on reader demand is small. The estimated σ is again positive and significant at the 1% significance level and much larger than the nesting parameter in the estimations under the assumption of single-homing by readers.

The other coefficients have the expected signs: both the coefficients for the dummy variables for the day of issue of a magazine of general information or the day of issue of a women magazine are positive and statistically significant in both specifications. Again the coefficient of the dummy variable for the issue of an economic insert is negative and statistically significant in the last specification. These dummy variables for the day of issue of a specific magazine or insert now measure whether there is at least one of these magazines/inserts in the bundle on a particular day. Those variables marked "plus" measure in addition whether there was a magazine/women magazine/economic insert issued on the same day in both

Table 4: Readers' Demand - Single-Homing

VARIABLES	(1)	(2)
Real cover price	-0.862***	-1.318***
	(-2.882)	(-4.291)
σ	0.231***	0.169***
	(3.460)	(2.736)
Advertising intensity (slots/pages)	0.003***	0.002**
	(6.558)	(2.492)
Generalist magazine (day)	0.218***	0.325***
	(3.503)	(5.012)
Women magazine (day)	0.300***	0.462***
	(2.918)	(4.369)
Economic insert (day)	-0.025	-0.052***
	(-1.402)	(-3.218)
Local pages	-0.005	-0.003
	(-1.473)	(-0.745)
Observations	8,795	8,795
R-squared	0.292	0.420
Number of Newspaper/Weekday FE	49	49
Website opening	YES	YES
Director dummy variables	YES	YES
Newspaper/Weekday Fixed Effects	YES	YES
Time trend	Year/Nest Fixed Effects	Year/Nest Fixed Effects
Seasonality	Month Fixed Effects	Month/Nest Fixed Effects
Adjusted R-squared	0.280	0.408
Kleibergen Paap stat.	59.94	50.46
p-value KP	0	3.81e-09
Chi-squared quadratic web	14.18	6.277
p-value web	0.0481	0.508

Robust z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

of the newspapers in the respective bundle. The effect of a second magazine or women magazine in the bundle is positive and significant while the effect of a second economic insert is negative and significant. The number of local pages in the bundle again has a negative impact on readers' demand for the bundle. Again, the effect of the launch of a website is mostly negative suggesting that the print version and the online version of a newspaper are substitutes from the readers' perspective. The Kleibergen-Paap test statistic for weak instruments indicates that there is no problem of weak instruments in the first stages.

Table 6 shows the resulting mean own- and cross-price elasticities for the seven newspapers based on the estimation results of specification (2) in Table 4, i.e. under the assumption of single-homing readers. While the mean own-price elasticity varies between -1.27 and -1.48, the cross-price elasticities are small and vary between 0.008 and 0.15.

While the dataset allowing for double-homing is at the bundle level, the price and network effect elasticities should still be at the product, i.e. newspaper level. We hence sum over all relevant marginal effects at the bundle level to get the marginal effects at the newspaper level when we account for double-homing by readers.[9] We then multiply these marginal effects with the respective price or advertising intensity (own or cross) and divide by the newspaper's market share to get to the elasticities.[10]

Table 7 shows the resulting mean own- and cross-price elasticities for the seven newspapers based on the estimation results of specification (2) in Table 5, i.e. under the assumption of double-homing readers. Firstly, the mean own-price elasticities now vary between -1.29 and -4.13, which is much larger than the estimated mean own-price elasticities based on the assumption of single-homing readers. Especially demand for the generalist newspapers is more elastic if double-homing is taken into account in the estimation.

Secondly, note that cross-price elasticities can now be positive or negative. In particular, we find that cross-price elasticities between newspapers of the same type (i.e. generalist, sport, financial) are positive, while cross-price elasticities between newspapers of different types are negative. This implies that newspapers of the same newspaper type are substitutes while newspapers of different types are complements. Also, the magnitude of the cross-price elasticities is mostly larger than those based on the

[9]For example, for the own-price effect of newspaper A, we take into account the effects of a price increase of all bundles containing newspaper A on all bundles containing newspaper A. For e.g. the cross-price effect on newspaper A of a price increase of newspaper B, we take into account the effect of a price increase of all bundles containing newspaper B on all bundles containing newspaper A. Note that this also includes the own-price effect of bundle AB increasing its price, which is negative.

[10]We multiply here with the market share based on the actual circulation of the newspaper contained in the newspaper level data. However, as a robustness check, we also computed the elasticities based on the newspaper market shares that are implied by the estimated newspaper circulation resulting from the procedure to create the bundle-level dataset. Qualitative results did not change when we used these alternative market shares in the computation of elasticities.

Table 5: Readers' Demand - Double-Homing

VARIABLES	(1)	(2)
Real cover price	-1.079***	-1.339***
	(-9.555)	(-11.342)
σ	0.730***	0.745***
	(12.785)	(12.877)
Advertising intensity (slots/pages)	0.001***	-0.001***
	(3.634)	(-2.765)
Generalist magazine (day)	0.241***	0.304***
	(9.989)	(11.910)
Generalist magazine plus (day)	0.203***	0.248***
	(4.846)	(5.344)
Women magazine (day)	0.371***	0.461***
	(9.952)	(11.879)
Women magazine plus (day)	0.337***	0.416***
	(10.088)	(11.838)
Economic insert (day)	-0.003	-0.016*
	(-0.331)	(-1.847)
Economic insert plus (day)	-0.035***	-0.032***
	(-2.871)	(-2.674)
Local pages	-0.002*	-0.003*
	(-1.859)	(-1.878)
Observations	35,105	35,105
R-squared	0.727	0.703
Number of Bundle/Weekday FE	196	196
Website opening	YES	YES
Director dummy variables	YES	YES
Bundle/Weekday Fixed Effects	YES	YES
Time trend	Year/Nest Fixed Effects	Year/Nest Fixed Effects
Seasonality	Month Fixed Effects	Month/Nest Fixed Effects
Adjusted R-squared	0.724	0.700
Kleibergen Paap stat.	298.2	288.5
p-value KP	0	0
Chi-squared quadratic web	50.38	82
p-value web	1.21e-08	0

Robust z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 6: Mean Own- and Cross-Price Elasticities - Readers' Demand - Single-Homing

	Corriere	Corriere Sport	Gazzetta Sport	Giornale	Repubblica	Il Sole	Stampa
Corriere	-1.479	0.010	0.014	0.040	0.107	0.012	0.067
	(0.229)	(0.002)	(0.003)	(0.006)	(0.022)	(0.002)	(0.015)
Corriere Sport	0.023	-1.313	0.152	0.008	0.021	0.012	0.013
	(0.005)	(0.079)	(0.010)	(0.001)	(0.005)	(0.002)	(0.003)
Gazzetta Sport	0.023	0.112	-1.268	0.008	0.021	0.012	0.013
	(0.005)	(0.009)	(0.070)	(0.001)	(0.005)	(0.002)	(0.003)
Giornale	0.117	0.010	0.014	-1.461	0.107	0.012	0.067
	(0.023)	(0.002)	(0.003)	(0.088)	(0.022)	(0.002)	(0.015)
Repubblica	0.117	0.010	0.014	0.040	-1.478	0.012	0.067
	(0.022)	(0.002)	(0.003)	(0.006)	(0.230)	(0.002)	(0.015)
Il Sole	0.023	0.010	0.014	0.008	0.021	-1.323	0.013
	(0.005)	(0.002)	(0.003)	(0.001)	(0.005)	(0.084)	(0.003)
Stampa	0.117	0.010	0.014	0.040	0.107	0.012	-1.444
	(0.023)	(0.002)	(0.003)	(0.006)	(0.022)	(0.002)	(0.207)

We report the mean elasticities over the years 1992-2006. Standard deviations are reported in parantheses.

