

# Price structure in two-sided markets: Evidence from the magazine industry\*

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## Abstract

We present and estimate a simple Hotelling model of competition in a two-sided market: the market for magazine readership and advertising. The model is estimated using data on magazines in Germany. We find some evidence that magazines have properties of two-sided markets. The results of the fitted model are consistent with the perception that subscription prices for readers are “subsidized” and magazines make most their money from advertisers.

**Note to the referees:** our data and software codes are available from the internet at <http://www.ulrichkaiser.com/papers/twosided.html>

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# 1 Introduction

Many markets where network externalities are important are in fact two-sided markets. Two-sided markets have the property that there are two distinct types of users, each of which wishes to interact on a common platform, and in which the structure of prices between the two sides (rather than just the total level of prices) matters.<sup>1</sup> Some common examples include directory services such as classifieds and Yellow Pages which cater to potential buyers and sellers; entertainment platforms such as video game platforms which cater to users and content providers; matching markets such as employment websites, dating agencies; payment schemes such as debit and credit card schemes which cater to cardholders and merchants; search engines which cater to searchers and websites; and trading posts such as auctions, B2B markets, car fairs, flea markets, and shopping malls which cater to buyers and sellers.

A key question arising in two-sided markets is how does the platform price to each type of user? Is one side of the market “subsidized” in order to attract the other? Armstrong (2004), Caillaud and Jullien (2003), and Rochet and Tirole (2003) each provide models of two-sided markets. In these models, two platforms compete, each offering a service to the two types of users. Users on each side are assumed to get some benefit from being able to interact with, or be on the same platform as, users from the other side of the market. The more users of the opposite type, the greater the benefit to being on the same platform. For example, buyers value a Yellow Pages directory which has lots of advertisers, and businesses value a Yellow Pages directory which will be used by lots of buyers. These models involve platforms pricing to both sides of the market, with key

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<sup>1</sup>See Rochet and Tirole (2004) for a more precise definition. See also Armstrong (2004) and Evans (2003a, 2003b).

differences in the models arising from whether platforms charge for transactions made between the two-sides or simply for joining the platform, how the two sides of the market are matched, whether the platforms are differentiated, and whether one or both sides can “multihome” (subscribe to both competing platforms in order to reach all users on the other side).

This paper represents a first attempt to estimate an explicit model of two-sided markets to explain the determinants of price structure, doing so using data on magazines for Germany. The model we estimate is a simple one. It is an adapted version of Armstrong’s model of a two-sided market with exclusive intermediation. In the model, two differentiated platforms set joining fees, and users on each side exclusively subscribe to one or other platform. Advertisers value the number of readers of the magazine and readers value the number of ads in the magazine. In addition, we allow readers to value the amount of content in the magazine.

There are several reasons for choosing magazines for this exercise. Many two-sided markets involve one side being charged nothing (for example, employment websites, real estate agencies, search engines, shopping malls, and Yellow Pages), in which case the existing models do not apply. Magazines involve both readers and advertisers being charged. Moreover, unlike other examples where both sides are charged (for example, payment cards and video game platforms), magazines do not involve widespread multihoming, and so provide a better match to the model of exclusive platform competition considered by Armstrong.<sup>2</sup> The nature of magazine pricing also matches the assumption made in

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<sup>2</sup>We checked this observation for the February 2004 issues of the two largest magazine groups in our sample. For ‘Do-It-Yourself’ magazines we found the ratio of multihoming ads to the total number of ads was 0.14, while for ‘Photography’ magazines, where one might expect a lot of multihoming by the major camera companies, the ratio was still only 0.24. We do not have any systematic information on

this framework, in that users on each side pay to “join” the platform (rather than for transactions made between the two types of users), and that there are markets with only two magazines competing.<sup>3</sup> Finally, there is publicly available data on magazines (for Germany), making the estimation possible.

In the model two magazines compete in a Hotelling fashion. A fixed number of consumers choose which of the two magazines to read, taking into account the amount of content in each magazine, the amount of advertising in each magazine, the price of each magazine, and their exogenous preferences for each magazine. Similarly, a fixed number of potential advertisers chooses which of the two magazines to advertise in, taking into account the number of readers in each magazine, the price charged for advertising in each magazine, and their exogenous preferences for each magazine. Magazines choose a cover price, an advertising price and the amount of content to produce in order to maximize their profits, given the prices and content choices of their rivals. Users are assumed to have rational expectations, so that for instance, advertisers are assumed to determine how many readers each magazine will have in equilibrium (from the model), when choosing which magazine to advertise in.

The model is estimated using an unbalanced panel of eight distinct two-magazine groups in Germany during the period 1979-2002. We illustrate how the estimated parameters can then be used to determine the size of the network benefits in each direction (how much readers value ads, and how much advertisers value readers), and how the structure of the price-cost margins reflects asymmetries in these network externalities and asymmetries in the extent of product differentiation between the readers’ side and the advertisers’ side. The rest of the paper proceeds as follows. Section 2 presents the

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how many readers multihome, but we suspect it is relatively low.

<sup>3</sup>Currently, there are no models in the literature that allow for more than two platforms to compete.

model of a two-sided market that we estimate. Section 3 describes the data, while Section 4 describes our empirical specification. Results are presented in Section 5, with Section 6 providing some concluding comments.

## 2 A model of magazines as a two-sided market

We adapt the generic model of two-sided exclusive platform intermediation developed by Armstrong (2004, Section 4) to the magazine market. Magazines provide three types of services. They provide content for readers, ads which allow readers to find out about products (possibly) of interest, and an advertising outlet which provides firms with a way to inform readers about their products.

We assume there are just two magazines in the market, and consumers are assumed to only purchase one of the two magazines. Specifically suppose there is a measure  $S$  of consumers who will buy from one or other of the magazines. These consumers are located uniformly on the interval  $[0, 1]$ , and the magazines are located at either ends of the interval. Suppose a consumer located at  $x$  gets net utility  $v_1$  if they subscribe to magazine 1, where

$$v_1 = \gamma' N_1^a + \psi' N_1^c - p_1 + \bar{\varepsilon}_1 - tx$$

and gets net utility  $v_2$  if they subscribe to magazine 2, where

$$v_2 = \gamma' N_2^a + \psi' N_2^c - p_2 + \bar{\varepsilon}_2 - t(1 - x).$$

The utility of reading a magazine is assumed to be a linear function of the number of pages of ‘ads’  $N_i^a$  in magazine  $i$ , and the number of pages of content  $N_i^c$  in magazine  $i$ . The consumers’ net utility is decreasing in the price charged by magazine  $i$ , denoted  $p_i$ . These three variables are observable. The random variable  $\bar{\varepsilon}_i$  measures the unobservable intrinsic

benefits of subscribing to magazine  $i$  that consumers obtain, while the last term measures the unobservable transportation costs consumers face from consuming a magazine that is not their ideal. The parameter  $t$  is the transportation cost (a measure of how differentiated are the magazines of the given subject type), and  $x$  is a consumer's particular location in product space between 0 and 1. We define  $\bar{\varepsilon}_1 = v_0 + b' + \varepsilon'_1$  and  $\bar{\varepsilon}_2 = v_0 + \varepsilon'_2$ , where  $\varepsilon_i$  has mean zero, so that  $v_0$  and  $b'$  are unobserved constants. The parameter  $b'$  measures the intrinsic consumer preference for magazine 1 over magazine 2; that is, brand loyalty. The parameter  $v_0$  is assumed to be high enough so that all consumers want to buy one of the magazines.

