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When Pricing Below Marginal Cost Pays Off: Optimal Price Choice in a Media Market with Upfront Pricing

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Abstract: I derive a model of profit maximization for a print media firm with upfront advertising pricing. The model is estimated using detailed quarterly data on German women's magazines observed between I/1994 and IV/2004. Main empirical results are that (i) cover price increases lead to substantial reductions in advertising revenue, thereby offsetting possible corresponding gains in magazine sales revenue, (ii) magazines with particularly large advertising revenues per copy set cover prices well below marginal cost and (iii) marginal production cost are decreasing in a magazine's own circulation but are unaffected by the own publishers' total printing volume which does not provide evidence for an efficiency defense in print media mergers.
Keywords: magazines, cost estimation, twosided markets
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1 Introduction

Print media markets have a property that distinguishes them from other product markets:

a profit–maximizing print media firm must take *two* types of consumers on board, readers

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and advertisers. Advertisers value circulation so that advertising demand and magazine demand are related — and to the extent that readers (dis–) like advertising, they are inter–related. Such network externalities have important consequences for print media pricing since for example an increase in cover prices leads to a decrease in magazine demand which in turn causes a reduction in advertising revenue.

Other common examples of such "two–sided" markets (Armstrong, forthcoming; Rochet and Tirole, forthcoming) are classifieds, Yellow Pages, matching markets such as employment websites or dating agencies, other media markets such as newspapers and Internet Portals as well as trading posts such as auctions, B2B markets, and shopping malls.

Earlier media market studies have acknowledged these demand dependencies,[1] but have neither attempted to estimate their economic importance nor do these studies correspond well with the specific feature of many media markets that advertising prices ("advertising rates") are often "upfront prices", e.g. they are published and fixed in advance, for example, in every fall for the entire upcoming year. Such an upfront price disclosure is present in the German print media industry which is in the focus of the present paper and in other media markets. Large US media companies such as Viacom/CBS, Disney/ABC, GE/NBC or Fox for example set advertising rates in spring for advertisements appearing in fall.[2]

Recent empirical papers on two–sided markets include Argentesi and Filistrucchi (forthcoming); Rysman (2004; forthcoming) as well as Kaiser and Wright (2006). Argentesi and Filistrucchi (forthcoming) study market power in the Italian newspaper industry, Kaiser and Wright (2006) investigate the price structure in "two–magazine markets" (markets with just two competing platforms), Rysman (2004) analyzes the utility interdependencies between advertisers and readers of Yellow Pages and Rysman (forthcoming) identifies

[1] Blair and Romano (1993); Bucklin et al. (1989); Chaudhri (1998); Corden (1952–1953); Dertouzos and Trautman (1990); Dewenter and Kraft (2001); Ferguson (1983); Kaiser and Wright (2006); Merrilees (1983); Rosse (1967,1970); Thompson (1989).

[2] See for example Dukes and Gal–Or (2003) who describe such pricing behavior for a Pittburgh NBC affiliate. There is anecdotal evidence for the Italian newspaper market where price lists are also published long before the newspapers actually appear.

positive feedbacks between consumer usage and merchant acceptance for payment cards. The main contribution of the present paper is that it considers the *structure* of prices, e.g. the level of prices on each market side, while the papers by Rysman consider markets where only one market side is charged. This makes my paper an extension of Kaiser and Wright (2006) for oligopoly markets. Argentesi and Filistrucchi (forthcoming) do not discuss subsidization of the advertising market. Other contributions of this paper are that it (i) provides estimates for scope and scale effects in magazine production, (ii) incorporates upfront pricing as an important feature of many media markets and that it (iii), like Rysman (2004; forthcoming) but in contrast to Argentesi and Filistrucchi (forthcoming), allows advertisers to "multi–home", i.e. to advertise in more than one outlet.

My analysis is based on a theoretical model for media markets with upfront pricing which is estimated using detailed quarterly data on German women's magazines observed in the period I/1994 to IV/2004. This data contains information on both magazine reader characteristics and magazine contents. Estimation of the model allows for insights into the importance of the market's feedback mechanisms and returns to scale in production. Attention is restricted to women's magazines since it is the most competitive segment in the German magazine market.[3]

Recent industrial policy debates both in Europe (Röller et al. 2000) and in Germany have dealt with the cost–saving effects of mergers. Although neither European nor German merger legislation explicitly allows for efficiency defenses, merging firms often claim that their proposed concentration will lead to cost savings to be passed on to consumers. Such an argument was for example brought up in a high profile merger case between two German

[3]In 2004, 49 titles were published, more than twice as many as in the second–densely populated segment, TV magazines. Market concentration, as measured by the Hirshman–Herfindahl index, is much lower in women's magazines than in any other segment, and this is true both in the magazine demand and in the advertising demand dimension. Restricting attention to a single subsegment of the magazine market makes it possible to display and discuss estimation results for individual magazines, an issue that is especially valuable with respect to the external validation of the estimation results.

publishers in 2003.[4] The German monopoly commission rejected the merging parties' cost efficiency arguments. More importantly, the commission also did not explicitly consider negative feedback effects from potential copy price increases to the advertising market.

My paper finds economically significant feedbacks from advertising to magazine cover pricing. Magazines substantially subsidize advertising or, to be more precise, advertising revenue subsidizes circulation costs. The extent of subsidization is the larger the higher advertising revenue per copy and/or the more elastic advertising rates are with respect to circulation. Magazines with particularly large negative feedbacks set cover prices markedly below marginal production cost.

My estimation results provide evidence for substantial returns to scale in production: a one percent increase in a magazine's own circulation leads to a decrease in marginal cost of 23 percent (standard error seven percent). By contrast, the own publisher's total printing volume (the total number of pages printed in a given quarter) does not have a significant effect on marginal cost. This paper provides no evidence that would support an efficiency defense in print media merger cases, when such a defense is based on economies of scale of total publisher circulation.

2 The model

2.1 Model components

My model closely resembles the institutional features of the German magazine market, and possibly also that of other "upfront" media markets. It is based on several interviews with industry participants from both markets side, advertisers and publishers.

It consists of three components: (i) an inverse demand for advertising equation, (ii) a magazine demand equation and (iii) a supply equation. The timing of the model is that magazines first set "upfront" advertising rates in period t for period $t+1$. Advertising

[4]The merger case between Georg von Holtzbrinck and Berliner Verlag was eventually blocked by the German monopoly commission. The commission's report is available on the internet at http://www.monopolkommission.de/sonder.htm.

rates depend on expected circulation (which, since I assume static expectations, is in fact circulation at time t). Magazines thereafter maximize profits for period $t+1$ by setting cover prices at the end of period t. Their optimal cover price choice depends upon advertiser's reaction to changes in circulation caused by changes in cover prices which leads to a pricing equation that depends on this demand dependency. Magazine's strategic variables are advertising rates and cover prices. Marginal cost are backed out from the supply equation.

2.2 Institutional framework

German print media determine and publish advertising rates in November each year.[5] These rates are valid for the entire upcoming year. None of the magazines in my data changed advertising rates within a year. Advertiser willingness to pay for advertising space depends on, according to advertisers and advertising booking agencies I have spoken to, (i) the extent to which a magazine reaches the advertiser's target audience and (ii) circulation. This is consistent with earlier empirical work on print media markets work by Thompson (1989). Advertising rates are set, as one industry source put it, "in consultation" with major advertisers, most importantly advertising booking agencies.

The composition of a magazine's readership varies little over time, which could be a consequence of little "within" variation in magazine content.[6] If publishers identify a new reader group that may attract advertisers, they would rather launch a new magazine than change the content of existing magazines. This implies that magazine content, and thus readership composition, is not a magazine's choice variable (given magazine launch).

A large fraction, up to 80 percent, of advertising pages is booked one year in advance.[7]

[5] A typical example for a advertising price list, a brochure that contains advertising rates and readership composition information, is downloadable at URL http://www.media.brigitte.de/de/brigitte/pdf/brigitte_preisliste2006.pdf.

[6] Dewenter and Kaiser (2006) discuss readership and content composition of German magazine market in detail.

[7] Personal communication with Armin Rott (Hamburg Media School) who also assessed that upfront booking has been declining in the past few years and that upfront booking various substantially across

Magazines tend to set cover prices following the publication of the advertising rates at the end of period t having in mind the consequences of their price setting for both sides of the market.

A final issue worth mentioning in an institutional context is that the ratio of advertising pages to content pages is fairly constant across time for each magazine; there is little "within" variation. Even though my industry sources did not explicitly subscribe to my interpretation, it seems that magazines take as many advertisements as possible and add content pages until the long–run ratio of advertisements to content is reached. This leads to a high correlation between advertising pages and content pages. The coefficient of correlation in my data is 0.75.