Table 7: Mean Own- and Cross-Price Elasticities - Readers' Demand - Double-Homing

	Corriere	Corriere Sport	Gazzetta Sport	Giornale	Repubblica	Il Sole	Stampa
Corriere	-3.621	-0.004	-0.144	0.144	0.710	-0.145	0.686
	(0.574)	(0.021)	(0.032)	(0.062)	(0.144)	(0.019)	(0.155)
Corriere Sport	-0.013	-3.043	1.246	-0.065	-0.240	-0.064	-0.008
	(0.050)	(0.240)	(0.126)	(0.049)	(0.084)	(0.018)	(0.032)
Gazzetta Sport	-0.241	0.917	-2.498	-0.032	-0.019	-0.069	-0.067
	(0.057)	(0.096)	(0.170)	(0.049)	(0.028)	(0.021)	(0.020)
Giornale	0.417	-0.082	-0.054	-4.127	0.818	-0.152	0.502
	(0.192)	(0.056)	(0.074)	(0.267)	(0.204)	(0.027)	(0.136)
Repubblica	0.775	-0.112	-0.015	0.313	-3.778	-0.141	0.653
	(0.157)	(0.023)	(0.018)	(0.081)	(0.555)	(0.022)	(0.140)
Il Sole	-0.268	-0.051	-0.076	-0.096	-0.240	-1.288	-0.099
	(0.048)	(0.011)	(0.022)	(0.017)	(0.050)	(0.089)	(0.021)
Stampa	1.197	-0.006	-0.072	0.301	1.047	-0.094	-3.959
	(0.228)	(0.021)	(0.026)	(0.059)	(0.198)	(0.015)	(0.549)

We report the mean elasticities over the years 1992-2006. Standard deviations are reported in parantheses.

assumption of single-homing by readers.

Tables 8 and 9 show instead the mean own- and cross-network effects elasticities based on the same estimation results under the assumption of single-homing and double-homing readers respectively.

As the estimated coefficient on the advertising intensity is small but positive in specification (2) in Table 4, the estimated own-network effect elasticities are small and positive, while the cross-network effect elasticities are negative but small. The own-network effect elasticities vary between 0.13 and 0.22 while the cross-network effect elasticities vary between -0.001 and -0.021.

As the estimated coefficient on the advertising elasticity is instead negative in specification (2) in Table 5, when we account for double-homing by readers, the estimated own-network effect elasticities are now negative and vary between -0.10 and -0.42. As for the cross-price elasticities, also the cross-network effect elasticities suggest that newspapers of the same type are substitutes while newspapers of different types are complements.

Table 8: Mean Own- and Cross-Network Effect Elasticities - Readers' Demand - Single-Homing

	Corriere	Corriere Sport	Gazzetta Sport	Giornale	Repubblica	Il Sole	Stampa
Corriere	0.216	-0.001	-0.002	-0.004	-0.012	-0.001	-0.007
	(0.066)	(0.001)	(0.001)	(0.002)	(0.004)	(0.001)	(0.002)
Corriere Sport	-0.003	0.151	-0.021	-0.001	-0.002	-0.001	-0.001
	(0.001)	(0.062)	(0.007)	(0.000)	(0.001)	(0.001)	(0.000)
Gazzetta Sport	-0.003	-0.013	0.173	-0.001	-0.002	-0.001	-0.001
	(0.001)	(0.005)	(0.058)	(0.000)	(0.001)	(0.001)	(0.000)
Giornale	-0.017	-0.001	-0.002	0.144	-0.012	-0.001	-0.007
	(0.006)	(0.001)	(0.001)	(0.047)	(0.004)	(0.001)	(0.002)
Repubblica	-0.017	-0.001	-0.002	-0.004	0.168	-0.001	-0.007
	(0.006)	(0.001)	(0.001)	(0.002)	(0.054)	(0.001)	(0.002)
Il Sole	-0.003	-0.001	-0.002	-0.001	-0.002	0.132	-0.001
	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.060)	(0.000)
Stampa	-0.017	-0.001	-0.002	-0.004	-0.012	-0.001	0.155
	(0.006)	(0.001)	(0.001)	(0.002)	(0.004)	(0.001)	(0.051)

We report the mean elasticities over the years 1992-2006. Standard deviations are reported in parantheses.

Table 9: Mean Own- and Cross-Network Effect Elasticities - Readers' Demand - Double-Homing

	Corriere	Corriere Sport	Gazzetta Sport	Giornale	Repubblica	Il Sole	Stampa
Corriere	-0.4239	-0.0005	-0.0156	0.0117	0.0646	-0.0115	0.0579
	(0.1286)	(0.0019)	(0.0059)	(0.0062)	(0.0216)	(0.0052)	(0.0185)
Corriere Sport	-0.0018	-0.2808	0.1364	-0.0051	-0.0223	-0.0054	-0.0004
	(0.0057)	(0.1138)	(0.0463)	(0.0045)	(0.0110)	(0.0033)	(0.0025)
Gazzetta Sport	-0.0279	0.0850	-0.2734	-0.0027	-0.0016	-0.0056	-0.0059
	(0.0092)	(0.0357)	(0.0907)	(0.0045)	(0.0026)	(0.0034)	(0.0028)
Giornale	0.0506	-0.0076	-0.0059	-0.3281	0.0752	-0.0119	0.0426
	(0.0275)	(0.0068)	(0.0093)	(0.1070)	(0.0287)	(0.0054)	(0.0154)
Repubblica	0.0912	-0.0105	-0.0016	0.0251	-0.3441	-0.0114	0.0555
	(0.0307)	(0.0053)	(0.0021)	(0.0101)	(0.1077)	(0.0054)	(0.0173)
Il Sole	-0.0313	-0.0047	-0.0084	-0.0075	-0.0218	-0.1029	-0.0084
	(0.0093)	(0.0021)	(0.0038)	(0.0026)	(0.0075)	(0.0469)	(0.0028)
Stampa	0.1413	-0.0003	-0.0083	0.0242	0.0953	-0.0077	-0.3426
	(0.0481)	(0.0020)	(0.0046)	(0.0098)	(0.0317)	(0.0041)	(0.1164)

We report the mean elasticities over the years 1992-2006. Standard deviations are reported in parantheses.

5.2 Estimation Results Advertisers' Demand

We present here the results on the estimation of advertisers' demand, first at the top level, where advertisers decide on the budget to spend on advertising in print newspapers and second, at the newspaper level, where advertisers decide on how to split this advertising budget across the different newspapers. Since we aim to highlight the possible bias due to the omission of information on multi-homing by readers, at the newspaper level, we present results from two specifications: one disregarding information on double-homing by readers; the other making use of the information on captive readers and overlapping readers between newspapers.