Given this specification of readers' utility, the number of readers obtained by magazine 1 is

$$\begin{aligned} S_1 &= \left( \frac{1}{2} + \frac{\left( \gamma' N_1^a + \psi' N_1^c - p_1 + b' + \varepsilon'_1 \right) - \left( \gamma' N_2^a + \psi' N_2^c - p_2 + \varepsilon'_2 \right)}{2t} \right) S \\ &= \left( \frac{1}{2} + (\gamma N_1^a + \psi N_1^c - \beta p_1) - (\gamma N_2^a + \psi N_2^c - \beta p_2) + b + \varepsilon_1 - \varepsilon_2 \right) S \end{aligned} \quad (1)$$

and

$$S_2 = S - S_1, \quad (2)$$

where we have defined  $\beta = 1/2t$ ,  $\gamma = \gamma'/2t$ ,  $\psi = \psi'/2t$ ,  $b = b'/2t$ ,  $\varepsilon_1 = \varepsilon'_1/2t$  and  $\varepsilon_2 = \varepsilon'_2/2t$ .

The advertisers' choice of magazine is modeled in a similar way. There are a measure  $N$  of firms that will advertise in one or other of the two magazines. Let  $a_i$  be the advertising price set by magazine  $i$ . Then a firm gets a contribution to profit from advertising in magazine  $i$  that is assumed to be a linear function of the number of readers of the magazine, and the price they are charged for the ad  $a_i$ , as well as some exogenous factors (such as precisely how well the magazine target audience matches the firms' potential

customers). To model the latter, suppose firms are located uniformly on the unit interval  $[0, 1]$ , with transportation costs for a firm located at  $y$  of  $\tau y$  for advertising in magazine 1 and transportation costs  $\tau(1 - y)$  for advertising in magazine 2. The contribution to a firm's profits of advertising in magazine 1 is thus given as

$$\pi_1 = \rho' S_1 - a_1 + \bar{\xi}_1 - \tau y$$

and the contribution to profits to a firm's profit of advertising in magazine 2 is

$$\pi_2 = \rho' S_2 - a_2 + \bar{\xi}_2 - \tau(1 - y),$$

where  $\bar{\xi}_i$  is some exogenous unobservable benefit firms get from having an ad in magazine  $i$  (for example, advertising may be beneficial to their reputation — the ad may be seen by suppliers, employees, and creditors, thereby enhancing the firm's reputation). We define  $\bar{\xi}_1 = \pi_0 + \phi' + \xi_1'$  and  $\bar{\xi}_2 = \pi_0 + \xi_2'$ , where  $\xi_i'$  has mean zero, so that  $\pi_0$  and  $\phi'$  are unobserved constants. The parameter  $\phi'$  measures the intrinsic preference of advertisers for magazine 1 over magazine 2 (the brand loyalty of magazine 1), while  $\pi_0$  is assumed to be high enough so that all firms want to advertise in one of the magazines. Since there is assumed to be one ad per firm, the number of ads in each magazine will be equal to

$$\begin{aligned} N_1^a &= \left( \frac{1}{2} + \frac{(\rho' S_1 - a_1 + \phi' + \xi_1') - (\rho' S_2 - a_2 + \xi_2')}{2\tau} \right) N \\ &= \left( \frac{1}{2} + (\rho S_1 - \eta a_1) - (\rho S_2 - \eta a_2) + \phi + \xi_1 - \xi_2 \right) N \end{aligned} \quad (3)$$

and

$$N_2^a = N - N_1^a, \quad (4)$$

where we have defined  $\eta = 1/2\tau$ ,  $\rho = \rho'/2\tau$ ,  $\phi = \phi'/2\tau$ ,  $\xi_1 = \xi_1'/2\tau$  and  $\xi_2 = \xi_2'/2\tau$ .

The profit of magazine  $i$  is the sum of profits from readership and from advertising,

less the costs of producing content and any fixed costs. These profits can be written as

$$\Pi_i = (p_i - f_i) S_i + (a_i - c_i) N_i^a - d_i (N_i^c)^2 - F_i, \quad (5)$$

where  $f_i$  is the cost of printing and distributing the magazine per copy sold<sup>4</sup>,  $c_i$  is the cost of producing a single advertisement for magazine  $i$ ,  $d_i$  is the cost of producing a page of content (that also varies between the magazines), and  $F_i$  is other fixed costs of operations. Variable cost that are associated with producing advertisements include liaising with clients on each advertisement. Note that content is costly to produce. It only contributes to profit to the extent it causes an increase in subscriptions, and indirectly advertising revenue. Moreover, content is assumed to have increasing marginal costs (it is more and more expensive to get additional interesting stories and material for each issue).

Each magazine sets  $p_i$ ,  $a_i$  and  $N_i^c$  to maximize its profits, given the choices of its rival. After observing the choice of these variables, consumers (readers) decide which magazine to buy and firms (advertisers) decide which magazine to advertise in. Rational expectations are assumed, so readers and advertisers work out how many of each type will subscribe to each magazine using the above model when making their own decision. Rational expectations demands facing each magazine are determined by the simultaneous solution to (1)-(4). We re-write these four equations as share equations by dividing both sides by the total number of users in each case (the lower case variables  $s_i$  and  $n_i^a$  are

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<sup>4</sup>In the case the magazines are sold via subscription this would include the cost of postage and handling, while if the magazines are sold via kiosks, newstands and bookstores, then this would include the payment that these retailers would require. Unlike the case in the United States, in Germany most subscription prices are quite similar to those offered at the newstands, suggesting the costs of both channels are similar (Kaiser, 2003).



shares):

$$s_1 = \frac{1}{2} + (\gamma N_1^a + \psi N_1^c - \beta p_1) - (\gamma N_2^a + \psi N_2^c - \beta p_2) + b + \varepsilon_1 - \varepsilon_2 \quad (6)$$

$$s_2 = 1 - s_1 \quad (7)$$

$$n_1^a = \frac{1}{2} + (\rho S_1 - \eta a_1) - (\rho S_2 - \eta a_2) + \phi + \xi_1 - \xi_2 \quad (8)$$

$$n_2^a = 1 - n_1^a. \quad (9)$$

These share functions can be solved to give

$$s_1 = \frac{\frac{1}{2} + \psi (N_1^c - N_2^c) - \beta (p_1 - p_2) + b + \varepsilon_1 - \varepsilon_2 + 2\gamma N (\phi - \rho S + \xi_1 - \xi_2 - \eta (a_1 - a_2))}{1 - 4\rho\gamma NS} \quad (10)$$

$$n_1^a = \frac{\frac{1}{2} - \eta (a_1 - a_2) + \phi + \xi_1 - \xi_2 + 2\rho S (b - \gamma N + \varepsilon_1 - \varepsilon_2 - \beta (p_1 - p_2) + \psi (N_1^c - N_2^c))}{1 - 4\rho\gamma NS} \quad (11)$$

with  $s_2 = 1 - s_1$  and  $n_2^a = 1 - n_1^a$ . Using these share functions and (5), we get the first order conditions:

$$(1 - 4\gamma\rho NS) s_1 - \beta (p_1 - f_1) - 2\rho\beta (a_1 - c_1) N = 0 \quad (12)$$

$$(1 - 4\gamma\rho NS) n_1^a - \eta (a_1 - c_1) - 2\gamma\eta (p_1 - f_1) S = 0 \quad (13)$$

$$\psi (p_1 - f_1 + 2\rho (a_1 - c_1) N) S - 2(1 - 4\gamma\rho NS) d_1 N_1^c = 0 \quad (14)$$

$$(1 - 4\gamma\rho NS) s_2 - \beta (p_2 - f_2) - 2\rho\beta (a_2 - c_2) N = 0 \quad (15)$$

$$(1 - 4\gamma\rho NS) n_2^a - \eta (a_2 - c_2) - 2\gamma\eta (p_2 - f_2) S = 0 \quad (16)$$

$$\psi (p_2 - f_2 + 2\rho (a_2 - c_2) N) S - 2(1 - 4\gamma\rho NS) d_2 N_2^c = 0. \quad (17)$$