2.3 Magazine grouping

Magazine demand is modelled in a "nested logit" framework as described in Subsection 4. It requires to partition the women's magazine market into subsegments. My grouping of women's magazines follows industry convention, for example Jahreszeitenverlag (1994–2004), so that I am inclined to believe that it is appropriate. The publishing industry distinguishes the following market segments: fashion magazines, lifestyle magazines, classical magazines, counselling magazines, "yellow" women's magazines and "girls" magazines.

Table 1 displays some summary statistics for the six market segments. It shows that there are very distinct differences between groups (but a lot of similarities within groups, not shown in the table) regarding circulation, circulation revenue (circulation times copy price), advertising and advertising revenue (advertising pages times advertising rates). Magazine groups that have a large market share in circulation, for example "counselling magazines", do not necessarily possess large market shares on the advertising side. This emphasizes the importance of targeting "valuable" (to the advertisers) audiences.

Insert Table 1 about here!

magazines.

2.4 Inverse demand for advertising

To model inverse demand for advertising I borrow the constant elasticity framework used by Berry and Waldfogel (1999), who model the demand for advertising time in radio broadcasting, since it combines the two most important ingredients of advertising rate determination — audience targeting and circulation — with the upfront pricing mechanism in a simple way. Such a framework is also chosen by Rysman (2004) to model inverse demand for advertising space in Yellow Pages.

My inverse demand for advertising rates equation is:

$$p^a_{jt+1} = E[\lambda_{jt+1} q^{\eta}_{jt+1} ADP^{\delta}_{jt+1}], \tag{1}$$

where the term λ_{jt+1} is a scalar that relates observed and unobserved features of magazine j and its readership characteristics (target audience characteristics) to advertising price at time $t+1$ and $E[.]$ is the usual expectations operator. The term q denotes magazine circulation and ADP denotes the number of advertising pages.

The term λ is assumed to depend upon variables that influence advertising prices, summarized by row vector $\boldsymbol{w}$, and an unobserved (to me) component that is denoted by ψ:

$$\lambda_{jt+1} \;=\; exp(\boldsymbol{w_{jt+1}\kappa} + \psi_{jt+1}). \tag{2}$$

The error term ψ is decomposed into a time–invariant component that may be correlated with $\boldsymbol{w}$ ("fixed effect") and an idiosyncratic component: $\psi_{jt+1} = \omega_j + \varpi_{jt+1}$.

Taking logarithms and under the assumption of static expectations, my specification of the inverse demand for advertising is:

$$ln(p^a_{jt+1}) = \eta ln(q_{jt}) + \delta ln(ADP_{jt}) + \boldsymbol{w_{jt}\kappa} + \omega_j + \varpi_{jt}. \tag{3}$$

An alternative representation of the advertising equation is a logit–type demand function where advertisers choose between placing advertisement in differentiated outlets. Such a specification is chosen by Argentesi and Filistrucchi (forthcoming) to model advertising demand for four national Italian newspapers. It is, however, not consistent with upfront

pricing and is also problematic with respect to potential multi–homing by advertisers. While multi–homing is not an issue for the market considered by Argentesi and Filistrucchi (forthcoming), it is of considerable importance for German women's magazines. Kaiser and Wright (2006) calculate that 10.6 percent of the advertisers in "Women's fashion" magazines and 37.2 percent of the advertisers in "Women's counselling" magazines multi–home. Both magazine segments are part of my data.

2.5 Magazine demand

Nested logit demand

Magazine demand is specified by a "nested logit" functional form (Anderson et al. 1992), a standard model in empirical industrial organization. This model is very well described in the literature so that I omit a detailed description here.

The nested logit demand model places products into different groups so that products within a group are similar to one another and products of different groups are dissimilar. The correlation between magazines within the same group is represented by parameter σ, a parameter that is to be estimated.

Relative demand for magazine j at time t is given by:

$$(4) \qquad ln(s_{jt}) \; - \; ln(s_{0t}) = \boldsymbol{x_{jt}\beta} + \alpha_{jt} p^c_{jt} + \sigma ln(\bar{s}_{jt|g}) + \tau_t + \mu_j + \xi_{jt},$$

where s_{jt} denotes the market share of magazine j at time t (relative to market size M) and s_{0t} denotes the market share of the "outside good" which is needed to identify the model. It is defined as $s_{0t} = (M_t - \sum_{j=1}^{N} M_t s_{jt})/M_t$, where M is total market size. M is defined as total German female population aged 14 years or older, and the summation is over all women's magazines in the data. Magazine j's relative market share depends on its cover price, p^c, observed magazine quality characteristics, $\boldsymbol{x}$, and unobserved (to me) time–invariant quality characteristics ("fixed effects"), μ_j, the market share of magazine j at time t in magazine group g, $\bar{s}_{jt|g}$, and demand shocks that are the same for all magazines, τ_t. The term ξ denotes unobserved time–variant magazine–specific quality components. Note that the fixed effects capture for example magazine periodicity and

publisher identity since both variables do not vary over time.

Magazine periodicity

Magazines appear in different frequencies (weekly, biweekly and monthly). Much like Nevo (2001), who converts pounds of cereal into daily servings in his study of the US ready–to–eat cereal industry, I convert magazine circulation (and also the number of content pages) into weekly units. For example, if a magazine appears once a month, the corresponding circulation is divided by 4, if it appears biweekly it is divided by 2 and if it appears once a week, circulation and the number of content pages is left unchanged. My estimation results differ neither qualitatively nor quantitatively much if magazine circulation and the number of content pages is converted into monthly units instead.

Reader multi–homing

Multi–homing by magazine readers is a potential problem in logit–type models of demand. These models assume that the consumer and product–specific utility component is i.i.d. extreme value distributed which leads to the logit demand function. The i.i.d. assumption is problematic if readers multi–home unless consumer preferences for magazine A are uncorrelated with preferences for magazine B.

I use data from a consumer survey that asked readers what magazines, apart from magazine A, they *read* to assess how important multi–homing is in my data. The word "read" is emphasized here since the questionnaire does not ask consumers for actual purchase decisions. This distinction is particularly important for women's magazines that seem to belong to the standard equipment of hairdressers and the practices of medical doctors. The consumer survey data is therefore very likely to substantially overstate actual multi–buying. The average fraction of readers of a particular magazine that multi–read is 5.8 percent in my data.

Kaiser and Wright (2006) use the same consumer survey data and find that 6 percent of the "Fashion" magazine readers and that 10.7 percent of the "Women's counselling" magazine readers multi–read. They follow a suggestion by Doganoglu and Wright (2006) and calculate adjustment factors for their Hotelling–type demand model which are based

on those multi–reader fractions. Application of those adjustment factors does not qualitatively change their results.

Since the degree to which consumers multi–read is relatively low and since the extent of actual multi–homing is even lower, I proceed with the nested logit model as formulated in Equation (4).

An alternative setup of my nested logit model is a model where consumers first choose content and then the periodicity of magazines. Such a model collapses into the nesting structure of Equation (4) since, with one exception, magazines in each group have the same periodicity (see Table 1). A reverse nesting structure is also problematic since the "Classical" magazines are the only ones with biweekly appearance.

2.6 Profit maximization

When magazines determine cover prices shortly after they publish advertising rates, they maximize their expected profits for the upcoming year and take the feedback effects of next year's magazine prices on next year's advertising rates into account. They solve the maximization problem as:

$$(5) \quad max_{p^c_{t+1}} E[\Pi_{jt+1}] = E\left[p^c_{jt+1} M_{t+1} s[.]_{jt+1} + p^a_{jt+1} ADP_{jt+1} - C_{jt+1}(q_{jt+1}, \boldsymbol{z_{jt+1}}, \nu_{jt+1})\right],$$

where $C(.)$ denotes the cost of producing magazines. These cost depend upon circulation, $q = Ms$, as well as upon observed and unobserved cost components, $\boldsymbol{z}$ and ν respectively. There are two things noteworthy about Equation (5). First, cover prices set in period $t+1$ determine circulation in period $t+1$ and thereby advertising rates in period $t+2$. There hence is no contemporaneous link between advertising rates and cover prices which is consistent with the institutional settings. A contemporaneous link is established, however, through my assumption of static expectations. Second, optimal cover prices depend not only on revenues from copy sales, but also on revenues from advertising sales, which depends on the number of copies sold.