Table 10 shows results for top level advertisers' demand. The coefficient on the price index is negative and statistically significant at the 1% significance level. GDP as an indicator for the overall business cycle has a positive and statistically significant effect on overall advertising demand. We account for the time trend by including a weekday specific quadratic yearly time trend and allow for seasonality by including month fixed effects.

Specification (1) in Table 11 shows estimation results for advertisers' demand at the newspaper level when information on multi-homing by readers is omitted. The specification contains newspaper-weekday fixed effects as well as newspaper type-specific (generalist, sport, business) year fixed effects to account

Table 10: Advertisers' Demand - Top Level

VARIABLES	(1)
Log(advertising price index)	-1.856***
	(-3.764)
Log(GDP)	12.365***
	(10.266)
Constant	492.864***
	(5.556)
Observations	1,260
Time trend	Weekday specific quadratic yearly trend
Seasonality	Month Fixed Effects
Kleibergen Paap stat.	24.01
p-value KP	2.48e-05

Robust z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

for the time trend. Seasonality is accounted for by month fixed effects.

Specification (2) in Table 11 shows instead estimation results for advertisers' demand at the newspaper level when information on the percentage of captive readers and the percentage of overlapping readers is used.

The coefficient on advertising price is negative and significant at the 5% significance level in specification (1). The interaction term between the advertising slot price and the percentage of female readers is positive and significant. This implies that advertisers' demand is less elastic for newspapers that offer access to more female readers.

In specification (2), we allow the own advertising price elasticity in addition to depend on the percentage of captive readers of the newspaper. The coefficient on advertising price is negative and significant at the 1% level and much larger in magnitude than in specification (1) when information on multi-homing by readers is ignored in the estimation of advertising demand. The interaction term between the advertising slot price and the percentage of female readers is still positive and significant and larger in magnitude than in specification (1). Importantly, also the interaction term between the advertising slot price and the percentage of captive readers is positive and significant, while the interaction term between price, the percentage of captive readers and the percentage of female readers is negative and significant. This implies that advertisers' demand is less elastic for newspapers that offer exclusive access to more female and more captive readers, particularly if the latter are men.

The coefficient on the own circulation is positive and significant at the 1% significance level in both

Table 11: Advertisers' Demand - Newspaper Level

VARIABLES	(1)	(2)
Log(real price per ad slot)	-0.040***	-0.536***
	(-3.049)	(-7.883)
Log(real price per ad slot)*Log(captive readers)		0.139***
		(8.023)
Log(real price per ad slot)*Log(female readers)	0.011***	0.185***
	(4.532)	(9.683)
Log(real price per ad slot)*Log(captive readers)*Log(female readers)		-0.046***
		(-9.085)
Log(prints)	0.307***	0.307***
	(17.622)	(18.126)
Readers' income cross-price measure	0.009***	-0.001
	(4.434)	(-0.457)
Joint readers cross-price measure		0.018***
		(2.780)
Same type cross-prints measure	-0.005***	-0.005***
	(-9.464)	(-8.485)
Log(xt/Pt)*Corriere	-0.091***	-0.164***
	(-5.802)	(-9.208)
Log(xt/Pt)*Corriere Sport	0.150***	0.071***
	(10.365)	(5.786)
Log(xt/Pt)*Gazzetta Sport	0.147***	0.074***
	(10.214)	(5.767)
Log(xt/Pt)*Giornale	0.000	0.057***
	(0.005)	(3.433)
Log(xt/Pt)*Repubblica	-0.065***	-0.154***
	(-4.182)	(-8.992)
Log(xt/Pt)*Il Sole	0.198***	0.123***
	(11.007)	(6.808)
Log(xt/Pt)*Stampa	0.187***	0.020
	(12.571)	(1.272)
Observations	8,795	8,795
Number of id	7	7
Newspaper Fixed Effects	YES	YES
Weekday Fixed Effects	YES	YES
Time trend	Type specific quadratic yearly trend	Type specific quadratic yearly trend
Seasonality	Month Fixed Effects	Month Fixed Effects
Kleibergen Paap stat.	382.4	343.5
p-value KP	0	0
Chi-squared different xt_Pt terms	578.1	722.7
p-value	0	0

Robust z-statistics in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

specifications, highlighting that advertisers value a newspaper more the more readers this newspaper reaches (all else equal).

Cross-price effects are modelled as a function of the closeness in the income of newspaper readers and, in specification (2) when we take into account multi-homing reader information, also as a function of the overlap in readers between two newspapers. The reader income based cross-price measure is positive and significant in both specifications, implying that higher prices of competing newspapers increase own advertising demand and that newspapers are closer substitutes for advertisers if they reach readers that are similar/close in terms of socio-economic status/income. The coefficient on the joint readers cross-price measure in specification (2) is positive and significant, showing that newspapers are closer substitutes for advertisers if they have a higher share of readers in common, i.e. if these readers can be reached on either of the two newspapers. The coefficient is also much larger in magnitude than the ones on the reader income based cross-price measure, thus the overlap in readers seems to be a more important determinant of substitutability of newspapers for advertisers than readers' income.

Cross-circulation effects are modelled as a function of the discrete closeness measure of newspaper type in both specifications. The negative and statistically significant coefficient on the same type cross-prints measure shows that higher circulation of competing newspapers of the same newspaper type decreases own advertising demand.

Lastly, not all $\ln(\frac{x_{td}}{P_{td}})$ terms are statistically significant, indicating that for some newspapers an increase in the overall print advertising budget does not affect their advertising sales share, while other newspapers gain or lose sales share with increasing overall print newspaper advertising expenditures. For the computation of price elasticities, we set the statistically insignficant $\ln(\frac{x_{td}}{P_{td}})$ terms to zero.

Table 12 shows the resulting mean *conditional* own- and cross-price elasticities for advertising demand of the seven newspapers based on the estimation results of specification (1) in Table 11, i.e. without using information on multi-homing readers in the demand estimation. The mean conditional own-price elasticity varies between -0.87 and -3.04. Note that the conditional cross-price elasticities can be positive or negative depending on the sign (and significance) of the estimated d_j and the magnitude of the $\frac{w_k^0}{w_{jt}}$ term, that captures the effect of a price change on P_t^L (see equation 11). The conditional cross-price elasticities vary between -0.47 and 1.09.

Table 13 shows instead the resulting mean *conditional* own- and cross-price elasticities for advertising demand of the seven newspapers based on specification (2) in Table 11, i.e. using information on multi-homing readers in the demand estimation. The mean conditional own-price elasticity now varies between -1.33 and -5.34, which is much larger than the estimated mean own-price elasticities when information on multi-homing readers is disregarded in the estimation of advertising demand. The conditional cross-price elasticities now vary between -1.35 and 2.05.