The solution to the model (the equilibrium) is given by the solution to (10)-(17). The result is a complicated expression that does not afford a useful interpretation. A further difficulty is that we cannot identify the cost parameters  $f$ ,  $c$ , and  $d$  in terms of estimation without further assumptions. Also the set of equations implies many non-linear cross-equation restrictions, which prevents reliable estimation given our limited data set.

One way to avoid all three difficulties is just to estimate the share equations (10) and (11), and then interpret the results in the special case in which both magazines are symmetric (we do not impose symmetry when estimating the model). This allows us to obtain interesting results without estimating the marginal costs  $f$  and  $c$ . Interpreting the model at the symmetric equilibrium roughly corresponds to interpreting the parameter estimates at industry averages, as opposed to specific magazine averages. This approach does not seem unreasonable given that the magazines in our sample are broadly symmetric — with the average absolute difference between the readership share  $s_1$  and one-half (the case of symmetry) being 0.08 (standard deviation 0.13). The corresponding figure for ad share is 0.02 (0.13), and for content share it is 0.02 (0.07).

Setting  $\varepsilon_1 = \varepsilon_2 = \xi_1 = \xi_2 = b = \phi = 0$  and  $f = f_1 = f_2$ ,  $c = c_1 = c_2$  and  $d = d_1 = d_2$ , we get an equilibrium with  $s_1 = s_2$ ,  $n_1^a = n_2^a$ ,  $N_1^c = N_2^c$ ,  $p_1 = p_2$ , and  $a_1 = a_2$ . Then the ten equations simplify to just three:

$$1 - 4\gamma\rho NS - 2\beta(p_1 - f) - 4\rho\beta(a_1 - c)N = 0$$

$$1 - 4\gamma\rho NS - 2\eta(a_1 - c) - 4\gamma\eta(p_1 - f)S = 0$$

$$\psi S - 4d\beta N_1^c = 0$$

The simultaneous solution to these three equations is the symmetric equilibrium

$$p_1^* - f = p_2^* - f = \frac{1}{2\beta} - \frac{\rho N}{\eta} \quad (18)$$

$$a_1^* - c = a_2^* - c = \frac{1}{2\eta} - \frac{\gamma S}{\beta} \quad (19)$$

$$N_1^c = N_2^c = \frac{\psi S}{4d\beta} \quad (20)$$

Equilibrium cover prices are marked up above marginal cost to the extent of product differentiation on the readership side, but discounted to reflect the externality generated on the advertising side of the market from a magazine attracting more readers. In equi-

librium, the magazines discount cover prices to attract more readers, thereby attracting more advertisers. This effect is increasing in the extent to which advertisers' value readers  $\rho$  and in the total number of firms wanting to place ads  $N$ , and is decreasing in the sensitivity of a magazine's ad demand to its ad rate  $\eta$  (if ad demand is very sensitive to ad rates, then lowering ad rates becomes a cheaper way for magazines to generate additional advertisers rather than subsidising readers).

Likewise, ad rates are marked up above marginal cost to the extent of product differentiation on the advertisers' side, but discounted to reflect the externality generated on the readership side of the market from a magazine attracting more ads. If attracting more ads, allows a magazine to attract more readers, then the magazines will take this into account when pricing ads. Specifically, they discount ad rates by the extent to which readers value ads  $\rho$ , by the total number number of magazine readers  $S$ , but increase ad rates when readers are more sensitive to a magazine's cover price  $\beta$  (if readers are very sensitive to cover prices, then lowering cover prices is a cheaper way for magazines to generate additional readers rather than discounting ads).

Finally, the level of content is increasing in the amount readers value content and in the total number of magazine readers (since then each page of content generates more revenue), but is decreasing in the cost of producing content  $d$  and in the sensitivity of magazine readers to the cover price (if readers are very sensitive to cover prices, then lowering cover prices is a cheaper way for magazines to generate additional readers rather than producing additional content).

The estimation approach therefore is to estimate the share equations (6) and (8) so as to obtain estimates of the parameters  $\gamma, \psi, \beta, \rho$ , and  $\eta$ . These can then be used to solve for the equilibrium markup expressions (18)-(19) which are the expressions of central interest. This avoids the need to estimate costs through the first order conditions (which involve

numerous non-linear cross equation restrictions), or to interpret results for the general case (which without symmetry, is not practical).

### 3 Data

Our original data set comprises of quarterly information on cover prices, advertising prices, number of ad pages<sup>5</sup>, number of content pages, and number of subscribers for German magazines that existed between the first quarter of 1972 and the fourth quarter of 2002. All information we use is publicly available and can be downloaded from the Internet at <http://medialine.focus.de>. The original source of our data is the ‘Information Association for the Determination of the Spread of Advertising Media’ (‘Informationsgemeinschaft zur Feststellung der Verbreitung von Werbeträgern e.V’, IVW). IVW ascertains, monitors and publishes circulation and magazine dissemination information. All other information was originally gathered from the ‘Association Media Analysis’ (‘Arbeitsgemeinschaft Media-Analyse’, AG.MA), an association of the German advertising industry for the research of mass communication. The purpose of the AG.MA is to gather and to supply data for media audience measurement. AG.MA closely cooperates with IVW.<sup>6</sup>

We annualize our quarterly data since both cover prices and advertising rates almost always do not change within a year. Our identification of markets with just two magazines competing, a prerequisite to the estimation of the theoretical model, proceeds in two steps. First, we place each magazine into a unique magazine segment (or magazine submarket)

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<sup>5</sup>For simplicity we assume advertisements are all the same size, which we define as ‘one page’. We do not have any systematic information about advertising sizes but sampling the magazines in our study revealed that most ads tended to be the same size (which was one page).

<sup>6</sup>Our data and software code are downloadable from the internet at <http://www.ulrichkaiser.com/papers/twosided.html>.

and then check in what periods between 1972 to 2002 the respective magazine group has consisted of just two competing magazines (competing publishers).<sup>7</sup> The initial magazine grouping follows industry convention. We use the grouping by Jahreszeitenverlag (1981–2002).<sup>8</sup> Jahreszeitenverlag distinguishes between 35 different magazine groups. We search for two-magazine markets inside these 35 distinct groups and identify a total of 18 two-magazine markets that ever existed during our period of observation. The number of years of existence range between one and 29 years.

