

Dewenter, Ralf

**Working Paper**

## Estimating the Valuation of Advertising

Diskussionspapier, No. 12

**Provided in Cooperation with:**

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*Suggested Citation:* Dewenter, Ralf (2003) : Estimating the Valuation of Advertising, Diskussionspapier, No. 12, Universität der Bundeswehr Hamburg, Fächergruppe Volkswirtschaftslehre, Hamburg, <https://nbn-resolving.de/urn:nbn:de:gbv:705-opus-1462>

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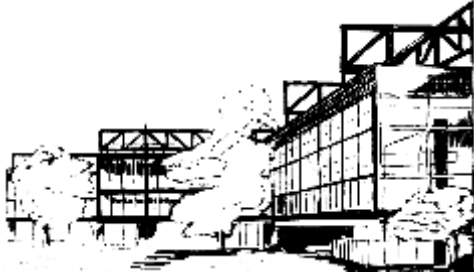
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Fächergruppe Volkswirtschaftslehre  
Department of Economics

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Discussion Paper No.  
June 2003

12

# **Estimating the Value of Advertising**

Ralf Dewenter

# Estimating the Valuation of Advertising

Ralf Dewenter <sup>\*†</sup>  
University FAF Hamburg  
Holstenhofweg 85  
D-22043 Hamburg  
Germany

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<sup>\*</sup>Institute for Economic Policy, Department of Economics, University of the Federal Armed Forces Hamburg, Holstenhofweg 85, D-22043 Hamburg, Germany, Tel.: 040/6541-2941, Fax: 040/6541-2042 email: ralf.dewenter@unibw-hamburg.de

<sup>†</sup>I am grateful to Andreas Kunert, Peter von der Lippe and Michael Westermann for valuable comments. I am also obliged to the participants of the VI. Spring Meeting of Young Economists 2001 in Copenhagen for a fruitful discussion.

# Estimating the Valuation of Advertising

## **Abstract**

Mass-medias are characterized by at least two interrelated markets. Therefore, the media firm has to satisfy two interdependent demands, the demand for magazines and the demand for advertising. The utility of the readers is affected by the information of the editorial and the advertising share. The advertising customers in contrast, are interested in the quality and quantity of the target group. The present paper analyzes both the marginal willingness to pay of readers for advertising and the marginal willingness to pay of advertising customers for sociodemographic attributes of the readers. Using the hedonic price approach the shadow prices are calculated using simple OLS and the Box-Cox regressions. Subsequently, because of the interrelationship of the demands, both markets are modelled simultaneously using 2SLS techniques.

**JEL-Classification:** C21, D12, L82

**Keywords:** Mass-Media, Magazines, Hedonic Prices, Box-Cox Approach

# 1 Introduction

The peculiarity of advertising intensive media, particularly of print media like public magazines, is a strong interrelationship of at least two markets, the reader market and the advertising market. On the one hand, the media firm sells magazines and their contents to the readers and on the other hand, it sells advertising space to advertising customers. Therefore, the publisher has to set optimal parameters like prices and qualities on both markets. Hence, a more or less exact knowledge of the relation between the sub-markets and of the price- and advertising elasticities is necessary.

The primary relations seem to be clear; the readers prefer high editorial and maybe advertising quality and low copy prices. The advertising customers in contrast are interested in target group specific sales and also relatively low prices. Thus, a direct connection between both markets is the circulation of the magazines. The aim of the publisher is to obtain a high number sales, to rise the attractiveness of the magazines for the advertising customers. A second relationship of the markets is given by the advertising volumes. Depending on the significance of advertising from the readers point of view, advertisements influence the utility of a reader positively or negatively. If subjective information content of an advertisement is high, advertising can be considered as a good, endowing a positive utility. The willingness to pay increases with increasing quantity of advertising. If so, the optimization problem for the publisher is simple. The aim is to maximize advertising and simultaneously circulation by lowering copy prices. If there is a saturation quantity of advertising or if advertising influences the utility in a negative manner, then there will be, of course, a trade-off between advertising and circulation.