Table 12: Mean Conditional Own- and Cross-Price Elasticities - Advertisers' Demand - Disregarding DH Readers

	Corriere	Corriere Sport	Gazzetta Sport	Giornale	Repubblica	Il Sole	Stampa
Corriere	-0.906	0.014	0.022	0.022	0.096	0.061	0.051
	(0.001)	(0.008)	(0.010)	(0.010)	(0.033)	(0.036)	(0.019)
Corriere Sport	-1.371	-1.533	-0.236	-0.262	-1.328	-0.801	-0.682
	(0.862)	(0.201)	(0.073)	(0.137)	(0.880)	(0.540)	(0.385)
Gazzetta Sport	-0.770	-0.081	-1.380	-0.152	-0.756	-0.477	-0.390
	(0.340)	(0.024)	(0.092)	(0.068)	(0.379)	(0.305)	(0.170)
Giornale	0.011	0.003	0.003	-0.997	0.018	0.012	0.005
	(0.005)	(0.001)	(0.001)	(0.016)	(0.010)	(0.007)	(0.002)
Repubblica	0.080	0.011	0.018	0.019	-0.932	0.045	0.039
	(0.036)	(0.011)	(0.018)	(0.010)	(0.002)	(0.022)	(0.017)
Il Sole	-0.448	-0.061	-0.101	-0.080	-0.388	-1.209	-0.215
	(0.336)	(0.063)	(0.101)	(0.062)	(0.267)	(0.007)	(0.156)
Stampa	-0.396	-0.053	-0.085	-0.075	-0.365	-0.224	-1.179
	(0.169)	(0.040)	(0.056)	(0.026)	(0.142)	(0.104)	(0.003)

We report the mean elasticities over the years 1992-2006. Standard deviations are reported in parantheses.

Looking back at the formula for the conditional own-price elasticity in equation 11, note firstly that the b_{jj} will be lower, the higher the percentage of female readers and captive readers of newspaper j. This implies that newspapers, which have a high percentage of captive and female readers should have a lower own price elasticity. This is the case for Corriere della Sera, Repubblica and La Stampa. In contrast, the own-price elasticities for Corriere dello Sport and Gazzetta dello Sport are particularly high, which can be explained by their extremely low percentage of female readers (on average 13% for both newspaper compared to a mean across newspapers of 32%). Secondly, the own-price elasticity is larger (in absolute value), the smaller the advertising sales share wjt of newspaper j. This drives up own-price elasticities for Corriere dello Sport, Gazzetta dello Sport and Il Giornale, which have low mean advertising sales shares compared to the other newspapers (between 4% and 6% compared to a mean across newspapers of 14%). See Appendix A.4 for the relevant newspaper level summary statistics.

Cross-price elasticities will be higher the more joint readers two newspapers have, all else equal. One example are the two sport newspapers, Corriere dello Sport and Gazzetta dello Sport, for which the cross-price elasticities increase between specification (1) and (2) when multi-homing reader information

Table 13: Mean Conditional Own- and Cross-Price Elasticities - Advertisers' Demand - Including DH Readers

	Corriere	Corriere Sport	Gazzetta Sport	Giornale	Repubblica	Il Sole	Stampa
Corriere	-0.756	0.027	0.048	0.039	0.173	0.114	0.092
	(0.018)	(0.014)	(0.018)	(0.016)	(0.059)	(0.066)	(0.034)
Corriere Sport	-0.601	-0.712	0.057	-0.108	-0.563	-0.353	-0.307
	(0.382)	(0.196)	(0.079)	(0.058)	(0.383)	(0.244)	(0.174)
Gazzetta Sport	-0.345	0.006	-0.795	-0.066	-0.353	-0.225	-0.184
	(0.156)	(0.026)	(0.104)	(0.032)	(0.181)	(0.149)	(0.081)
Giornale	-0.246	-0.023	-0.020	-0.325	-0.253	-0.133	-0.131
	(0.124)	(0.027)	(0.039)	(0.352)	(0.113)	(0.075)	(0.054)
Repubblica	0.186	0.030	0.047	0.038	-0.776	0.110	0.094
	(0.085)	(0.027)	(0.045)	(0.018)	(0.023)	(0.053)	(0.040)
Il Sole	-0.250	-0.031	-0.047	-0.042	-0.215	-0.839	-0.122
	(0.192)	(0.036)	(0.055)	(0.035)	(0.148)	(0.233)	(0.091)
Stampa	0.010	0.004	0.013	0.005	0.012	0.010	-0.915
	(0.003)	(0.001)	(0.003)	(0.001)	(0.004)	(0.003)	(0.024)

We report the mean elasticities over the years 1992-2006. Standard deviations are reported in parantheses.

is taken into account, as these newspapers have a high share of readers in common (see Table 1).

Unconditional advertising price elasticities however also need to take into account how advertising price increases by one newspaper change the overall price index for advertising in newspapers, how this in turn then changes the overall demand for advertising in print newspapers at the top level (relative to other media outlets) and how this change in total advertising expenditures x_t then affects the advertising quantity demanded on newspaper j. The unconditional price-elasticities for advertising demand take these effects into account.

[TO BE COMPLETED]

Lastly, Tables 16 and 17 show the own- and cross-network effect elasticities based on the newspaper level advertising demand estimation results of specification (1) and (2) in Table 11 respectively. As the cross-circulation effects are modelled as a function of the discrete closeness measure of newspaper type, cross-circulation effects are zero by construction between newspapers of different newspaper types. When multi-homing reader information is disregarded, own-network effect elasticities vary between 1.69 and 14.63 while the cross-network effect elasticities are small and vary between -0.07 and -0.62. When instead multi-homing reader information is used in the advertising demand estimation, own-network effect elasticities vary between 0.85 and 7.33, while the cross-network effect elasticities are small and vary between -0.02 and -0.18.

Table 14: Mean Unconditional Own- and Cross-Price Elasticities - Advertisers' Demand - Disregarding DH Readers

	Corriere	Corriere Sport	Gazzetta Sport	Giornale	Repubblica	Il Sole	Stampa
Corriere	-1.069	-0.008	-0.014	-0.009	-0.050	-0.028	-0.029
	(0.057)	(0.009)	(0.015)	(0.009)	(0.042)	(0.025)	(0.022)
Corriere Sport	-2.790	-1.695	-0.507	-0.539	-2.693	-1.630	-1.396
	(1.627)	(0.188)	(0.143)	(0.262)	(1.665)	(1.040)	(0.731)
Gazzetta Sport	-1.674	-0.194	-1.558	-0.334	-1.630	-1.028	-0.853
	(0.656)	(0.056)	(0.072)	(0.136)	(0.740)	(0.613)	(0.334)
Giornale	-0.229	-0.030	-0.050	-1.046	-0.205	-0.127	-0.117
	(0.058)	(0.019)	(0.026)	(0.024)	(0.051)	(0.057)	(0.030)
Repubblica	-0.096	-0.012	-0.020	-0.016	-1.099	-0.058	-0.051
	(0.054)	(0.015)	(0.026)	(0.011)	(0.049)	(0.030)	(0.022)
Il Sole	-1.074	-0.148	-0.242	-0.200	-0.947	-1.518	-0.523
	(0.667)	(0.132)	(0.208)	(0.124)	(0.520)	(0.051)	(0.305)
Stampa	-0.977	-0.135	-0.213	-0.190	-0.903	-0.557	-1.462
	(0.359)	(0.091)	(0.128)	(0.059)	(0.300)	(0.243)	(0.032)

We report the mean elasticities over the years 1992-2006. Standard deviations are reported in parantheses.