After substituting the inverse demand equation for advertising rates, Equation (1), into

Equation (5), the following first–order condition for profit maximization is obtained:

$$(6)\frac{\partial E[\Pi_{jt+1}]}{\partial p^c_{t+1}} = E\left[p^c_{jt+1}M_{t+1}\frac{\partial s_{jt+1}(.)}{\partial p^c_{t+1}} + M_{t+1}s_{jt+1}(.) + \frac{\partial p^a_{jt+1}}{\partial p^c_{jt+1}}ADP_{jt+1} - \frac{\partial C_{jt+1}(.)}{\partial p^c_{jt+1}}\right] = 0$$

Rearranging terms and again using static expectations leads to the following markup decomposition:[8]

$$(7) \qquad p^c_{jt} - \frac{\partial C_{jt}(.)}{\partial q_{jt}(.)} = \underbrace{-\frac{s_{jt}(.)}{\frac{\partial s_{jt}(.)}{\partial p^c_{jt}}}}_{\text{“usual markup”}} - \underbrace{\frac{p^a_{jt}ADP_{jt}}{q_{jt}(.)}\eta}_{\text{“markup deterioration”}},$$

where the markup deterioration — the network externality — is the change in advertising revenue that is caused by a cover price change.

Cover prices hence deviate from the usual “price–equals–marginal–cost–plus–a–markup” formula of standard oligopoly models by a markup deterioration that depends upon the circulation elasticity of advertising demand, η, and advertising revenue per copy, p^aADP/q: the less circulation–elastic advertising demand (given advertising revenue per copy) and the higher advertising revenue per copy, the larger the markup deterioration. Magazines hence “cannibalize” cover prices in order to increase advertising sales, unless $\eta = 0$ (advertisers do not care about circulation) and/or they do not sell advertising space. Marginal cost might even exceed cover prices if advertising demand is very circulation elastic and/or if magazines make large revenues from advertising sales. Below marginal cost pricing is a well documented phenomenon in the newspaper industry (Ludwig 2003; Wagner 1981).

3 Data

My data set consists of information on all 49 German women’s magazines that existed between the first quarter of 1994 and the fourth quarter of 2004. A total of 1,673 observations is used in the (quarterly) estimations. Data on circulation, cover prices, editorial pages and advertising pages were downloaded from the internet at http://medialine.focus.de.

[8]Note that the term M, total market size, cancels out from Equation (6).

This data has been updated quarterly since 1972 and is continuously recorded.[9] It is complemented by annual information on magazine contents that I received from the publishing house "Jahreszeitenverlag" (Jahreszeitenverlag 1994–2004). Jahreszeitenverlag distinguishes between 22 different content categories. These are: fashion for purchase, self–crafted fashion, cosmetics, cooking, interior design, handicraft, children, health, partnership, vacation, counselling, hobby, cars, politics, science, the arts, sensational journalism, VIPs, fiction, sex as entertainment, TV program, and service pages of the editors (Table of Contents etc.). The content shares are, for example, measured as the ratio of cosmetics pages to the total number of content pages.

Data on magazine reader characteristics was provided by "Arbeitsgemeinschaft Media–Analyse" (AG.MA), an association of the German advertising industry for the research of mass communication.

Advertising rates and cover prices are measured in Euro and are deflated by the quarterly German consumer price index. My magazine data contains price and quantity information on three types of advertisements: black and white advertisements, two–color advertisements and four color advertisements. I use this information to define advertising rates as the weighted average of these three types of advertisements. Estimation results remain unaffected when I use the price for a four color advertisement instead. This is unsurprising since the coefficient of correlation between the two advertising rate measures is 0.92.

Descriptive statistics of the variables involved in the estimations are presented in Appendix A.

4 Empirical specification

Inverse demand for advertising

[9] The original data source is "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. It is the German equivalent to the US Bureau of Circulation.

Elements of the vector of magazine and consumer characteristics, $\boldsymbol{w}$, that affect advertising rates are (i) the shares of readers in age groups 14–19, 20–29, 30–39, 40–49 and 50–59 years (base age group: more than 59 years of age) to take into account advertisers' preferences with regard to the age distribution of readers, (ii) the content share variables and (iii) the set of year dummy variables that represent shocks common to all magazines, for example business cycle effects.

The other components of inverse demand for advertising, circulation, q, and the number of advertising pages, ADP, are endogenous variables. Identification issues related to all three equations to be estimated are discussed in Section 5.

Magazine demand

Elements of the vector of magazine and consumer characteristics, $\boldsymbol{x}$, that affect magazine demand are (i) the natural logarithm of the number of content pages to capture consumer utility received from content pages, (ii) the share of advertising pages in the total number of pages to account for consumer preferences regarding advertising intensity, (iii) the set of content share variables, (iv) content share concentration (measured as the sum of squared content shares), (v) year dummy variables and (vi) quarter dummy variables. I use the share of advertising pages in the total number pages instead of the level of advertising pages because of the high correlation between advertising pages and content pages.

Other components of magazine demand are cover prices, p^c, and within group market shares, $\bar{s}$. Both variables are endogenous since both consumers and producers know the unobserved magazine quality component ξ. The ratio of advertising pages to the total number of pages is endogenous since advertising demand depends on magazine demand. As discussed in Section 2.2, it appears as if there is a fixed ratio of advertising pages to content pages, so the number of content pages is an endogenous variable as well.

Cost components

Marginal cost are backed out from Equation (7) using the estimated values of η and $\frac{\partial s_{jt}(.)}{\partial p^c_{jt}}$ so that estimating an equation for marginal cost is not needed to identify the model. Regressing marginal cost on factors that are likely to affect them is, however, instructive

with respect to cost savings due to returns to scale and scope in production.

To derive an estimable supply equation I need a functional form assumption for marginal cost. To guarantee that marginal cost are positive, I define $\partial C_{jt}(.)/\partial q_{jt} = exp(aq_{jt} + \boldsymbol{z_{jt}\gamma} + \nu_{jt})$. This, in combination with my assumption of static expectations, yields the following restatement of Equation (6):

$$\frac{\partial C_{jt}(.)}{\partial q_{jt}} = \frac{1}{1-a}\left(p_{jt} + \frac{s_{jt}(.)}{\frac{\partial s_{jt}(.)}{\partial p_{jt}}} + \eta\frac{p^a_{jt}ADP_{jt}}{q_{jt}}\right). \tag{8}$$

I decompose the error term ν_{jt} into a "fixed effect" and an idiosyncratic component. The fixed effects capture for example paper quality (e.g. glossy paper) or publisher–specific factors.

Variables in $\boldsymbol{z}$ are (i) scale variables, (ii) scope variables, and (iii) shocks common to all magazines.

(i) *Scale variables* are (a) the natural logarithm of a magazine's circulation — it is well known that newspaper production cost decrease substantially in circulation (Dertouzos and Thorpe 1982; Dertouzos and Trautman 1990; Genesove 2003; Ludwig 2003; Rosse 1967, 1970; Wagner 1981) — and (b) the natural logarithm of own publisher's "printing volume". Printing volume of magazine A is defined as the total number of pages produced by the own publisher in a given quarter. I exclude the total number of pages produced for magazine A from the calculation to obtain a direct measure of the effects of a concentration on marginal cost.

Printing volume effects on marginal cost, if they exist, may be due to discounts in paper purchasing. Paper cost make, according to industry professionals, around 30 per cent of all variable printing cost. Discounts on paper purchase are common practice and a larger printing volume increases buyer power.[10] Both scale variables need to be instrumented since they are functions of unobserved marginal cost ν as it is discussed in detail in Section 5 below.

(ii) *Scope variables* are (a) the total number of magazines published by the own publishing house and (b) the total number of market segments (including segments outside the

[10]Personal correspondence with Jörg Hüner, Prinect Systemhaus Heidelberg.

women's magazine market) the own publisher is active in. The effects of these variables is unclear a priori. Multi magazine/multi group publishers might have more flexible production technologies at their disposal so that they can quickly adjust printing machines to their current needs. Compared to more specialized publishers they might, however, be less able to exploit cost digressions in production since less specialized publishers might use more specialized printing equipment.

I also include the NBSK Pulp Benchmark Index, a price index for pulp and paper prices, as a *common cost shock*.

5 Identification

The endogenous variables of my model are: cover price, within group market share, the natural logarithm of content pages and the ratio of advertising pages to the total number of pages in the magazine demand equation; the number of advertising pages and circulation in the inverse demand for advertising equation as well as the natural logarithm of a magazine's total circulation and the natural logarithm of the printing volume of the own publisher in the marginal cost equation.

Table 2 provides an overview of the endogenous variables and their instruments.