Table 1 (in the appendix) gives an overview of our sample selection. Ten of the eighteen two-magazine markets are eliminated because of difficulties in their definitions or data. This amounts to a total “loss” of 60 observations. Note that all magazines are published in German, even those that are originally from foreign countries such as ‘Elle’ and ‘Vogue’. Magazines also differ substantially from the original version with respect to content (though not by layout). Since the foreign originals (or other similar foreign magazines) are difficult to obtain and are typically significantly more expensive, we do not believe that they impose a competitive constraint on the German equivalents.

We do not consider ‘Magazines with special character’ (‘Neue Revue’ and ‘Reader’s Digest Das Beste’) since they are completely different magazines. ‘Neue Revue’ is concerned with the latest gossip surrounding European celebrities, while ‘Reader’s Digest

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<sup>7</sup>One advantage of using German data for this purpose is that there were a number of magazine groups for which only two German language magazines existed (two competing publishers). In English speaking countries, competition from British and American (English language) magazines is likely to make the identification of distinct magazine types with just two publishers competing quite difficult.

<sup>8</sup>Jahreszeitenverlag is a major German magazine publisher which made its annual publication ‘Function–analysis: fact book of magazine contents and portraits’ (‘Funktions–Analyse: Factbook für Inhalte und Portraits von Zeitschriften’) available to us upon request. We have access to the ‘Factbooks’ from 1992 to 2002.

Das Beste' is the German version of 'Reader's Digest'. We think a more appropriate label for these magazines would have been 'miscellaneous'.

We also exclude the 'Travel' magazines despite the fact that they in fact both deal with travelling. They come, however, in a different periodicity and one magazine ('Geo Saison') deals with a wide array of topics while the other one ('Merian') exclusively is concerned with a single travel destination. This is also the argument for leaving out 'Sports' magazines ('Sport Illustrierte' and 'kicker-sportmagazin'), 'Young illustrated' magazines ('Max' and 'Prinz'), 'Fitness' ('Vital' and 'Fit for Fun') magazines, 'Youth' magazines ('Bravo' and 'Musikexpress') and 'Riddle' magazines ('Extra Rätsel' and 'Freizeit Revue').<sup>9</sup> It might be true that all these magazines appear to be close substitutes from an advertiser's perspective, which is presumably why Jahreszeitenverlag allocated them as it did. From a reader's perspective however, these magazines are very different. One two-magazine market (Fiction magazines) is lost because we completely lack information on advertising pages and on content pages for one of the two magazines ("Romanwoche"). Lastly, we excluded 'PC' magazines ('Chip' and 'PC Welt'). For both magazines we expect resources on the Internet to be a particularly relevant competitor, so we do not expect this to behave as a two-magazine group.

In total we are left with only 90 usable observations (82 after first differencing), so the usual caveats of empirical work with small samples apply. The eight two-magazine

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<sup>9</sup>Specifically, 'kicker-sportmagazin' exclusively reports about soccer events, while 'Sport Illustrierte' covers a wide range of sport events. 'Prinz' comes in 13 different regional editions (and faces significant competition from local newspapers and free city magazines) and has its focus on reporting on local events, while 'Max' is a regular lifestyle magazine with people below 35 as target audience. 'Vital' is a magazine for women while 'Fit for Fun' is a magazine mainly for men. 'Musikexpress' is concerned with music and music stars only, while 'Bravo' covers a broad range of topics. 'Extra Rätsel' contains riddles only, while 'Freizeit Revue' also contains other content.

markets that we include in our estimation make up 18.1 percent of the total number of titles published in the total German magazine market, 10.8 percent of total circulation, and 13.9 percent of total advertising pages (in the time period 1979–2002). They hence still constitute a significant part of the German magazine market.

The two most important groups (in terms of observations) are ‘Do-It-Yourself’ magazines and ‘Photography’ magazines. Together these account for sixty percent of all our usable observations. Some summary statistics on the variables involved in the estimation are given in Table 2 (in the appendix). The mean subscription price for a magazine in our sample was 2.75 Euros, whereas advertisers pay on average 10,673 Euros per ad. A typical magazine in our sample has about 700,000 “readers” per year (the mean is closer to 1 million), and runs about 465 ads per year. Magazines in our sample run slightly more than three content pages for every ad page.

## 4 Empirical specification

Recall the empirical approach is to estimate the equations (6) and (8) so as to obtain estimates of the parameters  $\gamma, \psi, \beta, \rho$ , and  $\eta$ . We use GMM to jointly estimate the two equations using our panel data set. To remove magazine-group specific constants (magazine-group fixed effects) we first difference the data. To capture time-specific effects we include a constant and linear time trend in the first-differenced model (the  $\theta$  terms).<sup>10</sup> Our estimation equations are hence

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<sup>10</sup>This corresponds to allowing for a quadratic function of time in the original share equations. This parsimonious treatment of the time-specific effects is used given the small number of magazine groups we observe (only eight).

$$\begin{aligned}
\Delta s_{1t} &= \gamma (\Delta N_{1t}^a - \Delta N_{2t}^a) + \psi (\Delta N_{1t}^c - \Delta N_{2t}^c) - \beta (\Delta p_{1t} - \Delta p_{2t}) + \Delta \varepsilon_{1t} - \Delta \varepsilon_{2t} + \theta_{11} + \theta_{12}T \\
\Delta n_{1t}^a &= \rho (\Delta S_{1t} - \Delta S_{2t}) - \eta (\Delta a_{1t} - \Delta a_{2t}) + \Delta \xi_{1t} - \Delta \xi_{2t} + \theta_{21} + \theta_{22}T
\end{aligned} \tag{22}$$

where  $\Delta$  denotes the first difference operator, and  $T$  denotes a linear time trend.

A key estimation issue is that the price and quantity variables in both equations are potentially endogenous. The potential endogeneity is especially important in this analysis, given the two-way causation between advertising and readership which the model allows for. We exploit the fact each publisher of a given magazine in our sample produces magazines across many subjects (most of which are not in our sample). We instrument the potentially endogenous variables in (21) and (22) with the average of the same variable for the magazine's publisher across all its *other* magazine publications. For example, the instrument for the number of readers of a particular magazine is taken as the average readership of the same publisher across all the *other* magazines the publisher produced in the particular year under consideration. To avoid changes in this instrument caused by a new magazine being produced or a magazine being closed down, we only consider those magazines which the publisher produces which existed both at the time the corresponding two-magazine market began and at the time the corresponding two-magazine market ended. To the extent changes in a specific magazine's readership is driven by changes made at the publisher level for the same variable (say due to the opening up of new distribution channels for the publisher, a change in the publisher's costs, or a change in the publisher's strategy), then these changes should not be determined by a change in the other variables for the *specific* magazine in consideration. Time trends are also included as instruments.<sup>11</sup>

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<sup>11</sup>The use of first differences requires instruments for the lagged endogenous variables. Straightforward



For an instrument to be statistically valid it has to have two properties: (i) it has to be highly correlated with the variable to be instrumented and (ii) it has to be uncorrelated with the residual of the equation of interest. Property (i) is checked in Table 3a – Table 3c in the Appendix which displays ‘first stage’ OLS regression results of the instruments on the endogenous explanatory variables. Although there is no ‘first stage’ in GMM, the regression results are instructive with respect to the explanatory power of the instruments. Table 3 clearly shows a high correlation between the instruments and the endogenous explanatory variables as indicated by high values for the tests for joint significance and by high adjusted  $R^2$ s. Property (ii) is formally tested using a test for orthogonality of the instruments. This test cannot reject orthogonality of the instruments at the usual significance level (compare ‘J-test’ in Table 4). A final undesirable property of share equations is that the error terms are heteroscedastic by construction. GMM estimation corrects for heteroscedastic error terms, so inefficient parameter estimates are not likely to be an issue here.