Table 15: Mean Unconditional Own- and Cross-Price Elasticities - Advertisers' Demand - Including DH Readers

	Corriere	Corriere Sport	Gazzetta Sport	Giornale	Repubblica	Il Sole	Stampa
Corriere	-0.856	0.014	0.027	0.021	0.089	0.066	0.046
	(0.072)	(0.013)	(0.019)	(0.019)	(0.083)	(0.072)	(0.043)
Corriere Sport	-1.397	-0.806	-0.099	-0.264	-1.323	-0.817	-0.708
	(0.756)	(0.210)	(0.096)	(0.121)	(0.769)	(0.500)	(0.344)
Gazzetta Sport	-0.920	-0.068	-0.911	-0.182	-0.904	-0.571	-0.478
	(0.330)	(0.048)	(0.126)	(0.072)	(0.381)	(0.328)	(0.174)
Giornale	-0.761	-0.093	-0.133	-0.423	-0.729	-0.423	-0.388
	(0.295)	(0.069)	(0.099)	(0.363)	(0.256)	(0.190)	(0.123)
Repubblica	0.098	0.019	0.030	0.021	-0.867	0.058	0.049
	(0.130)	(0.040)	(0.070)	(0.024)	(0.062)	(0.058)	(0.056)
Il Sole	-0.730	-0.098	-0.154	-0.135	-0.646	-1.083	-0.360
	(0.414)	(0.085)	(0.130)	(0.077)	(0.315)	(0.275)	(0.190)
Stampa	-0.231	-0.030	-0.040	-0.044	-0.210	-0.130	-1.037
	(0.056)	(0.018)	(0.025)	(0.016)	(0.046)	(0.056)	(0.052)

We report the mean elasticities over the years 1992-2006. Standard deviations are reported in parantheses.

Note that the own-network effect elasticities are given by the coefficient on the own circulation divided by the advertising sales share wjt of newspaper j (see equation 12). This implies firstly that newspapers with a low advertising sales share will have large own-network effect elasticities, which is the case for Corriere dello Sport, Gazzetta dello Sport and Il Giornale. Secondly, the own-network effect elasticities are cut in half from specification (1) to specification (2) because the estimated coefficient on the own circulation is cut in half between the two specifications.

Table 16: Mean Own- and Cross-Circulation Elasticities - Advertisers' Demand - Disregarding DH Readers

	Corriere	Corriere Sport	Gazzetta Sport	Giornale	Repubblica	Il Sole	Stampa
Corriere	1.154	0.000	0.000	-0.018	-0.018	0.000	-0.018
	(0.281)			(0.004)	(0.004)		(0.004)
Corriere Sport	0.000	9.955	-0.155	0.000	0.000	0.000	0.000
		(5.277)	(0.082)				
Gazzetta Sport	0.000	-0.091	5.845	0.000	0.000	0.000	0.000
		(0.035)	(2.263)				
Giornale	-0.093	0.000	0.000	5.971	-0.093	0.000	-0.093
	(0.030)			(1.936)	(0.030)		(0.030)
Repubblica	-0.019	0.000	0.000	-0.019	1.243	0.000	-0.019
	(0.006)			(0.006)	(0.400)		(0.006)
Il Sole	0.000	0.000	0.000	0.000	0.000	2.320	0.000
						(1.368)	
Stampa	-0.036	0.000	0.000	-0.036	-0.036	0.000	2.286
	(0.009)			(0.009)	(0.009)		(0.604)

We report the mean elasticities over the years 1992-2006. Standard deviations are reported in parantheses. Cross-circulation elasticities across different newspaper types are zero by construction.

6 Evaluating the Impact of Multi-Homing

6.1 Market Definition

[...]

6.2 Merger Simulation

[...]

Table 17: Mean Own- and Cross-Circulation Elasticities - Advertisers' Demand - Including DH Readers

	Corriere	Corriere Sport	Gazzetta Sport	Giornale	Repubblica	Il Sole	Stampa
Corriere	1.156	0.000	0.000	-0.018	-0.018	0.000	-0.018
	(0.282)			(0.004)	(0.004)		(0.004)
Corriere Sport	0.000	9.975	-0.156	0.000	0.000	0.000	0.000
		(5.288)	(0.083)				
Gazzetta Sport	0.000	-0.092	5.857	0.000	0.000	0.000	0.000
		(0.035)	(2.267)				
Giornale	-0.094	0.000	0.000	5.983	-0.094	0.000	-0.094
	(0.030)			(1.940)	(0.030)		(0.030)
Repubblica	-0.019	0.000	0.000	-0.019	1.245	0.000	-0.019
	(0.006)			(0.006)	(0.401)		(0.006)
Il Sole	0.000	0.000	0.000	0.000	0.000	2.325	0.000
						(1.371)	
Stampa	-0.036	0.000	0.000	-0.036	-0.036	0.000	2.290
	(0.009)			(0.009)	(0.009)		(0.605)

We report the mean elasticities over the years 1992-2006. Standard deviations are reported in parantheses. Cross-circulation elasticities across different newspaper types are zero by construction.

7 Conclusions

We studied the role of multi-homing in the newspaper market. We first built a micro-founded structural econometric model, which encompasses the demand for differentiated products on both sides of the market and allows for multi-homing on each side of the market. We then estimated the model above alternatively taking into account and not taking into account information on multi-homing by readers. Finally, we discussed to what extent disregarding multi-homing information may bias policy decisions, particularly in the field of competition policy. In the application, we focused on the Italian market for national daily newspapers and ran counterfactual policy simulations (such as testing the traditional market definition distinguishing generalist, financial and sport newspapers) that are potentially affected by the use of information on multi-homing.

Preliminary results for the readers' side of the market showed that not accounting for multi-homing leads to a substantial bias in the estimation of own and cross-price elasticities as well as own and cross network effect elasticities. Similarly, disregarding multi-homing information, may bias the estimation of own and cross price and network effects elasticities on the advertising side of the market.

This is likely to bias the conclusions of such exercises as market definition or merger evaluations in which both own and cross-price elasticities and own and cross-network effect elasticities play a crucial role.

References

AFFELDT, P., L. FILISTRUCCHI, AND T. J. KLEIN (2013): "Upward Pricing Pressure in Two-sided Markets," *The Economic Journal*, 123(572), F505–F523.

ALSTON, J. M., K. A. FOSTER, AND R. D. GREEN (1994): "Estimating Elasticities with the Linear Approximate Almost Ideal Demand System: Some Monte Carlo Results," *Review of Economics and Statistics*, 76(2), 351–356.

AMBRUS, A., E. CALVANO, AND M. REISINGER (2016): "Either or Both Competition: A 'Two-Sided' Theory of Advertising with Overlapping Viewerships," *American Economic Journal: Microeconomics*, 8(3), 189–222.

ANDERSON, S. P., Ø. FOROS, AND H. J. KIND (2018): "Competition for Advertisers and for Viewers in Media Markets," *The Economic Journal*, 128(608), 34–54.