5.1 Identification of the coefficients in the demand equations

My main assumption regarding the identification of the two demand equations is, like in Kaiser and Wright (2006), that (unobserved) cost factors are common across magazines published by a magazine's own publisher and that other (demand–side) shocks are not correlated with these factors, an approach used by Hausman (1997). This for example implies that cover prices of a publisher's magazines in other segments of the magazine market are assumed to be driven by common underlying costs associated with a publisher's production, distribution and marketing of its magazines to readers. These costs also determine the cover price of a particular magazine, but are assumed to be uncorrelated with the error terms in the product demand equations which is why the average cover

price of a publisher's *other* magazines can for example be used as an instrument for cover prices.[11]

I follow the same identification strategy for the number of advertising pages, the number of content pages and the share of advertising pages: common (unobserved) demand factors affect publishers, and these factors are uncorrelated with the magazine's marginal cost shocks. Due to for example better management, some publishers at certain times may be better than others at attracting successful editors, across their whole range of magazines. Successful editors produce popular content that attracts a larger number of readers. Alternatively, a particular publisher may have access to a wider distribution channel than other publishers, resulting in higher demand for all magazines. By the same token, a particular publisher may form an ongoing relationship with a large advertising client through one of its magazines, but this will tend to raise demand for advertising in the publisher's other magazines, given some large advertisers may place advertisements across different magazine markets ("cross–selling" as it is termed in the media industry). This suggests that reasonable instruments for my three other endogenous variables in the magazine demand equation are the average number of advertising pages, the average number of content pages and the average share of advertising pages of the publisher's other magazines.

A number of additional instruments is used. To instrument cover prices I also use the pulp and paper price index as a cost–side variable that should be unrelated to the unobserved magazine–specific quality component ξ. I also use a dummy variable that is coded one if a magazine of the own publisher contained a supplement in a given quarter as an instrument for the number of advertising pages in the inverse demand for advertising equation and as an instrument for advertising share in the magazine demand equation. Supplements

[11] If the magazine demand equation was not estimated by fixed effects, other magazines' prices could not be used as an instrument if, for example, a publisher's strategy is to cluster publications among high quality content or to use glossy (and therefore costly) paper since other magazines' cover prices then reflect unobserved publisher quality. The fixed effects proxy, however, publisher strategy directly (at least to the extent it is time–invariant).

expand advertising space while advertising rates for the core magazine cannot react in the short–run. Supplements by magazines from the same publisher hence induce competition for advertisers but are unlikely to affect unobserved quality of a magazine from an advertiser's perspective, ϖ.

Within group market share is instrumented by the ratio of the number of market segments the own publisher is active in to the number of market segments competing publishers are active in. It measures how diversified the own publisher is relative to competing publishers. A highly diversified publisher will not be in a competitively strong position in any one market segment and hence will possess relatively low within group market shares. At the same time, diversification is unlikely to affect unobserved magazine quality ξ.

I instrument magazine circulation in the inverse demand for advertising equation by my cover price instruments, average cover prices of other magazines by the own publisher, and the paper and pulp price index since magazine circulation is a function of cover prices. The pulp and paper index is interacted with publisher–specific dummy variables to introduce additional variation to the index.[12]

Some elements of the vector of cost–components, $\boldsymbol{z}$, described in Section 4, are candidates as instruments for cover prices. I experimented with the inclusion of these variables but tests for orthogonality rejected their validity.

5.2 Identification of the parameters in the supply equation

While it is fairly straightforward to find instruments for the endogenous variables in the magazine demand and the advertising demand equations through variables that are likely to affect production cost but not demand, it is much harder to find instruments for the endogenous variables in the marginal cost equation. To identify the related parameters in the marginal cost equation, one would need to find variables that affect for example demand but not unobserved marginal cost ν. In that vein, a candidate instrument for

[12]Tests for orthogonality reject the interactions in the magazine demand equation which is why cover prices are only instrumented with the pulp and paper index and not also with the interactions in that equation.

circulation is total circulation by other publishers since demand shocks hitting competing publishers are unlikely to be related to unobserved marginal cost but have an effect on magazine circulation. This variable varies, however, only across publishers and not across magazines. Another candidate instruments for circulation is the composition of disposable income of magazine readers which I do not observe.

My approach to identify the parameters of the marginal cost equation therefore is to use the four period lags (one year lags) of the two endogenous variables and the four period lag of the cover price instrument as instruments. The identifying assumption here is that marginal cost shocks are not correlated between period t and period $t-4$.

5.3 Instrument validity

For an instrument to be valid it needs to have two properties: (i) correlation with the endogenous variable and (ii) uncorrelatedness with the error term of the equation of interest. The first property is tested by estimating "first stage" regressions of the endogenous variables on the instruments and the exogenous variables. Corresponding estimation results are shown in Appendix B. The appendix indeed shows a high correlation between the instruments and the endogenous variables in all three equations. The instruments are at least jointly highly significant, and all equations include various instruments that are also separately highly significant. The second property is checked by tests for overidentifying restrictions. The results tables, Table 3, Table 4 and Table 5, show the corresponding test statistics. These tests cannot reject that my instruments are orthogonal to the residual of the equation of interest.

Insert Table 2 about here!

5.4 Estimation technique

I estimate the inverse demand for advertising equation, the magazine demand equation and the marginal cost equation separately one after the other. The reason for doing the less efficient equation–by–equation estimation rather than joint estimation is that a

mis–specification of any of the three equations contaminates the estimates of the other equations. Another reason is the difference in the periodicity of the data. Advertising rates are set annually so that I annualize the originally quarterly data. My magazine demand equation is based on quarterly data and so is the marginal cost equation.

All equations are estimated by instrumental–variables methods (Two Stages Least Squares) using the instruments listed in Table 2. All variance covariance matrices are robust to autocorrelation and heteroscedasticity.

6 Results

6.1 Advertising rate equation

Estimation results for the advertising rate equation are shown in Table 3. The coefficient on circulation in the inverse demand for advertising equation is 0.36 (standard error 0.16), implying positive feedback effects from magazine demand to advertising demand. Advertisers in German women's magazines hence have a substantially smaller willingness to pay for circulation than advertisers in US Yellow Pages have for usage. Rysman's (2004) estimate for the latter is 0.56 (standard error 0.13). This difference in usage effects could reflect the higher ability of women's magazines to focus target audiences compared to Yellow Pages.

The point estimate for the effect of advertising pages on advertising rates is -0.17 (standard error 0.08) which compares to Rysman's corresponding estimate of -0.73 (standard error 0.19).

Table 3 underscores the importance of instrumenting the number of advertising pages and circulation. If the latter is not instrumented, a positive and highly significant effect of advertising pages on advertising rates is estimated. This is an economically implausible result since it indicates upward sloping demand for advertising. A comparison of the IV and OLS results also shows that the coefficient on circulation substantially increases which is consistent with a positive correlation between circulation and the unobserved

inverse demand for advertising component, ϖ: a shock in unobserved advertising efficiency is positively correlated with circulation, possibly since it is positively correlated with unobserved magazine quality ξ.

The estimation results also indicate that advertisers particularly appreciate consumers aged 50 to 59 years, young consumers between 14 and 19 years of age and consumers between 30 and 39 years. The remaining age groups are less popular with the differences between them being insignificant.

The set of content shares plays a statistically significant role in the determination of advertising rates. It is jointly significant at the five percent marginal significance level.

Insert Table 3 about here!

6.2 Magazine demand equation

Estimation results for the magazine demand equation are shown in Table 4.[13] The coefficient on price, α, is -0.25 (standard error 0.09) which means that a one unit (i.e. one Euro) change in (deflated) cover prices leads to a percentage decrease in relative market shares (relative to the outside good) of the same magnitude. The point estimate of the within–group correlation coefficient, σ, is 0.86 (standard error 0.09), suggesting that a magazine in one segment is a poor substitute to a magazine in another segment. A comparison of IV and OLS estimates shows that both coefficients are substantially larger once they are instrumented, indicating a positive correlation between unobserved magazine quality and prices as well as within group market shares.

Consumers like magazines that come with many content pages and are advertising–neutral. The latter finding differs from Kaiser and Wright (2006), who estimate positive effects of advertising on magazine market shares. Their data do, however, contain

[13]Note that the number of magazines differs between the magazine demand estimation and the inverse demand for advertising equation. This is so since the age variables are missing for eight magazines. Leaving the age variables out leads to a point estimate for η of 0.48 in the inverse demand for advertising equation which includes, given a standard error of 0.15, the point estimate of the specification that does include the age variables.

very different magazine segments like Do–it–yourself or Photography magazines where advertising may be more informative than for women's magazines.

Content shares are jointly highly significant determinants of magazine demand.

Insert Table 4 about here!

6.3 Marginal cost equation

Estimation results for the marginal cost equation are displayed in Table 5. It shows that there are economically sizeable and statistically highly significant returns to scale in magazine production: own circulation has a highly significant and economically sizeable negative effect on marginal cost. Such a finding of significant and economically sizeable returns to scale is a main explanation for the existence of "few (and fewer and fewer) two–newspaper towns" (Genesove 2003).

Table 5 also shows, however, that printing volume does not have a statistically significant impact on marginal cost. This implies that my results do not support an efficiency defence in print media mergers.