## 5 Results

GMM estimation results for the equations (21) and (22) are displayed in Table 4. The upper part of Table 4 relates to magazine subscription demand from readers, while the lower part corresponds to advertising demand from firms. Table 5 displays the corresponding non-instrumented seemingly unrelated regression estimation results.

The relative number of content pages in one magazine versus its rival is found to be a significant determinant of the share of readers the magazine attracts within the magazine group. The parameter  $\psi$  is positive and statistically significant (at the 5% level). 

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instruments for the lagged endogenous variables are lagged instruments, and this is how we proceed.

Magazines with more content attract more readers. The relative number of ad pages is found to be less important, both statistically and economically. Still there is some weak evidence that consumers have a taste for magazine advertising. Our parameter estimate for  $\beta$ , the coefficient on cover prices, is not statistically significantly different from zero suggesting that the difference in cover prices between two magazines is not a significant determinant of readership share in our data. The coefficient of 0.076 implies that if one magazine lowers its price by 1 Euro relative to its rival (that is, an approximate one-third drop in price), this will increase its market share by 7.6 basis points (for example, from 0.500 to 0.576).

### **Magazine advertising demand**

The advertising demand equation shows a significant effect of the circulation of one magazine versus its rival on the share of advertising the magazine attracts from within the magazine group. The parameter  $\rho$  is positive and statistically significant at the 5% significance level. Magazines with more readers are able to attract more advertisers (for given ad rates). We do not find, however, a statistically significant effect of the difference in advertising rates between two magazines on their advertising shares. The parameter  $\eta$  is estimated imprecisely. The parameter estimate implies an increase in the ad rate of magazine 1 by 1,000 Euros (that is, an approximate ten percent increase in the ad rate) would decrease the share of ads in magazine 1 by only 2.182 basis points (for example, from 0.500 to 0.4718). Later we will explore the implications of adjusting our estimated coefficients to allow for stronger price-effects.

### Checking for non-explosive network effects

For the equilibrium solutions to the theoretical model to be well defined, it must be that the expression  $1 - 4\rho\gamma NS$  which appears in the denominator of the reduced form market share equations is positive. If not, network effects dominate, and the model would predict tipping to the case one magazine takes the whole market. Using our parameter estimates, and the median value of  $NS$  over all observations, this expression equals 0.803, with a corresponding standard error of 0.121.<sup>12</sup> Thus, we can easily reject explosive network effects, and our estimated model is well behaved.

### Implied structure of prices-cost markups

One of the key points of interest in a two-sided market is to understand the determinants of the *structure* of prices. How much is charged to readers versus advertisers? In the theoretical model we considered, one determinant of the structure of prices is the structure of costs. The price to readers will reflect the cost of making a sale to an additional reader (distribution and retailing costs), while the price charged to advertisers will reflect the cost of including an additional ad in the magazine (the costs of dealing with an additional client, and producing the ad). Since we do not measure costs, we instead concentrate on the structure of price-cost markups.

Equations (18) and (19) specify the determinants of these price-cost markups assuming symmetric firms. The first term in each case is the regular Hotelling markup. This is simply an estimate of the corresponding transportation cost. The estimate of  $t$  ( $= 1/2\beta$ ) is 6.626 with a standard error of 6.610. The estimate of  $\tau$  ( $= 1/2\eta$ ) is 22,919 with a standard error of 22,001. Neither of these parameter estimates is statistically significant

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<sup>12</sup>Standard errors were calculated using the ‘Delta’ method (e.g. Greene 2003, Section 5.4.2). Standard errors, just as the implied coefficients, depend on data which is why both are calculated at the medians of the involved variables.

(this just follows from the lack of significance of the price-effects above).

The additional terms in equations (18) and (19) are the new network externality terms that arise from the two-sided nature of the market. In the case of the cover price markup, publishers will charge readers less when advertisers get more profits from advertising in magazines with more readers. By subsidising readers, each magazine publisher attempts to attract more readers, and thereby more demand (profits) from advertisers. Similarly, by subsidising advertisers, each publisher attempts to attract more advertisements so as to attract readers. Our estimates can provide some insight into which effect is more important.

The estimated network externality term  $\rho N/\eta$  for the equilibrium cover price equation has a median estimated value of 9.177 with a corresponding standard error of 10.644. This is an estimate of how much magazines lower cover prices (in a symmetric equilibrium), as a result of the fact advertisers value magazines with lots of readers. The result suggests magazines may actually set their cover prices below cost. In fact, the net effect of the Hotelling markup and the network externality discount is for magazines to set their cover price at 2.55 Euros below cost (note, however, the standard error on this estimate is 8.221). In comparison, the median cover price in our sample is 2.56 Euros, which from the estimated equilibrium pricing equations implies costs per subscriber of 5.11 Euros. According to these results, the magazines discount cover prices, so as to attract readers, and therefore more lucrative advertisers. Obviously, given the imprecise estimates of  $\beta$  and  $\eta$ , a wide range of discounting of cover prices and implied costs are consistent with the estimated model. Instead, our results should be viewed as illustrative of how such a model can be estimated and interpreted.

The estimated network externality term  $\gamma S/\beta$  for the equilibrium advertising price equation has a median estimated value of 3,264 Euros with a corresponding standard

error of 3,250. This is an estimate of how much advertising rates would rise if magazine readers did not value ads. This represents a 32 percent increase in the ad rate (the median ad rate is 10,089 Euros). In percentage terms this externality appears to be much smaller than that running in the opposite direction. In this sense, advertisers care more about readers than readers care about ads. The results imply that in a symmetric equilibrium, the magazines would set their advertising prices at 19,655 Euros (per ad) above cost (with a standard error of 20,692). Given actual ad rates, the backed out costs implied by this result must in fact be negative. This is consistent with the view that the price sensitivity terms in the share functions are actually larger than those estimated (this will lower the Hotelling markup, and so raise the implied costs necessary to match prices). We explore this possibility below.

### **Sources of profit contributions**

As noted above, the results of our model lend support to the general perception that readers are subsidized and that magazines receive the bulk of their margins from the advertisers. This is confirmed by estimating the direct contribution to profits from readers and from advertisers. We calculate the equilibrium price-cost markup for readers multiplied by the number of readers:  $S/(4\beta) - \rho NS/(2\eta)$ , which is a measure of the direct contribution to equilibrium profits from readers. The median value of this expression is 939,270 Euros. Compare this to the equilibrium price-cost markup for advertisers multiplied by the number of ads:  $N/(4\eta) - \gamma NS/(2\beta)$ , which is a measure of the direct contribution to equilibrium profits from advertisers. The median value of the latter expression is 4,325,783 Euros. Of course readers contribute to profits indirectly by raising demand from advertisers (with no readers, a magazine would not be able to attract any advertisers), but this is why readers are “subsidized” in the above equilibrium.