ANDERSON, S. P., AND J. J. GABSZEWICZ (2006): "The Media and Advertising: A Tale of Two-Sided Markets," in *Handbook of the Economics of Art and Culture*, ed. by V. A. Ginsburgh, and D. Throsby, vol. 1, pp. 567–614. Elsevier.

ANDERSON, S. P., AND B. JULLIEN (2015): "The Advertising-Financed Business Model in Two-Sided Media Markets," in *Handbook of Media Economics*, ed. by S. P. Anderson, J. Waldvogel, and D. Stromberg, vol. 1, pp. 41–90. NorthHolland.

ARGENTESI, E., AND L. FILISTRUCCHI (2007): "Estimating Market Power in a Two-Sided Market: The Case of Newspapers," *Journal of Applied Econometrics*, 22(7), 1247–1266.

ARMSTRONG, M. (2006): "Competition in Two-Sided Markets," *RAND Journal of Economics*, 37(3), 668–691.

ATHEY, S., E. CALVANO, AND J. S. GANS (2016): "The Impact of Consumer Multi-homing on Advertising Markets and Media Competition," *Management Science*, 64(4), 1574–1590.

BERRY, S., J. LEVINSOHN, AND A. PAKES (1995): "Automobile Prices in Market Equilibrium," *Econometrica*, 63(4), 841–890.

BERRY, S. T. (1994): "Estimating Disrete-Choice Models of Product Differentiation," *RAND Journal of Economics*, 63(4), 841–890.

CAILLAUD, B., AND B. JULLIEN (2001): "Competing Cybermediaries," *European Economic Review*, 45(4-6), 797–808.

——— (2003): "Chicken and Egg: Competition Among Intermediation Service Providers," *RAND Journal of Economics*, 34(2), 309–328.

DEATON, A., AND J. MUELLBAUER (1980): "An Almost Ideal Demand System," *American Economic Review*, 70(3), 312–326.

EVANS, D. S. (2003): "The Antitrust Economics of Multi-Sided Platform Markets," *Yale Journal on Regulation*, 20, 325–382.

EVANS, D. S., AND R. SCHMALENSEE (2007): "The Industrial Organization of Markets with Two-Sided Platforms," *Competition Policy International*, 3(1), 151–179.

FAN, Y. (2013): "Ownership Consolidation and Product Characteristics: A Study of the U.S. Daily Newspaper Market," *American Economic Review*, 103(5), 1598–1628.

FILISTRUCCHI, L. (2005): "The Impact of Internet on the Market for Daily Newspapers in Italy," *EUI Working Paper ECO No. 2005/12*.

FILISTRUCCHI, L., D. GERADIN, E. VAN DAMME, AND P. AFFELDT (2014): "Market Definition in Two-Sided Markets: Theory and Practice," *Journal of Competition Law and Economics*, 10(2), 293–339.

FILISTRUCCHI, L., AND T. J. KLEIN (2013): "Price Competition in Two-Sided Markets with Hetergoenous Consumers and Network Effetcs," *NET Institute Working Paper No. 13-20*.

FILISTRUCCHI, L., T. J. KLEIN, AND T. MICHIELSEN (2012): "Assessing Unilateral Merger Effects in a Two-Sided Market: An Application to the Dutch Daily Newspaper Market," *Journal of Competition Law and Economics*, 8(2), 297–329.

GENTZKOW, M. (2007): "Valuing New Goods in a Model with Complementarity: Online Newspapers," *American Economic Review*, 97(3), 713–744.

GENTZKOW, M., J. M. SHAPIRO, AND M. SINKINSON (2014): "Competition and Ideological Diversity: Historical Evidence from US Newspapers," *American Economic Review*, 104(10), 3073–3114.

HAUSMAN, J., G. LEONARD, AND J. D. ZONA (1994): "Competitive Analysis with Differentiated Products," *Annales d'Economie et de Statistique*, 34, 159–180.

HEIEN, D., AND G. POMPELLI (1988): "The Demand for Beef Products: Cross-Section Estimation of Demographic and Economic Effects," *Western Journal of Agricultural Economics*, 13(1), 37–44.

IVALDI, M., AND C. MULLER-VIBES (2018): "The Differentiated Effect of Advertising on Readership: Evidence from a Two-Sided Market Approach," *Toulouse School of Economics Working Paper Number 18-900*.

KAISER, U., AND J. WRIGHT (2006): "Price Structure in Two-Sided Markets: Evidence from the Magazine Industry," *International Journal of Industrial Organization*, 24(1), 1–28.

LIU, Y.-H. (2018): "The Impact of Consumer Multi-homing Behavior on Ad Prices: Evidence from an Online Marketplace," Mimeographed.

NEVO, A. (2000): "A Practioner's Guide to Estimation of Random Coefficients Logit Models of Demand," *Journal of Economics & Management Strategy*, 9(4), 513–548.

PARKER, G. G., AND M. W. VAN ALSTYNE (2005): "Two-Sided Network Effects: A Theory of Information Product Design," *Management Science*, 51(10), 1494–1504.

PINKSE, J., AND M. SLADE (2004): "Mergers, Brand Competition and the Price of a Pint," *European Economic Review*, 48(3), 617–643.

PINKSE, J., M. SLADE, AND C. BRETT (2002): "Spatial Price Competition: a Semiparametric Approach," *Econometrica*, 70(3), 1111–1155.

ROCHET, J.-C., AND J. TIROLE (2002): "Cooperation among Competitors: Some Economics of Payment Card Associations," *RAND Journal of Economics*, 33(4), 549–570.

——— (2003): "Platform Competition in Two-Sided Markets," *Journal of the European Economic Association*, 1(4), 990–1029.

——— (2006): "Two-sided Markets: A Progress Report," *RAND Journal of Economics*, 37(3), 645–667.

ROJAS, C. (2008): "Price Competition in U.S. Brewing," *The Journal of Industrial Economics*, 56(1), 1–31.

ROJAS, C., AND E. B. PETERSON (2008): "Demand for Differentiated Products: Price and Advertising Evidence from the U.S. Beer Market," *International Journal of Industrial Organization*, 26(1), 288–307.

RYSMAN, M. (2004): "Competition between Networks: A Study of the Market for Yellow Pages," *Review of Economic Studies*, 71(2), 483–512.

——— (2007): "An Empirical Analysis of Payment Card Usage," *The Journal of Industrial Economics*, 55(1), 1–36.

SHI, M. C. (2015): "Catching (Exclusive) Eyeballs: Multi-Homing and Platform Competition in the Magazine Industry," Mimeographed.

SLADE, M. (2004): "Market Power and Joint Dominance in UK Brewing," *The Journal of Industrial Economics*, 52(1), 133–163.

WRIGHT, J. (2004): "One-Sided Logic in Two-Sided Markets," *Review of Network Economics*, 3(1),

44–64.