One of my measures for returns to scope in production, the total number of titles produced by the own publisher is statistically significant from zero and *positive* which implies that product diversification increases production cost. This is clearly not an argument in favor of cost efficiency gains due to mergers either.

The other proxy variable for returns to scope, the number of magazine groups a magazine is active in, is insignificant at any conventional significance level.

Insert Table 6 about here!

6.4 Implied pricing structure

Table 6 displays the main results that I back out of my model: marginal cost, the absolute difference of cover prices and marginal cost, the "usual" markup, the "markup deterioration" and advertising revenue per copy. The figures are averages for 2004 or for the last available year for those magazines that exited the market prior to 2004.

The most important result of Table 6 is that a substantial fraction of magazines, one quarter, indeed sets cover prices below marginal cost, thereby subsidizing the advertising side of the magazine market.

All "fashion" magazines, all "classical" magazines as well as more than half of the "lifestyle" magazines and "classical" magazines show such pricing behavior. These are the magazine groups where advertising revenue per copy is particularly large.

By contrast, the less advertising intensive segments "counselling" and "yellows" price above marginal cost.

In Appendix C I conduct an external validation of my marginal cost estimates based on information I gathered from industry sources and compare them with my estimated marginal cost. I find that they generally compare quite well, thereby providing indication for model validity. My cost estimates for the fashion magazines appear, however, to be too high.

7 Conclusions

This paper derives and estimates a model for media markets where advertising rates are set "upfront", e.g. long before advertisements are actually published. It is estimated on data for German women's magazines where such pricing behavior is present. The model underlines the importance of taking the two–sidedness of magazine markets into account. It consists of three equations, an inverse demand for advertising equation, an equation for magazine demand and a supply equation from which I obtain estimates for marginal production cost.

A main estimation result is that below–marginal–cost–pricing is predominant for magazines whose advertising rates depend, through the circulation feedback, strongly on cover prices. Those magazines substantially subsidize their advertising revenue stream by setting low cover prices that may even lead to negative magazine sales revenue. This suggests that any increase in cover prices has to be weighed against (over–) compensating losses in advertising revenue.

My estimation results also indicate statistically significant and economically substantial returns to scale in production, as measured by a magazine's own circulation. The own publishers total printing volume, a variable that is directly affected by a media merger, does not have a statistically significant effect on marginal cost. This paper hence does not provide evidence in favor of an efficiency defense in print media mergers if total printing volume is used as a measure of economies of scale.

Table 1: Summary statistics

	Fashion magazines	**Lifestyle magazines**	**Classical magazines**	**Counselling magazines**	**"Girls" magazines**	**"Yellow" magazines**
Periodicity	Monthly	Monthly	Biweekly	Weekly	Weekly	Weekly, biweekly, monthly
Market shares across magazine groups						
Circulation share	3.1	11.6	14.2	25.4	8.1	38
Advertising share	14.7	15.2	40.1	16.9	4.2	9.3
Circulation revenue share	9	17.5	19	14.8	9.1	31.3
Advertising revenue share	15.3	16.7	24.5	13.9	5.9	24.4
Averages within magazine groups						
Circulation per quarter	131,073	353,360	733,321	1,041,662	333,420	611,743
# of advertising pages per quarter	365	187	492	239	113	181
Cover price	4.49	1.85	1.62	0.84	1.55	1.01
Advertising rate	13,875	11,238	22,896	20,051	11,386	8,857

Table 1 shows summary statistics for the six magazine groups. The market shares are in percent of the total women's magazine market. Cover prices and advertising rates are measured in Euros.

Table 2: List of endogenous variables and their instruments

Endogenous variables	**Instruments**
Inverse demand for advertising equation	
# advertising pages	# adpages in *other* magazines by own publisher;
	Dummy for other magazines by same publisher with supplements;
Circulation	Average cover price of other magazines by own publisher;
	Pulp and paper price index interacted with publisher dummies
Magazine demand equation	
Cover price	Main cover price instrument at t and $t-1$;
	Pulp and paper price index;
Within group market share	# of segments own publisher is active in/# of segments relative to competing publishers are active in at t and $t-1$;
# content pages	# of content pages of *other* magazines by own publisher at t and $t-1$;
Share advertising pages	Dummy for other magazines by same publisher with supplements; Share of advertising pages of *other* by own publisher at t and $t-1$
Marginal cost equation	
Circulation	Circulation lagged by one year;
Printing volume	Total # of pages of publisher's other magazines lagged by one year

Table 2 summarizes instrument choice. The subscript $t-1$ corresponds to the previous quarter in the magazine demand and marginal cost equation. It corresponds to the previous year in the inverse demand for advertising equation.

Table 3: Fixed effects estimation results for inverse advertising demand, Equation (3)

	IV		OLS	
	Coeff.	**Std. Err.**	**Coeff.**	**Std. Err.**
Parameters of main interest				
ln(APD) (δ)	-0.17**	0.08	0.04*	0.03
ln(q) (η)	0.36**	0.16	0.22***	0.04
Consumer age shares				
Share consumers 14–19 years	0.79**	0.40	0.25	0.26
Share consumers 20–29 years	-0.36	0.31	-0.18	0.25
Share consumers 30–39 years	0.54*	0.33	0.29	0.22
Share consumers 40–49 years	0.14	0.38	-0.06	0.27
Share consumers 50–59 years	1.08***	0.31	0.74***	0.24
Test of overidentifying restrictions				
	Test	***p*–val.**		
	20.94	0.18		
Within R^2, # of obs. and # of magazines				
	Test	***p*–val.**	**Test**	***p*–val.**
Specification	92.95	0.00	3.67	0.00
Content shares	36.80	0.02	1.95	0.01
Consumer age shares	18.87	0.00	3.21	0.01
Year dummies	11.62	0.31	3.53	0.00
Fixed effects	21.53	0.00	36.99	0.00
"Within" R^2, # of observations and # of magazines				
Within R^2	0.14		0.30	
# obs.	367		397	
# magazines	41		43	

Table 3 displays fixed effects regression results of Equation (3). The dependent variable is the natural logarithm of the advertising rate in period $t+1$. Explanatory variables are measured at t. The left panel of the table ("IV") shows IV fixed effects estimation results, the right panel ("OLS") shows fixed effects estimation results without instrumentation. Table 2 provides a list of instruments used in the IV estimation. Both specifications contain year dummies and 21 shares of magazine content as listed in Section 3. The asteriks' "***", "**" and "*" indicate statistical significance at the one, five and ten percent marginal significance level.

Table 4: Fixed effects estimation results for magazine demand, Equation (4)

	IV		OLS	
	Coeff.	**Std. Err.**	**Coeff.**	**Std. Err.**
Cover price (α)	-0.25***	0.09	-0.10***	0.01
$ln(s_{j\|g})$ (σ)	0.86***	0.09	0.71***	0.01
Advertising share	-0.21	0.49	0.18***	0.05
ln(# content pages)	0.34**	0.15	0.11***	0.02
Content conc.	-0.09	0.31	0.25	0.17
Test of overidentifying restrictions				
	Stat.	***p*–val.**		
	6.59	0.36		
Tests of joined significance				
	Wald	***p*–val.**	F	***p*–val.**
Content shares	111.47	0.00	10.91	0.00
Year dummies	799.89	0.00	277.49	0.00
Quarter dummies	29.40	0.00	137.50	0.00
Fixed effects	451.50	0.00	680.63	0.00
Specification	10072.19	0.00	449.25	0.00
"Within" R^2, # of observations and # of magazines				
Within R^2	0.88		0.92	
# obs.	1,673		1,681	
# magazines	49		49	

Table 4 displays fixed effects regression results of Equation (4). The dependent variable is the natural logarithm of relative market share of magazine j at time t, $ln(s_{jt}/s_{0t})$. The left panel of the table ("IV") shows IV fixed effects estimation results, the right panel ("OLS") shows fixed effects estimation results without instrumentation. Table 2 provides a list of instruments used in the IV estimation. Both specifications contain quarter dummies, year dummies, 21 shares of magazine content as listed in Section 3 and a content concentration index. The asteriks' "***" and "**" indicate statistical significance at the one and five percent marginal significance level.