### **Content pages production cost**

Unlike price-cost margins, we cannot determine the optimal level of content implied by the fitted model without knowing the content page production costs parameter  $d$ , since in the symmetric equilibrium  $N_1^c = N_2^c = \psi S / (4d\beta)$ . However, we can obtain an estimate of the marginal production cost of a page of content from the model since

$$\begin{aligned} mc_{it} &= 2d_{it}N_{it}^C \\ &= \frac{\psi S}{2\beta} \end{aligned}$$

From the estimated model, we get that the median marginal cost of producing one additional page of content (across all observations) is 948 Euros (standard error of 787). To run comparative statics on the model it is useful to back out the value of  $d$  which makes the value of  $N_1^c = N_2^c$  predicted by the model equal to its (average) counterpart in the data. Thus, we solve for

$$d = \frac{\psi S}{2(N_1^c + N_2^c)\beta}$$

which gives a median  $d = 0.380$  (standard error of 0.242).

### Some comparative statics

Another way to interpret the results from the model is to consider what happens if one magazine faces an exogenous increase in demand by readers, say attracting 10% more readers. Starting from the symmetric case with  $b = 0$ , we set  $b = 0.05$  so that if everything else remained constant,  $s_1$  would increase from 0.5 to 0.55 (a 10% increase). We can see how much this changes the equilibrium value of other variables by solving the model (using the value of  $d$  from above). We assume  $\varepsilon_1 = \varepsilon_2$ ,  $\xi_1 = \xi_2$ ,  $f = f_1 = f_2$ ,  $c = c_1 = c_2$  as above. The model to solve is

$$s_1 = \frac{\frac{1}{2} + \psi(N_1^c - N_2^c) - \beta(p'_1 - p'_2) + b + 2\gamma N(\phi - \rho S - \eta(a'_1 - a'_2))}{1 - 4\gamma\rho NS} \quad (23)$$

$$s_2 = 1 - s_1 \quad (24)$$

$$n_1^a = \frac{\frac{1}{2} - \eta(a'_1 - a'_2) + \phi + 2\rho S(b - \gamma N - \beta(p'_1 - p'_2) + \psi(N_1^c - N_2^c))}{1 - 4\gamma\rho NS} \quad (25)$$

$$n_2^a = 1 - n_1^a \quad (26)$$

$$0 = (1 - 4\gamma\rho NS)S_1 - \beta p'_1 S - 2\rho\beta a'_1 NS \quad (27)$$

$$0 = (1 - 4\gamma\rho NS)N_1^a - \eta a'_1 N - 2\gamma\eta p'_1 NS \quad (28)$$

$$0 = \psi(p'_1 + 2\rho a'_1 N)S - 2(1 - 4\gamma\rho NS)dN_1^c \quad (29)$$

$$0 = (1 - 4\gamma\rho NS)S_2 - \beta p'_2 S - 2\rho\beta a'_2 NS \quad (30)$$

$$0 = (1 - 4\gamma\rho NS)N_2^a - \eta a'_2 N - 2\gamma\eta p'_2 NS \quad (31)$$

$$0 = \psi(p'_2 + 2\rho a'_2 N)S - 2(1 - 4\gamma\rho NS)dN_2^c \quad (32)$$

where we have denoted the price-cost margins as  $p'_1 = p_1 - f_1$ ,  $p'_2 = p_2 - f_2$ ,  $a'_1 = a_1 - c_1$ ,  $a'_2 = a_2 - c_2$ . Prior to the change (with  $b = 0$  and  $\phi = 0$ ), we have the symmetric case with the solution given in (18)-(20).

Here we interpret some of the most obvious channels by which this exogenous change in readership demand affects the equilibrium. It is helpful to first consider the case without

any network effects ( $\gamma = 0$  and  $\rho = 0$ ), as this provides a benchmark for the case with network effects. Without network effects it is straightforward to show that

$$\Delta p'_1 = -\Delta p'_2 = \frac{d}{3\beta d - \psi^2 S} \Delta b \quad (33)$$

$$\Delta a'_1 = -\Delta a'_2 = \frac{1}{3\eta} \Delta \phi \quad (34)$$

$$\Delta s_1 = -\Delta s_2 = \frac{\beta d}{3\beta d - \psi^2 S} \Delta b \quad (35)$$

$$\Delta n_1^a = -\Delta n_2^a = \frac{1}{3} \Delta \phi \quad (36)$$

$$\Delta N_1^c = -\Delta N_2^c = \frac{\psi S}{2(3d\beta - \psi^2 S)} \Delta b \quad (37)$$

where  $\Delta b$  and  $\Delta \phi$  represent the two types of shocks we will consider.

The results before and after the change in  $b$  are given in Table 6. In reporting the results after the change in  $b$ , we first note how the equilibrium shares, prices etc change if we close down the network effects in working out the change in equilibrium variables, as determined by (33)-(37). We then allow for network effects, and calculate the change in shares, prices etc after the change in  $b$  using (23)-(32).

Absent network effects, the 10% increase in exogenous readership demand only increases the equilibrium market share for magazine 1 by 3.98%, as the increase in demand by readers for magazine 1 causes magazine 1 to raise its price by 10.08%, thereby offsetting some of the original increase in demand. This is a standard result (in Hotelling type models without network effects). When one firm enjoys an exogenous increase in demand from its rival, it will face more “captive” consumers and will charge more (and its rival will charge less). The price effect is partially offset by the fact that magazine 1 increases its production of content to take advantage of the higher equilibrium margins. This increase in content, increases readership. If not for this content effect, readership would only increase by 3.33%. Given the lack of network effects, there is no impact on ad rates or the number of ads of an exogenous change in readership demand, as equations



(34)-(36) demonstrate.

Taking into account the estimated network effects in each direction, the increase in demand by readers increases the price magazine 1 charges by 12.55% and decreases the price magazine 2 charges by 12.55%. This price change again dampens the total effect on the quantity demanded, which after taking into account the change in ads and content production, results in a 7.15% increase in the equilibrium number of readers. The increase in readers is nearly twice as large as without network effects, and this is true despite a somewhat greater increase in prices in this case. This reflects the higher advertising demand caused by the increase in readers. In the new equilibrium, the number of ads on magazine 1 increases by 1.58% (and likewise, decreases by 1.58% on magazine 2). The greater number of ads feeds back directly into higher reader demand. It also results in higher ad rates for magazine 1 (the normal ‘captive customer’ effect). The higher ad rates and cover prices leads magazine 1 to increase the production of content, which further increases reader demand.

We repeat the exercise for an increase in  $\phi$ , where we increase the number of ads in magazine 1 by 10% (which we do by setting  $\phi = 0.05$ ). Results are presented in Table 7. Without network effects, the results are just given by (34) and (36). The greater exogenous demand for advertising, raises the equilibrium ad rate charged by magazine 1 by 3.89% and raises the equilibrium number of advertisers on magazine 1 by 3.33%. There are no effects on the cover price, readership share, or content production. When network effects are taken into account, not only are the effects on ad rates and the equilibrium number of advertisers stronger, but now the shock affects the readership side of the market, and the production of content.

In response to the greater ad margins (and given advertisers value readers), magazine 1 increases the production of content, which then results in an increase in readers (there

is also a small direct effect of increased advertising on readers). With more readers, magazine 1 increases its cover price (by 1.15%), and magazine 2 decreases its cover price by an equal amount.