A Appendix

A.1 Data Sources

Table 18: Used Data and Corresponding Data Sources

Data	Source
Newspaper Data	
Average prints	Accertamenti Diffusione Stampa
Cover prices	Newspaper publishers
Magazines, inserts, local pages, websites, editors	Newspaper publishers
Number of pages	Nielsen Media Research
Advertising quantities and revenues	Nielsen Media Research
Data on multi-homing readers	Audipress
Reader demographics (age groups, gender, socio-economic status)	Audipress
Additional Data	
Italian consumer price index	OECD
Italian population above 14	ISTAT
Italian GDP	OECD
Paper price	Camera di Commercio di Milano
Hourly wage index printed media sector	ISTAT
Journalist hourly wage index	ISTAT
Electricity prices for industrial consumers	Eurostat
Italian internet penetration rate	ISTAT

A.2 Construction of Bundle Level Dataset

In order to estimate readers' demand accounting for multi-homing by readers, we estimate a demand equation where consumers are allowed to read up to two newspapers (which is what we observe in the data). Readers are therefore allowed to choose between all possible couples of newspapers, including single-homing on a newspaper.

We hence construct a dataset in which the level of observation is no longer a newspaper at a particular point in time but a bundle of up to two newspapers for a given average weekday within a month.

We construct the monthly average circulation for each day of the week for a given bundle based on the survey data on multi-homing behaviour of readers. First of all, for each newspaper we compute the share of single-homing (captive) readers, which also includes readers of other newspapers not included in our sample. Multiplying this share of single-homing readers with the circulation of the newspaper gives the circulation of the single-homing "bundle" at a particular point in time.

Constructing the circulation of a bundle of two newspapers is more complicated as double-homing reader percentages are not symmetric. For example, the percentage of readers of newspaper A who also read newspaper B will not be the same as the percentage of readers of newspaper B who also read newspaper A. However, multiplying these percentages with the respective newspaper circulation provides a lower and an upper bound for the circulation of the bundle of the two newspapers at a particular point in time.

We then have to decide on the optimal point within the interval between lower and upper bound bundle circulation. Of course, setting bundle circulation to any value within this interval implies that, if we calculate newspaper circulation as the sum of the circulation of all bundles containing that particular newspaper, overall newspaper level circulation will not be equal to the actual circulation of that newspaper in the original data.

We therefore choose the optimal point in the interval between lower and upper bound bundle circulation so as to minimize the difference between actual and estimated newspaper circulation for the seven newspapers at each point in time. We did so by running constrained regressions for each half-year period (the interval at which we have information on reader multi-homing). The dependent variable in this regression is the circulation of the respective newspaper minus the single-homing circulation minus the lower bound circulations of all bundles including this newspaper. The dependent variable is hence the part of the total newspaper circulation that we still need to distribute across bundles. The independent variables are then the differences between upper and lower bound circulation for all possible bundles of two newspapers, where this difference is set to zero for all bundles that do not include the respective newspaper. We then run a constrained OLS regressions, in which all the coefficients are constrained to lie between zero and one - the estimated coefficients thus give us the optimal points in the respective intervals between lower and upper bound bundle circulation for all bundles of two newspapers. We repeated this constrained regression for every half year period in the dataset and constructed the bundle circulation for all bundles of two newspapers based on the estimated optimal points in the interval between lower and upper bound bundle circulation.

As mentioned before, this procedure implies that if we collapse the bundle level dataset back to the newspaper level, circulation at the newspaper level will not be equal to the actual newspaper circulation of the original dataset. Table 19 shows the mean actual and mean estimated newspaper circulation as well as the mean percentage difference between the two. The percentage difference between actual and estimated newspaper circulation based on the constrained regression procedure is always lower than 8%.

Table 19: Difference between Actual and Estimated Circulation by Newspaper

Newspaper	Mean Actual Circulation	Mean Estimated Circulation	Mean Percentage Difference
Corriere	866,130	850,469	1.52
Corriere Sport	428,295	414,402	2.59
Gazzetta Sport	584,629	608,265	-4.28
Giornale	315,328	292,570	7.24
Repubblica	799,423	808,024	-1.48
Il Sole	462,816	443,114	4.22
Stampa	521,152	511,133	1.81

The construction of the other variables in the bundle level dataset is straightforward: the bundle price is the sum of the two newspaper prices, advertising intensity is the sum of advertising slots in both newspapers divided by the total number of pages of the two newspapers, the paper cost is the sum of the two newspaper costs, the number of local pages is the sum of the local pages of the two newspapers. For the other newspaper characteristics, which are dummy variables (for example the point in time when the newspaper introduced a website), we also calculate the sum of the two dummy variables. However, this variable will then only capture when, for example the first website in the bundle was introduced. We therefore define additional variables for these product characteristics which capture the change from zero to one for the second newspaper included in the bundle.

A.3 Elasticities Advertisers' Demand

A.3.1 Conditional Price Elasticities

Differentiating the advertising sales share w_{jt} of newspaper j at time t with respect to own- and cross-prices (p_{jt} and p_{kt}), holding x_t constant, gives:

$$\frac{\partial w_{jt}}{\partial p_{kt}} = \begin{cases} \frac{\partial(p_{jt}q_{jt}/x_t)}{\partial p_{jt}} = \frac{q_{jt}}{x_t} + \frac{p_{jt}}{x_t}\frac{\partial q_{jt}}{\partial p_{jt}} = \frac{q_{jt}}{x_t} + \frac{p_{jt}}{x_t}\frac{\partial q_{jt}}{\partial p_{jt}}\frac{q_{jt}}{q_{jt}} = \frac{q_{jt}}{x_t} + \frac{q_{jt}}{x_t}\tilde{\eta}_{jj} & \text{if } k = j \\ \frac{\partial(p_{jt}q_{jt}/x_t)}{\partial p_{kt}} = \frac{p_{jt}}{x_t}\frac{\partial q_{jt}}{\partial p_{kt}} = \frac{p_{jt}}{x_t}\frac{\partial q_{jt}}{\partial p_{kt}}\frac{p_{kt}}{q_{jt}}\frac{q_{jt}}{p_{kt}} = \frac{w_{jt}}{p_{kt}}\tilde{\eta}_{jk} & \text{if } k \neq j \end{cases} \tag{14}$$

Solving for $\tilde{\eta}_{jj}$ and $\tilde{\eta}_{jk}$ gives:

$$\tilde{\eta}_{jk} = \begin{cases} \frac{x_t}{q_{jt}}\frac{\partial w_{jt}}{\partial p_{jt}} - 1 & \text{if } k = j \\ \frac{\partial w_{jt}}{\partial p_{kt}}\frac{p_{kt}}{w_{jt}} & \text{if } k \neq j \end{cases} \tag{15}$$

Now, given the functional form of the estimation equation for w_{jt} in equation (7), the own- and cross-price derivatives, $\frac{\partial w_{jt}}{\partial p_{jt}}$ and $\frac{\partial w_{jt}}{\partial p_{kt}}$, are the following:

$$\frac{\partial w_{jt}}{\partial p_{kt}} = \begin{cases} \frac{\partial w_{jt}}{\partial \ln(p_{jt})}\frac{\partial \ln(p_{jt})}{\partial p_{jt}} = \frac{1}{p_{jt}}\frac{\partial w_{jt}}{\partial \ln(p_{jt})} = \frac{1}{p_{jt}}[b_{jj} - d_j w_{jt}] & \text{if } k = j \\ \frac{\partial w_{jt}}{\partial \ln(p_{kt})}\frac{\partial \ln(p_{kt})}{\partial p_{kt}} = \frac{1}{p_{kt}}\frac{\partial w_{jt}}{\partial \ln(p_{kt})} = \frac{1}{p_{kt}}[b_{jk} - d_j w_{kt}] & \text{if } k \neq j \end{cases} \tag{16}$$

Lastly, the conditional own- and cross-price elasticities are obtained by replacing (16) into (15):

$$\tilde{\eta}_{jk} = \begin{cases} -1 + \frac{b_{jj}}{w_{jt}} - d_j & \text{if } k = j \\ \frac{b_{jk}}{w_{jt}} - d_j \frac{w_{kt}}{w_{jt}} & \text{if } k \neq j \end{cases} \tag{17}$$

Note that the b_{jj} potentially is a function of own product characteristic while b_{jk} is a function of the closeness measures.