Table 5: Fixed effects estimation results for marginal cost

	IV		OLS	
	Coeff.	**Std. Err.**	**Coeff.**	**Std. Err.**
Endogenous variables				
ln(circulation)	-0.23***	0.07	-0.45***	0.05
ln(printing volume by own publisher)	-0.01	0.01	-0.00	0.01
Scope variables				
# of titles by own publisher	0.04***	0.01	0.03***	0.00
# groups own publisher is active in	-0.02	0.02	-0.018	0.01
Pulp and paper index				
Pulp & paper index	0.04	0.05	-0.06	0.06
Test of overidentifying restrictions				
	Stat.	***p*–val.**		
	1.45	0.69		
Tests of joined significance				
	F	***p*–val.**	*F*	***p*–val.**
Fixed effects	262.41	0.00	304.10	0.00
	Wald	***p*–val.**	*F*	***p*–val.**
Scope effects	50.75	0.00	25.38	0.00
Scale effects	16.00	0.00	48.13	0.00
Year dummies	37.1	0.00	3.29	0.01
Quarter dummies	35.98	0.00	11.29	0.00
Specification	1458.13	0.00	26.16	0.00
"Within" R^2, # of obs., # of magazines, test for overid. Restr.				
Within R^2	0.21		0.23	
# obs.	1,469		1,615	
# magazines	48		48	

Table 5 displays fixed effects regression results of Equation (8). The dependent variable is the natural logarithm of marginal production cost. The left panel of the table ("IV") shows IV fixed effects estimation results, the right panel ("OLS") shows fixed effects estimation results without instrumentation. Table 2 provides a list of instruments used in the IV estimation. Both specifications contain quarter dummies and year dummies. The asteriks "***" indicates statistical significance at the one percent marginal significance level.

Table 6: Implied estimation results

	Cover price	Marginal cost	Price cost difference	"Usual" markup	"Markup deterioration"	Advertising revenue per copy
Fashion magazines						
Elle	4.0	6.4	-2.4	1.0	5.0	36
Madame	6.0	7.5	-1.5	0.7	4.1	29
Marie Claire	2.5	2.7	-0.2	0.7	1.6	12
Vogue	6.0	12.5	-6.5	0.8	10.4	74
Lifestyle magazines						
Allegra	1.0	1.1	-0.1	0.7	1.0	8
Amica	2.6	4.9	-2.4	0.6	4.2	30
Carina	2.3	1.8	0.5	0.6	0.6	5
Cosmopolitan	2.6	3.9	-1.3	0.7	3.0	22
Frau im Leben	2.0	1.3	0.7	0.6	0.3	2
Maxi	1.8	1.9	-0.1	0.7	1.2	9
Petra	2.5	3.4	-0.9	0.7	2.4	17
Prima Carina	2.3	1.7	0.6	0.6	0.4	3
Ratgeber Frau und Familie	2.0	1.2	0.8	0.7	0.2	1
Classical magazines						
Brigitte	2.2	3.0	-0.8	0.8	2.3	34
Freundin	2.2	3.3	-1.1	0.7	2.6	38
Für Sie	2.1	2.2	-0.1	0.7	1.3	19
Journal für die Frau	2.1	1.7	0.3	0.6	0.8	11
Woman	1.1	1.0	0.0	0.7	0.9	13
Counselling magazines						
Bella	1.3	0.8	0.5	0.6	0.3	9
Bild der Frau	0.9	0.3	0.5	0.8	0.3	9
Laura	0.6	0.1	0.5	0.6	0.2	6
Lea	0.6	0.1	0.5	0.6	0.1	2
Lisa	0.9	0.4	0.5	0.6	0.2	7
Tina	1.3	0.7	0.6	0.7	0.3	8
"Girls" magazines						
Bravo Girl	1.7	1.2	0.5	0.7	0.5	7
Joy	1.6	1.6	0.0	0.7	1.1	8
Mädchen	1.7	1.1	0.6	0.7	0.4	5
Yam!	1.3	0.5	0.8	0.9	0.2	6
Brigitte Young Miss	1.5	1.4	0.1	0.6	0.9	7
"Yellow" magazines						
7 Tage	1.4	0.7	0.7	0.6	0.1	3
Das Goldene Blatt	1.4	0.7	0.7	0.6	0.1	3
Das Neue	1.4	0.7	0.7	0.6	0.0	1
Das Neue Blatt	1.4	0.7	0.7	0.6	0.1	2
Die Aktuelle	1.5	0.8	0.7	0.6	0.1	3
Die neue Frau	1.0	0.4	0.6	0.6	0.1	2
Echo der Frau	1.4	0.7	0.7	0.6	0.1	2
Frau aktuell	1.4	0.7	0.7	0.6	0.1	3
Frau im Spiegel	1.4	0.8	0.6	0.6	0.2	6
Frau mit Herz	1.4	0.8	0.6	0.6	0.1	4
Heim und Welt	1.4	0.8	0.6	0.6	0.2	5
Neue Post	1.4	0.6	0.8	0.7	0.1	2
Neue Revue	1.6	0.9	0.7	0.6	0.1	4
Neue Welt	1.4	0.7	0.7	0.6	0.1	3
Neue Woche	1.0	0.3	0.7	0.6	0.0	1
Vida	1.0	0.4	0.6	0.6	0.1	2
Welt der Frau	1.0	0.4	0.6	0.6	0.1	2
Woche der Frau	1.0	0.4	0.6	0.6	0.1	2

Table 6 displays estimation results that were backed out from the model. All figures are absolute numbers and measured in Euros.

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Appendix A: descriptive statistics
Inverse demand for advertising equation

	Mean	Std. dev.
Endogenous variables		
$ln(p^a_{t+1})$	9.28	0.75
$ln(ADP)$	5.18	0.64
$ln(q)$	12.88	0.67
Consumer age shares		
Share consumers 14–19 years	0.10	0.16
Share consumers 20–29 years	0.14	0.09
Share consumers 30–39 years	0.17	0.06
Share consumers 40–49 years	0.15	0.04
Share consumers 50–59 years	0.15	0.05
Content shares		
Children	0.01	0.01
Fashion for purchase	0.13	0.11
Self–crafted fashion	0.01	0.01
Cosmetics	0.05	0.04
Cooking	0.08	0.05
Interior design	0.03	0.02
Politics	0.01	0.01
Health	0.07	0.03
Partnership	0.04	0.04
Vacation	0.05	0.02
Counselling	0.02	0.02
Hobby	0.01	0.01
Cars	0.00	0.00
Science	0.03	0.02
The arts	0.03	0.03
Sensational journalism	0.01	0.01
VIPs	0.20	0.14
Fiction	0.13	0.09
Sex as entertainment	0.00	0.01
TV program	0.01	0.02
Service pages of the editors	0.06	0.02
Year dummies		
1994	0.07	—
1995	0.08	—
1996	0.08	—
1997	0.08	—
1998	0.09	—
1999	0.09	—
2000	0.10	—
2001	0.10	—
2002	0.10	—
2003	0.11	—
Instruments		
Average ln(adpages) of other magazines by publisher	7.52	1.18
Average cover price of other magazines by publisher	1.54	0.64
Dummy for supplement in at least one other magazine by publisher	0.90	0.29
Average circulation of other magazines by publisher	15.36	1.36
Pulp & paper index	565.58	143.34
Pulp & paper index interacted with dummy for publisher 1	16.43	98.07
Pulp & paper index interacted with dummy for publisher 2	147.63	258.71
Pulp & paper index interacted with dummy for publisher 3	56.30	177.32
Pulp & paper index interacted with dummy for publisher 4	3.89	43.78
Pulp & paper index interacted with dummy for publisher 5	16.43	98.07
Pulp & paper index interacted with dummy for publisher 6	61.41	182.52
Pulp & paper index interacted with dummy for publisher 7	32.86	136.73
Pulp & paper index interacted with dummy for publisher 8	65.44	186.24
Pulp & paper index interacted with dummy for publisher 9	27.22	126.14
Pulp & paper index interacted with dummy for publisher 10	61.44	182.59
Pulp & paper index interacted with dummy for publisher 11	49.30	165.01
Pulp & paper index interacted with dummy for publisher 12	16.43	98.07

Magazine demand equation

	Mean	Std. Err.
Endogenous variables		
$ln(s_j/s_0)$	-4.67	1.12
Cover price (α)	1.90	1.13
$ln(s_{j\|g})$ (σ)	-2.18	0.82
Advertising share	0.26	0.13
ln(# content pages)	4.47	0.37
Content shares		
Handicraft	0.02	0.02
Self–crafted fashion	0.01	0.05
Cosmetics 0.05 0.04 Cooking	0.08	0.06
Interior design	0.03	0.02
Politics	0.01	0.01
Children	0.01	0.01
Health	0.07	0.03
Partnership	0.04	0.04
Vacation	0.05	0.02
Counselling	0.02	0.02
Hobby	0.01	0.01
Cars	0.00	0.01
Science	0.03	0.02
The arts	0.03	0.03
Sensational journalism	0.01	0.01
VIPs	0.20	0.14
Fiction	0.11	0.08
Sex as entertainment	0.00	0.01
TV program	0.01	0.02
Service pages of the editors	0.05	0.02
Content concentration	0.15	0.06
Year dummies		
1994	0.08	—
1995	0.08	—
1996	0.08	—
1997	0.09	—
1998	0.09	—
1999	0.09	—
2000	0.09	—
2001	0.10	—
2002	0.10	—
2003	0.10	—
Quarter dummies		
1st quarter	0.25	—
2nd quarter	0.25	—
3rd quarter	0.25	—
Instruments		
Average cover price of other magazines by publisher at t	1.42	0.73
Average cover price of other magazines by publisher at $t-1$	1.42	0.73
Pulp & paper index	564.65	164.37
# of segments own publisher active in/ # of segments competing publishers active in	0.36	0.30
# of segments own publisher active in at t / # of segments competing publishers active in at t	0.37	0.33
Dummy for supplement in at least one other magazine by publisher	0.81	0.39
# adpages in other magazines by own publisher at t	3.33	2.57
# content pages in other magazines by own publisher	5.60	1.63
# content pages in other magazines by own publisher at $t-1$	5.60	1.63