As noted above we found very low (and insignificant) estimates of the price sensitivity of demand. Allowing for higher values of  $\beta$  and  $\eta$  seems to give more reasonable values of the costs implied by the model. Here we show implied costs are more reasonable when we increase both of these parameter estimates by two standard errors.

Using these new parameter values, the predicted price-cost margin for readers is now that the cover price is set 0.71 Euros below the cost per subscriber. This corresponds to an implied cost per subscriber of 3.27 Euros, a Hotelling markup of 1.66 Euros, and a discount (or subsidy) to readers due to network effects of 2.37 Euros.<sup>13</sup> If it was not for these network effects, the price predicted for magazines in this case would be 4.93 Euros, rather than the actual median price of 2.56 Euros in our sample.

Similarly, the result on the advertising share equation also seem more reasonable. Previously we found an implied cost per ad of *negative* 9,566 Euros, a Hotelling markup of 22,919 Euros, and a discount (or subsidy) to advertisers due to network effects of 3,264 Euros. This implied the ad rate was set 19,655 Euros above cost. In contrast, when the estimate of  $\eta$  is increased by two standard errors, the implied cost per ad is a more plausible 4,999 Euros, the implied Hotelling markup is 5,909 Euros, and the ‘subsidy’ to advertisers is 818 Euros. Costs are now positive (and plausible), and the subsidy to advertisers is only small (reflecting the small positive effect of ads on readers’ demand).

The impact of this change on profit contributions is interesting. Previously we found profits from the readership side contributed 17.83% of the profits of the publishers (this

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<sup>13</sup>Previously, the implied cost per subscriber was 5.11 Euros, the Hotelling markup was 6.63 Euros, and the subsidy to readers was 9.18 Euros. This implied the price was set 2.55 Euros below cost.

ignores fixed and common costs). With readership and advertising being more price sensitive, the publisher now in fact makes a (small) ‘loss’ on the readership side, which it more than makes up on the advertising side.

## 6 Conclusions

This paper provides a first attempt to estimate a theoretical model of two-sided markets. We chose an industry — magazine publishing — that allows a close fit between the theory (an adapted version of Armstrong’s model of exclusive competition in a two-sided market) and the data. Consistent with the theory, there are magazine groups in Germany which involve competition between only two publishers, for which publishers charge both sides of the market a ‘subscription’ price, and for which (most) users do not multihome.

The model is estimated using panel data from the German magazine industry between 1972 and 2002. Unlike many empirical IO studies, where estimates of marginal costs play a key role, we show that interesting results in two-sided markets can be obtained without the need for estimating marginal costs explicitly. Our focus is on the structure of price-cost markups between the two sides. We find non-explosive network benefits, so that our estimated model is well behaved. We ask, what is the markup charged to advertisers relative to that charged to readers? Our results are consistent with the conventional wisdom that advertisers value readers more than readers value advertisers, and that as a result, magazines “subsidize” subscription, and make most of their profit (if not all of there profits) from advertisers.

Given the limited data used in this study, and the lack of significance on the estimated price effects, we treat our results as only illustrative. The approach used shows how one can draw conclusions on the role of network effects in determining the structure of

pricing in studying two-sided markets. Future work could explore collecting and using a more extensive data set on magazine pricing, which might afford tighter estimates of price elasticities of demand. One approach worth considering is to use cross-country data on specific magazines segments, where magazine segments in different countries (and languages) can be considered to have different demands and costs, and for which the demand from each side of the market (advertising versus readership) should depend on country specific factors that can be observed.

## 7 References

Armstrong, M. (2004) “Competition in two-sided markets,” mimeo, University College London.

Caillaud, Bernard and Bruno Jullien (2003) “Chicken & Egg: Competition Among Intermediation Service Providers,” *RAND Journal of Economics* 34: 309-328.

Evans, David (2003a) “The Antitrust Economics of Multi-Sided Platform Markets,” *Yale Journal on Regulation*, forthcoming.

Evans, David (2003b) “Some Empirical Aspects of Multi-sided Platform Industries,” *Review of Network Economics* 2: 1-20.

Greene, William. (2003) “Econometric Analysis (International edition),” Prentice-Hall, Upper Saddle River.

Jahreszeitenverlag (1981-2002). “Funktions-Analyse: Factbook fuer Inhalte und Portraits von Zeitschriften,” Jahreszeitenverlag, Hamburg.

Kaiser, Ulrich. (2003). “The effects of website provision on the demand for German women’s magazines,” mimeo, University of Southern Denmark.

Rochet, Jean-Charles. and Jean Tirole (2003) “Platform Competition in Two-Sided

Markets,” *Journal of the European Economics Association* 1: 990-1029.

Rochet, Jean-Charles and Jean Tirole (2004) ”Defining Two-Sided Markets,” mimeo, IDEI and GREMAQ, Toulouse.

## 8 Appendix

Table 1: Sample selection

Segment	Title 1	Title 2	Period	
			Begin	End
<i>Included magazines</i>				
Health	Goldene Gesundheit	Medizin heute	1977 Q1	1979 Q3
Entertaining	Bunte	Gala	1994 Q2	1999 Q3
Photo	Color Foto	fotoMAGAZIN	1972 Q3	2002 Q3
Do-it-yourself	SelberMachen	Selbst ist der Mann	1979 Q1	2002 Q3
Food	Essen & Trinken	Meine Familie & Ich	1973 Q2	1986 Q3
Gardening	Flora	Mein schöner Garten	1986 Q2	1998 Q3
Monthly high priced women's	Madame	Vogue	1983 Q1	1988 Q3
Weekly counselling women's	Bella	Tina	1979 Q3	1983 Q3
<i>Excluded magazines</i>				
Magazines with special character	Neue Revue	Readers Digest Das Beste	1972 Q3	1990 Q3
Travel	Geo Saison	Merian	1990 Q1	2002 Q3
Young illustrated	Max	Prinz	1991 Q1	2002 Q3
City/lifestyle	Tempo	Wiener	1986 Q4	1994 Q3
PC	Chip	PC Welt	1985 Q2	1993 Q3
Sports	Sport Illustrierte	kicker-sportmagazin	1972 Q3	1976 Q3
Fitness	Fit for Fun	Vital	1994 Q2	1995 Q3
Youth	Bravo	Musikexpress	1977 Q1	1977 Q3
Riddles	Extra Rätsel	Freizeit Revue	1985 Q1	1986 Q3
Fiction	Romanwoche	Meine Geschichte	1984 Q1	2002 Q3

Table 2: Summary statistics

	Median	Mean	Std. Dev.
$s_1$	0.4504	0.41874	0.1280
$N_1^a$	450.0000	535.55222	312.8846
$N_2^a$	471.7500	627.15281	486.5182
$N_1^c$	1,791.0000	1,932.98889	947.4625
$N_2^c$	1,444.0000	1,849.86014	1,244.7143
$p_1$	2.6538	2.83925	1.1492
$p_2$	2.5600	2.65683	1.1939
$n_1^a$	0.5097	0.48074	0.1285
$S_1$	653,010.5000	692,174.8444	466,254.2188
$S_2$	748,731.5000	1,349,685.944	1,441,378.8020
$a_1$	9,439.0000	9,912.18333	2,587.5875
$a_2$	10,222.5000	11,434.34722	5,279.6897