The recent literature on media markets offers a number of empirical and theoretical studies, analyzing market relations of local or regional newspaper. Those media are of special interest, because a clear market structure, due to geographical market delineation, consists. A first study regarding interrelated market is carried out by Corden (1952). He describes interrelated markets as a special case

of the static theory of the firm and reflects the maximization problem that occurs in those markets. Corden describes a possible link between advertising space and the reader market but does not analyze its effects. Nevertheless, he assumes positive attitudes towards advertising in daily newspaper that typically consists of classified advertisements like job offers or second hand goods. Gustafsson (1978), in contrast, considers the link between advertising and circulation and models a positive relation. The so called circulation-advertising-spiral leads to higher advertising volumes due to higher circulation and vice versa. Sonnac (2000) raise “...the question of whether newspaper readers are ad-lovers or ad-avers.” She concludes that attitudes toward advertising is a country specific phenomenon. Furthermore, she considers this question theoretically and derives optimal prices (for both products) if readers are ad-avers. Surprisingly, a possible outcome is that the circulation spiral holds even if advertising is weighted negatively by the readers.

Blair and Romano (1993) model the links of the reader and the advertising markets of newspapers under the assumption of a positive relation between advertising and circulation. Assuming informative advertising they conclude a self-enforcing process due to the positive utility of advertising. Hence, Blair and Romano (1993) find strong support for the circulation-advertising spiral. Bucklin et al. (1989) analyze demand and pricing behavior in interrelated markets with regard to the optimization problem of a newspaper monopolist and find an empirical evidence for such a positive relation between advertising and circulation. This outcome can also be found in several studies (e.g. Rosse 1970 or Thompson 1989).

It is conspicuous that all of these studies use the absolute advertising volume, independently of the methodology used. Solely Thompson (1988) uses the share of advertisements. Thereby, it is not surprising, that a huge number of advertisements within a magazine is highly correlated with circulation because the advertising customer is interested in magazines or newspaper with high circulation. Thus, the risk of spurious regression or misinterpretation of the causality consists.

To prevent this problem this study follows Thompson (1988) by utilizing a different method to determine the influence of the advertising volumes on the purchaser behavior, using an hedonic approach. The innovation of this paper is that both single OLS regressions using Box-Cox transformation and a simultaneous model regarding reader and advertising markets, are used to analyze the interrelationship of the sub-markets. Moreover, different age groups are used to distinguish between the attitudes against advertising of various readers. A priori, it is not clear whether the readership is at whole ad-loving or ad-averse. Furthermore, it is (to our knowledge) the first analysis on German data.

Using a hedonic approach (see Grilliches 1961) the shadow price of the proportion of advertising and editorial is determined. By this means, one can asses in which form advertising affects the utility of the readers. Furthermore, one can explain price differentials between the magazines, because of variables like number of pages, or sociodemographic factors. A further advantage is the independency of this method to the measures of market structure. While regional daily newspapers widely show monopolistic structures, the markets for magazines are rather polypolistic or oligopolistic. Sociodemographic variables are, however, helpful to discriminate between several markets.

In a second stage, hedonic price equations are computed for advertising rates of the magazines. Sociodemographic characteristics of the readers give the opportunity to divide them into several target groups. Criteria like gender, income, and age of the readership are accordingly determinants of the marginal willingness to pay of the advertising customers.

In a third stage, reader and advertising markets will be modelled simultaneously. As mentioned above, both markets are interrelated, therefore, it is should be necessary to taking this interrelationship into account.

## 2 Theoretical background

### 2.1 Optimal consumption of differentiated products

According to Lancaster (1971), each product can be represented by the vector  $Z$  of its  $r$  characteristics with  $Z = (z_1, z_2, \dots, z_r)$ . The values of the characteristics can be both dichotomous and continuous. To each of these  $r$  characteristics an optimal value  $a_i$ , with  $i = 1, \dots, r$  is assigned, that determines the most favored value of  $z_r$  by the consumer ( $A = [a_1, a_2, \dots, a_r]$ ). Choosing a good from a set of differentiated substitutional products, the consumer, therefore, minimizes the distance between the values of the characteristics and his preferences. Thus the utility function  $U$  can be described as:

$$(1) \quad U = U(Z, A, X),$$

where  $X$  includes the value of all goods compete for the disposal income  $Y$  of the consumer. Furthermore, each consumer is confronted with a price function  $P(Z)$  that describes the price subject to the characteristics of the product. The optimization problem follows as (see Rosen 1974):

$$(2) \quad \max_{Z, X} U(Z, A, X) \quad \text{s.t.} \quad Y \geq P(Z) + X,$$

where the auxiliary condition is given by the budget constraint. From the first order conditions subject to  $Z$  and  $X$  follows:

$$\frac{\frac{\partial U}{\partial z_i}}{\frac{\partial U}{\partial X}} = \frac{\partial P}{\partial z_i} \quad \text{resp.} \quad \frac{u_i}{u_x} = P_i \quad \forall i.$$

Accordingly, the utility function is maximized when the ratio of the marginal utility of a characteristic to the marginal utility of all goods is equal to the shadow price of a characteristic. Subjective marginal willingness to pay for the characteristic  $i$  is then determined by the price  $P_i$ , that is said to be the hedonic price. Thus, the function  $P(Z) = \sum_{i=1}^r P_i(z_i)$  is the so called hedonic price function.