Marginal cost equation

	Mean	Std. Err.
Endogenous variables		
ln(marginal cost)	0.30	1.10
ln(printing volume by own publisher)	20.98	1.30
ln(circulation)	12.80	0.69
ln(# of pages)	6.71	0.38
Pulp and paper index 6.30 0.25		
Scope variables		
# of titles by own publisher	15.86	11.84
# groups own publisher is active in	2.15	1.69
Year dummies		
1995	0.08	0.27
1996	0.08	0.27
1997	0.09	0.28
1998	0.09	0.29
1999	0.09	0.29
2000	0.09	0.29
2001	0.10	0.30
2002	0.10	0.30
2003	0.10	0.31
2004	0.10	0.30
Quarter dummies		
1st quarter	0.25	0.43
2nd quarter	0.25	0.43
3rd quarter	0.25	0.43
Instruments		
Average cover price of other magazines$_{t-4}$ by publisher at t	1.42	0.74
$ln(circulation)_{t-4}$	12.84	0.69
$ln(printingvolume)_{t-4}$	20.99	1.31
$ln(\#ofpages)_{t-4}$	6.71	0.38

Appendix B: first stage regressions

Inverse demand for advertising equation

	ln(# of advertising pages)		ln(circulation)	
	Coeff.	**Std. Err.**	**Coeff.**	**Std. Err.**
Consumer age shares				
Share consumers 14–19 years	1.36**	0.57	-1.52***	0.36
Share consumers 20–29 years	-0.35	0.59	0.08	0.38
Share consumers 30–39 years	1.34***	0.51	0.59*	0.32
Share consumers 40–49 years	1.67***	0.64	0.67*	0.41
Share consumers 50–59 years	0.75	0.57	-0.28	0.36
Content shares				
Children	5.33*	2.77	2.49	1.78
Fashion for purchase	-4.36***	1.33	1.38	0.85
Self–crafted fashion	-3.83**	1.85	1.68	1.18
Cosmetics	-4.40***	1.53	1.86*	0.98
Cooking	-3.95**	1.68	0.40	1.08
Interior design	-2.60*	1.46	0.27	0.93
Politics	-4.69*	2.75	3.60**	1.76
Health	-3.48**	1.47	-0.05	0.94
Partnership	-3.74***	1.44	1.02	0.92
Vacation	-6.25***	1.58	-0.31	1.01
Counselling	-4.25**	1.80	-0.89	1.15
Hobby	-6.60**	2.62	-2.62	1.68
Cars	1.32	3.82	4.98**	2.45
Science	-4.24***	1.62	0.43	1.04
The arts	-4.15**	1.79	1.52	1.15
Sensational journalism	-7.47***	2.12	3.92***	1.36
VIPs	-4.66***	1.31	0.46	0.84
Fiction	-5.34***	1.26	1.86**	0.81
Sex as entertainment	-2.64	3.08	-1.66	1.97
TV program	-2.85*	1.67	0.59	1.07
Service pages of the editors	-3.13**	1.57	0.47	1.01
Constant	33.93***	9.19	3.23	5.74
Instruments				
Average ln(adpages) of other magazines by publisher	0.29***	0.07	-0.05 *	0.05
Average cover price of other magazines by publisher	-0.02** ***	0.11	0.12	0.07
Dummy for supplement in at least one other magazine by publisher	-0.22***	0.09	0.02	0.06
Pulp & paper index	-0.20	0.08	0.07	0.05
Pulp & paper index · publisher 1	-0.05	0.02	0.02	0.01
Pulp & paper index · publisher 2 ∗ 1,000	-0.14	0.69	-0.56	0.44
Pulp & paper index · publisher 3 ∗ 1,000	-0.57	0.51	-0.52	0.33
Pulp & paper index · publisher 4 ∗ 1,000	-0.59	0.54	-0.51	0.35
Pulp & paper index · publisher 5 ∗ 1,000	0.67	2.30	-1.04	1.47
Pulp & paper index · publisher 6 ∗ 1,000	-0.58**	0.65	-0.51*	0.42
Pulp & paper index · publisher 7 ∗ 1,000	-0.45	0.54	-0.29***	0.35
Pulp & paper index · publisher 8 ∗ 1,000	-0.25	0.57	-0.48	0.37
Pulp & paper index · publisher 9 ∗ 1,000	-1.07	0.55	-0.60*	0.35
Pulp & paper index · publisher 10 ∗ 1,000	-0.51	0.58	-1.21**	0.37
Pulp & paper index · publisher 11 ∗ 1,000	-0.31	0.53	-0.43	0.34
Pulp & paper index · publisher 12 ∗ 1,000	-0.68	0.56	-0.66	0.36
Tests for joint significance				
	F	p–**value**	F–**test**	p–**val.**
All instruments	2.15	0.01	2.04	0.01
Pulp & paper index	1.44	0.14	1.66	0.07
Other instruments	3.67	0.01	1.69	0.15
Specification	14.88	0.00	13.20	0.00
Age shares	3.23	0.01	8.09	0.00
Content shares	2.99	0.00	4.51	0.00
Year dummies	3.85	0.00	10.14	0.00
"Within" R^2, # of obs. and # of magazines				
Within R^2	0.39		0.71	
# obs.	378		378	
# magazines	42		42	

The asteriks "***", "**" and "*" indicate statistical significance at the one, five and ten percent marginal significance level.