Table 3a: “First stage” regression results

Dep. var.	$N_1^c$		$N_2^c$		$N_1^a$		$N_2^a$	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
$\bar{N}_1^c$	-6.4549	0.002	-7.8121	0.003	-0.8583	0.218	-2.3066	0.015
$\bar{N}_2^c$	2.7149	0.174	3.4678	0.159	0.1147	0.864	1.3830	0.126
$\bar{N}_1^a$	-0.5941	0.788	-1.2485	0.647	1.2787	0.090	-0.3513	0.725
$\bar{N}_2^a$	-3.4361	0.086	-7.1152	0.004	-1.1170	0.098	-3.5740	0.000
$\bar{p}_1$	-697.0820	0.136	-911.4840	0.114	269.8830	0.089	121.7760	0.562
$\bar{p}_2$	-958.3330	0.013	-1776.0300	0.000	404.5350	0.002	-82.8120	0.628
$T$	40.6518	0.137	102.4380	0.003	-25.3123	0.007	7.4294	0.545
$T^2$	-0.0968	0.427	-0.3789	0.013	0.1201	0.004	-0.0397	0.470
<i>Const.</i>	7235.6100	0.000	8910.9800	0.000	508.1990	0.368	2319.5100	0.003
<i>Joint sign.</i>	8.5052	0.000	11.0846	0.000	7.6484	0.000	13.9648	0.000
<i>Adj.R<sup>2</sup></i>	0.4029		0.4755		0.3741		0.5382	
<i># of obs.</i>	90		90		90		90	

Note: the table displays OLS regression results of the explanatory

variables  $N_1^c$ ,  $N_2^c$ ,  $N_1^a$  and  $N_2^a$  on their instruments.

The bar above the explanatory variables indicates the respective instrument, namely the average of the variable for the magazine’s publisher across all its other magazine publications.

The estimation results have no economic meaning as such. The high adjusted  $R^2$ s and the highly significant tests for joint significance do, however, indicate a high correlation between the instruments and the endogenous explanatory variables.

“ $T$ ” and “ $T^2$ ” denote linear and quadratic time trends respectively.

The top row “Dep. variable” indicates the endogenous variable.



Table 3b: “First stage” regression results

Dep. var.	p <sub>1</sub>		p <sub>2</sub>	
	Coeff.	p-val.	Coeff.	p-val.
$\bar{N}_1^c$	-0.0005	0.698	-0.0018	0.083
$\bar{N}_2^c$	0.0057	0.000	0.0069	0.000
$\bar{N}_1^a$	0.0009	0.501	-0.0014	0.204
$\bar{N}_2^a$	-0.0006	0.613	-0.0024	0.017
$\bar{p}_1'$	1.1791	0.000	1.3810	0.000
$\bar{p}_2'$	2.9869	0.000	3.1327	0.000
$T$	-0.1253	0.000	-0.1074	0.000
$T^2$	0.0005	0.000	0.0004	0.000
<i>Const.</i>	-4.1906	0.000	-3.8923	0.000
<i>Joint sign.</i>	58.0274	0.000	106.6170	0.000
<i>Adj.R</i> <sup>2</sup>	0.8368		0.9047	
<i># of obs.</i>	90		90	

Note: See Table 3a.

Table 3c: “First stage” regression results

Dep. var.	$S_1/1000$		$S_2/1000$		$a_1$		$a_2$	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
$\bar{S}_1$	0.0018	0.000	0.0042	0.000	0.0078	0.000	0.0066	0.001
$\bar{S}_2$	0.0027	0.000	0.0088	0.000	0.0065	0.000	0.0207	0.000
$\bar{a}_1$	-0.1424	0.000	-0.3427	0.000	-0.4357	0.001	-0.6037	0.002
$\bar{a}_2$	-0.0697	0.000	-0.2271	0.000	-0.0845	0.115	-0.8607	0.000
$T$	61.8500	0.000	143.0210	0.000	144.6780	0.002	477.6450	0.000
$T^2$	-0.2237	0.000	-0.4008	0.000	-0.0289	0.895	-1.1511	0.001
<i>Const.</i>	-1523.0100	0.000	-4598.4600	0.000	318.2190	0.822	-5210.5600	0.023
<i>Joint sign.</i>	53.1878	0.000	87.4097	0.000	27.0338	0.000	53.1442	0.000
<i>Adj.R<sup>2</sup></i>	0.7787		0.8535		0.6370		0.7785	
<i># of obs.</i>	90		90		90		90	

Note: See Table 3a.

Table 4: GMM estimation results from the share equations

	<b>Coeff.</b>	<b>Std. Err.</b>	<b>P-val.</b>
<i>Magazine readership demand equation</i>			
Constant	0.0174	0.0108	0.105
1000 $\gamma$	0.1672	0.1020	0.101
1000 $\psi$	0.0972	0.0480	0.043
$\beta$	0.0755	0.0753	0.316
1000 $\theta_{12}$	-0.2082	0.1264	0.099
<i>Magazine advertising demand equation</i>			
Constant	-0.0123	0.0097	0.203
1000 $\rho$	0.2274	0.0905	0.012
1000 $\eta$	0.0218	0.0209	0.298
1000 $\theta_{22}$	0.0662	0.1180	0.575
# of obs.	82		
J-test	10.5493		0.8790

Table 5: SUR estimation results of share equations

**Coeff. Std. Err. P-val.**

*Magazine readership demand equation*

Constant 0.0426 0.0140 0.002

1000  $\gamma$  0.2854 0.0418 0.000

1000  $\psi$  0.0176 0.0179 0.327

$\beta$  -0.0006 0.0204 0.976

1000  $\theta_{12}$  -0.5274 0.1695 0.002

*Magazine advertising demand equation*

Constant -0.0134 0.0083 0.107

1000  $\rho$  0.0002 0.0000 0.000

1000  $\eta$  0.0019 0.0073 0.792

1000  $\theta_{22}$  0.1145 0.1206 0.342

# of obs. 82

Table 6: Increase in readership demand for magazine 1

Before shock	$s_1$	$s_2$	$n_1^a$	$n_2^a$	$N_1^c$	$N_2^c$	$p_1'$	$p_2'$	$a_1'$	$a_2'$
	0.500	0.500	0.500	0.500	1,246	1,246	-2.613	-2.613	19,655	19,655
After shock										
(no network effects)	0.520	0.480	0.500	0.500	1,296	1,196	-2.350	-2.876	19,655	19,655
After shock										
(incl. network effects)	0.536	0.464	0.508	0.492	1,335	1,157	-2.285	-2.941	19,783	19,520

Table 7: Increase in advertising demand for magazine 1

Before shock	$s_1$	$s_2$	$n_1^a$	$n_2^a$	$N_1^c$	$N_2^c$	$p_1'$	$p_2'$	$a_1'$	$a_2'$
	0.500	0.500	0.500	0.500	1,246	1,246	-2.613	-2.613	19,655	19,655
After shock										
(no network effects)	0.500	0.500	0.517	0.483	1,246	1,246	-2.613	-2.613	20,419	18,891
After shock										
(incl. network effects)	0.533	0.467	0.525	0.475	1,338	1,154	-2.583	-2.642	20,551	18,759