A.3.2 Unconditional Price Elasticities

Compared to the price elasticities of advertising demand $\tilde{\eta}_{jk}$ *conditional on total advertising expenditures* x_t, the *unconditional* advertising price elasticities η_{jk} also need to take into account how advertising price increases by one newspaper change the overall price index for advertising in newspapers, how this in turn then changes the overall demand for advertising in print newspapers at the top level (relative to other media outlets) and how this change in total advertising expenditures x_t then affects the advertising quantity demanded on newspaper j. See Heien and Pompelli (1988) for the general formula of the total own price elasticity in the AIDS model.

Given the functional form of the estimation equations in equations (5) and (7) and the choice of the price index P_t^L, the unconditional price-elasticities for advertising demand η_{jk} are given by:

$$\eta_{jk} = \begin{cases} \tilde{\eta}_{jj} + (1 + \frac{d_j}{w_{jt}})(\beta_2 + 1) w_{jt} & \text{if } k = j \\ \tilde{\eta}_{jk} + (1 + \frac{d_j}{w_{jt}})(\beta_2 + 1) w_{kt} & \text{if } k \neq j \end{cases} \tag{18}$$

The additional term in comparison to the conditional price elasticities of advertising demand $\tilde{\eta}_{jk}$ is the percentage change in advertising quantity q_{jt} demanded on newspaper j following an advertising price increase of newspaper k that goes via its effect on total advertising expenditure x_t:

- w_{kt} is the elasticity of the price index P_t with respect to a change in the advertising price of newspaper k p_{kt}.

- $(\beta_2 + 1)$ is the elasticity of total advertising expenditure x_t with respect to a change in the price index P_t^L (Heien and Pompelli, 1988, p.40), where β_2 is the overall price elasticity of advertising demand in the seven newspapers relative to other media outlets estimated at the top level (see top level estimation equation (5)).

- $(1 + \frac{d_j}{w_{jt}})$ is the expenditure elasticity, i.e. by how much a change in total advertising expenditure x_t changes the advertising quantity q_{jt} demanded on newspaper j (Alston, Foster, and Green, 1994, p.352). If a change in total advertising expenditure x_t leaves the advertising sales share of newspaper j w_{jt} unchanged (i.e. the estimated d_j in equation (7) is zero), the expenditure elasticity is 1. If instead w_{jt} changes with a change in x_t, the expenditure elasticity of newspaper j depends on the estimated d_j.

A.3.3 Circulation Elasticities

Circulation elasticities, which do not depend on total advertising expenditures x_t, are derived in a similar way as the conditional price elasticities. Differentiating the advertising sales share w_{jt} of newspaper j at time t with respect to own- and cross-circulation ($circ_{jt}$ and $circ_{kt}$) gives:

$$\frac{\partial w_{jt}}{\partial circ_{kt}} = \begin{cases} \frac{\partial (p_{jt}q_{jt}/x_t)}{\partial circ_{jt}} = \frac{p_{jt}}{x_t}\frac{\partial q_{jt}}{\partial circ_{jt}} = \frac{p_{jt}}{x_t}\frac{\partial q_{jt}}{\partial circ_{jt}}\frac{circ_{jt}}{q_{jt}}\frac{q_{jt}}{circ_{jt}} = \frac{w_{jt}}{circ_{jt}}\rho_{jj} & \text{if } k = j \\ \frac{\partial (p_{jt}q_{jt}/x_t)}{\partial circ_{kt}} = \frac{p_{jt}}{x_t}\frac{\partial q_{jt}}{\partial circ_{kt}} = \frac{p_{jt}}{x_t}\frac{\partial q_{jt}}{\partial circ_{kt}}\frac{circ_{kt}}{q_{jt}}\frac{q_{jt}}{circ_{kt}} = \frac{w_{jt}}{circ_{kt}}\rho_{jk} & \text{if } k \neq j \end{cases} \tag{19}$$

Solving for ρ_{jj} and ρ_{jk} gives:

$$\rho_{jk} = \begin{cases} \frac{\partial w_{jt}}{\partial circ_{jt}}\frac{circ_{jt}}{w_{jt}} & \text{if } k = j \\ \frac{\partial w_{jt}}{\partial circ_{kt}}\frac{circ_{kt}}{w_{jt}} & \text{if } k \neq j \end{cases} \tag{20}$$

Given the functional form of the estimation equation for w_{jt} in equation (7), the own- and cross-circulation derivatives, $\frac{\partial w_{jt}}{\partial circ_{jt}}$ and $\frac{\partial w_{jt}}{\partial circ_{kt}}$, are the following:

$$\frac{\partial w_{jt}}{\partial circ_{kt}} = \begin{cases} \frac{\partial w_{jt}}{\partial \ln(circ_{jt})}\frac{\partial \ln(circ_{jt})}{\partial circ_{jt}} = \frac{1}{circ_{jt}}\frac{\partial w_{jt}}{\partial \ln(circ_{jt})} = \frac{c_{jj}}{circ_{jt}} & \text{if } k = j \\ \frac{\partial w_{jt}}{\partial \ln(circ_{kt})}\frac{\partial \ln(circ_{kt})}{\partial circ_{kt}} = \frac{1}{circ_{kt}}\frac{\partial w_{jt}}{\partial \ln(circ_{kt})} = \frac{c_{jk}}{circ_{kt}} & \text{if } k \neq j \end{cases} \tag{21}$$

Lastly the own- and cross-circulation elasticities are obtained by replacing (21) into (20):

$$\rho_{jk} = \begin{cases} \frac{c_{jj}}{w_{jt}} & \text{if } k = j \\ \frac{c_{jk}}{w_{jt}} & \text{if } k \neq j \end{cases} \tag{22}$$

with c_{jj} potentially being a function of own product characteristics and c_{jk} being a function of the closeness measures.

A.4 Determinants of Advertisers' Demand Elasticities

Table 20: Mean Characteristics by Newspaper (1992-2006)

	Advertising expenditure share	Percentage of female readers	Percentage of single-homing readers
Corriere	28.09	40.97	45.81
Corriere Sport	3.92	13.08	41.45
Gazzetta Sport	6.21	12.67	50.08
Giornale	5.65	38.44	29.02
Repubblica	26.03	41.21	51.42
Il Sole	16.25	33.55	25.03
Stampa	14.27	41.7	61.63