Magazine demand equation

	ln(cover price)		$ln(s_{j\|g})$		Share advertising pages		# of content pages	
	Coeff.	**Std. Err.**	**Coeff.**	**Std. Err.**	**Coeff.**	**Std. Err.**	**Coeff.**	**Std. Err.**
Fashion for purchase	1.68***	0.58	1.28***	0.48	0.32***	0.12	1.16***	0.31
Self–crafted fashion	-0.24	0.47	1.36***	0.38	0.23**	0.10	0.56**	0.25
Cosmetics	-1.67***	0.49	1.53***	0.40	0.21**	0.10	0.21	0.26
Cooking	2.41***	0.41	-0.64*	0.34	0.13	0.09	-0.05	0.22
Interior design	0.16	0.51	0.35	0.41	0.39***	0.11	0.07	0.27
Politics	-0.13	0.97	0.35	0.79	-0.21	0.21	-0.18	0.52
Children	1.14	0.97	3.21***	0.79	0.90***	0.21	0.51	0.52
Health	2.58***	0.38	-0.59*	0.31	0.14*	0.08	0.44**	0.20
Partnership	1.42***	0.41	0.38	0.34	0.10	0.09	0.79***	0.22
Vacation	-0.31	0.45	0.31	0.37	0.01	0.10	0.33	0.24
Counselling	3.73***	0.62	-0.92*	0.51	0.20	0.13	-0.54*	0.33
Hobby	4.38***	0.91	-1.28*	0.75	0.17	0.19	1.32***	0.49
Cars	-4.53***	1.42	2.24**	1.16	0.56*	0.30	0.76	0.76
Science	0.21	0.49	0.27	0.40	0.05	0.10	0.58**	0.26
The arts	-1.11*	0.59	3.90***	0.48	0.45***	0.13	-0.33	0.32
Sensational journalism	-1.51*	0.80	4.18***	0.65	-0.25	0.17	-0.30	0.43
VIPs	1.05***	0.24	-1.49***	0.20	-0.04	0.05	0.31**	0.13
Fiction	0.62*	0.34	1.21***	0.28	-0.06	0.07	0.01	0.18
Sex as entertainment	5.81***	0.99	3.56***	0.81	-0.08	0.21	1.33***	0.53
TV program	-0.63	0.56	0.52	0.46	0.21*	0.12	0.17	0.30
Service pages of the editors	-0.13	0.46	0.71*	0.37	0.05	0.10	0.57**	0.24
Content concentration	0.76*	0.40	2.64***	0.33	0.18**	0.08	0.17	0.21
Year dummies								
1994	0.21***	0.02	0.11***	0.02	0.06***	0.01	-0.04***	0.01
1995	0.21***	0.03	0.07***	0.02	0.06***	0.01	-0.04***	0.01
1996	0.18***	0.02	0.05***	0.02	0.03***	0.00	-0.04***	0.01
1997	0.16***	0.02	0.04**	0.02	0.03***	0.00	-0.02*	0.01
1998	0.17***	0.02	0.01	0.02	0.01***	0.00	-0.01	0.01
1999	0.17***	0.02	0.01	0.02	0.01**	0.00	-0.01	0.01
2000	0.13***	0.03	0.05*	0.02	0.01**	0.01	0.00	0.02
2001	0.11***	0.02	-0.02	0.02	0.01***	0.01	0.00	0.01
2002	0.00	0.02	-0.03*	0.02	0.01**	0.00	-0.04***	0.01
2003	0.00	0.02	-0.02*	0.02	0.00	0.00	-0.02*	0.01
Quarter dummies								
1st quarter	0.00	0.01	0.01	0.01	-0.03***	0.00	-0.01	0.01
2nd quarter	-0.01	0.01	0.01	0.01	0.00	0.00	-0.02***	0.01
3rd quarter	0.01	0.01	0.00	0.01	-0.03***	0.00	-0.02***	0.01
Constant	1.17***	0.27	-2.75***	0.22	0.19***	0.06	4.19***	0.14
Instruments								
Average cover price of other magazines by publisher at t	-0.08**	0.04	0.05	0.03	0.00	0.01	0.04*	0.02
Average cover price of other magazines by publisher at $t-1$	0.07*	0.04	0.11***	0.03	0.00	0.01	0.07***	0.02
Pulp & paper index	0.00	0.00	0.00	0.00	0.00***	0.00	0.00	0.00
# of segments own publisher active in/ # of segments competing publishers active in at t	0.14***	0.05	0.11***	0.04	-0.01	0.01	-0.01	0.03
# of segments own publisher active in/ # of segments competing publishers active in at $t-1$	-0.11**	0.05	0.10***	0.04	-0.01	0.01	0.01	0.03
Dummy for supplement in at least one other magazine by publisher	0.01	0.03	-0.02	0.02	0.00	0.01	-0.05***	0.01
# adpages in other magazines by own publisher at t	0.03***	0.01	0.00	0.01	0.00**	0.00	-0.01**	0.01
# content pages in other magazines by own publisher	-0.06***	0.02	-0.03*	0.02	0.00	0.00	-0.01	0.01
# content pages in other magazines by own publisher at $t-1$	0.01	0.02	-0.02	0.02	-0.01	0.00	0.00	0.01
Tests for joint significance								
	F–test	p–val.	F–test	p–val.	F–test	p–val.	F–test	p–val.
All instruments	5.70	0.00	8.19	0.00	2.79	0.00	8.13	0.00
Price instruments	1.61	0.18	11.45	0.00	3.32	0.02	12.89	0.00
Within group market share instr.	4.05	0.02	19.42	0.00	3.21	0.04	0.08	0.93
Adshare instruments	3.70	0.03	0.34	0.71	2.69	0.07	8.53	0.00
Content pages instruments	6.88	0.00	7.69	0.00	2.06	0.13	0.34	0.71
Tests for joint significance of specification and fixed effects and "within" R^2								
Specification	18.09	0.00	28.79	0.00	20.07	0.00	449.25	0.00
Fixed effects	13.93	0.00	50.36	0.00	69.54	0.00	117.23	0.00
Within R^2	0.3346		0.445		0.3581		0.1125	

The asteriks "***", "**" and "*" indicate statistical significance at the one, five and ten percent marginal significance level.

Marginal cost equation

	ln(printing volume)		ln(circulation)		ln(pages)	
	Coeff.	**Std. Err.**	**Coeff.**	**Std. Err.**	**Coeff.**	**Std. Err.**
# of titles by own publisher	0.02***	0.00	-0.01***	0.00	0.003*	0.002
# groups own publisher is active in	0.06***	0.01	0.00	0.01	0.003	0.004
Year dummies						
1994	-0.02	0.02	-0.02	0.02	-0.015	0.012
1995	-0.06***	0.02	-0.03**	0.01	-0.043***	0.010
1996	-0.05***	0.02	-0.03	0.01	-0.016	0.010
1997	-0.11***	0.02	-0.08***	0.01	-0.026***	0.010
1998	-0.08***	0.02	-0.07***	0.01	-0.026**	0.011
1999	-0.09***	0.02	-0.07***	0.02	-0.015	0.016
2000	-0.12***	0.02	-0.07***	0.02	-0.014	0.013
2001	-0.15***	0.02	-0.07***	0.01	-0.060***	0.012
2002	-0.16***	0.02	-0.09***	0.01	-0.036***	0.012
2003	-0.20***	0.02	-0.13***	0.02	-0.035***	0.012
Quarter dummies						
1st quarter	0.00	0.01	0.02***	0.01	-0.019***	0.006
2nd quarter	-0.01	0.01	0.01	0.01	-0.010*	0.006
3rd quarter	-0.01	0.01	0.02***	0.01	-0.024***	0.006
Constant	7.65***	0.47	2.53***	0.38	2.475***	0.310
Instruments						
Average cover price of other magazines by publisher at $t-4$	0.06***	0.02	0.05***	0.01	0.020**	0.010
ln(circulation) at $t-4$	0.13***	0.02	0.78***	0.02	-0.005	0.016
ln(printing volume) at $t-4$	0.55***	0.02	0.01	0.02	0.017	0.016
ln(# pages) at $t-4$	-0.02	0.03	0.02	0.03	0.599***	0.021
Tests of joint significance						
	Test	***p*–value**	**Test**	***p*–value**	**Test**	***p*–value**
All instruments	246.90	0.00	547.04	0.00	224.37	0.00
Specification	127.18	0.00	263.04	0.00	59.84	0.00
Fixed effects	12.67	0.00	9.42	0.00	9.36	0.00
"Within" R^2, # of magazines and # of obs.						
"Within" R^2	0.6152		0.7678		0.43	
# of observations	1,659		1,659		1,659	
# of magazines	48		48		48	

The asteriks "***", "**" and "*" indicate statistical significance at the one, five and ten percent marginal significance level.

Appendix C: external validation

Since cost information is probably the best kept secret in any industry, an external model validation is hard to perform, and what I do below might even be considered as an exercise in comparing apples and oranges. Indeed, the lack of cost data is the main reason why economists wish to estimate marginal cost in the first place. After a thorough internet search and several inquiries at publishing houses and firms from the printing industry, I received data on marginal cost for four German magazines.

Marginal cost for two of these four magazines were obtained from the internet. They correspond to "Der Schnitt" and "Filter", both cinema magazines that are comparable the women's magazines analyzed here in terms of circulation and the number of pages. According to Gangloff (2001), who cites the editor–in–chief of "Der Schnitt", the printing cost per copy of this magazine is 0.94 Euro. A business plan of "Filter", a magazine that is financed by a venture capitalist, shows that the editors estimate that paper and printing costs per copy are 0.78 Euro (Filter 2001). The upper part of the table below compares these marginal cost estimates gathered from industry sources with the estimated marginal cost to those magazines that come closest to "Der Schnitt" and "Filter" in terms of the number of pages and in terms of circulation. The table shows that the marginal cost for the two cinema magazines correspond well to the estimated marginal cost for the corresponding women's magazines.

The "actual" cost data in the lower part of the table stem from an advertiser and a representative from the printing industry.

While estimated and "real" cost are comparable in the upper panel of the table below, there are substantial differences between them in the lower panel. Marginal cost appear to be clearly over–estimated for the fashion magazines "Elle", "Madame" and "Vogue". For "Marie Claire" my cost estimates are in the reasonable range again, however.

While it is clearly questionable if the evidence presented in the table is really more than just a comparison of apples and oranges, the comparison at least indicates that my marginal cost estimates are not completely off reality.

	Circulation per issue	Pages per issue	Marginal cost per issue	Cover price
Der Schnitt	12,000	60	0.94	1.33
Filter	20,000	80	0.78	1.43
7 Tage	144,209	77	0.72	1.40
Heim und Welt	112,576	76	0.77	1.40
Vida	166,192	60	0.35	1.00
Magazine X	[230,000;270,000]	[300;350]	3.67	[2.04;2.55]
Allegra	219,380	235	2.48	1.95
Amica	275,263	302	3.95	2.00
Magazine Y	[200,000;250,000]	[250;300]	4.08	[3.06;3.57]
Elle	202,115	290	6.29	4.00
Madame	98,092	235	6.84	5.00
Marie Claire	156,153	215	2.67	2.50
Vogue	112,112	290	11.27	5.00

Cost data and prices are in Euros.