## 2.2 Hedonic price functions and specification

An analysis using hedonic price equations has already been realized in 1928 by Waugh, analyzing the influence of qualitative factors on vegetable prices. Over the years this method has become a standard instrument in empirical economics to determine not observable shadow prices of quality criteria and to assess the respective marginal willingness to pay for this characteristics. Especially, the combination of continuously and dichotomous regressors is a particular advantage of this approach. Fundamental research in this direction is carried out by Rosen (1974). In his article he determined the theoretical relationship between the characteristics differentiated products and their econometric verification.

A typical implementation of hedonic price functions is the analysis of durable goods, especially regarding real estates. Up to now the influences of several qualitative and quantitative characteristics like the age of a house, the neighborhood, the level of air pollution (see Graves et. al 1988), the impact of environmental protection (see Kohlhase 1991), or the accessibility of public transport (see Forrest et. al. 1996) on real estate prices have been frequently analyzed. Further applications concern automobile prices (see Grilliches 1961) or personal computers (see Cole et al. 1986). The hedonic prices calculation of not durable goods is relatively scarce. Exemptions are Nerlove's analysis of the wine consume in Sweden (Nerlove 1995) or Thompson's (1988) study about the reader market of British daily newspapers. Further analyses regarding non-durable goods can be found in the Marketing literature, e.g. Sander (1994) considers the evaluation of international brands.

The major problem regressing hedonic price functions is a proper specification. A priori, it is not clear which functional form is suited to mirror the adequate relation. Therefore, it is necessary to identify and compare the fit of various models. Typically, linear, semi-logarithmic, and logarithmic models are use, in the following form:

$$(3) \quad P_i = \beta_0 + \sum_{j=1}^N \beta_j x_{ij} + \varepsilon_i,$$

$$(4) \quad \log(P_i) = \beta_0 + \sum_{j=1}^N \beta_j \cdot x_{ij} + \varepsilon_i,$$

$$(5) \quad \log(P_i) = \log(\beta_0) + \sum_{j=1}^N \beta_j \cdot \log(x_{ij}) + \log(\varepsilon_i),$$

where  $P_i$  stands for the price of the good  $i$ ,  $x_{ij}$  for the particular characteristic and  $\varepsilon_i$  for an error component. Each equation can easily be regressed by least squares.

A particular problem of qualitative variables is that their values are often equal to zero, that typically occurs if a specific characteristic is absent. In consequence, in a logarithmic specification it is possible that the number of observations would reduce to a non acceptable amount. As a consequence a comparison of various specifications would not be feasible, since a comparison with varying samples is much more complicated.

A suitable approach to prevent those problems is the Box-Cox transformation (see Box and Cox 1964). This procedure allows a transformation of the variables that is close to the logarithm. A variable  $y$  is transformed using the Box-Cox parameter  $\lambda$  to:

$$y^{(\lambda)} = \begin{cases} \frac{y^\lambda - 1}{\lambda}, & \text{for } \lambda \neq 0 \\ \log(y), & \text{for } \lambda = 0. \end{cases}$$

The transformed values can be treated as an approximations for the logarithms for small  $\lambda$ 's, since according to the rule of L'Hôpital, it applies that (see Greene 1993):

$$\lim_{\lambda \rightarrow 0} \frac{y^\lambda - 1}{\lambda} = \lim_{\lambda \rightarrow 0} \frac{d(y^\lambda - 1)/d\lambda}{1} = \lim_{\lambda \rightarrow 0} y^\lambda \cdot \log(y) = \log(y).$$

Depending on the specification one can derive the following forms of regression equations:

$$(6) \quad P^{(\lambda)} = \beta_0 + \sum_{j=1}^N \beta_j x_{ij} + \varepsilon_i,$$

$$(7) \quad P^{(\lambda)} = \beta_0 + \sum_{j=1}^N \beta_j x_{ij}^{(\lambda)} + \varepsilon_i,$$

$$(8) \quad P^{(\lambda_1)} = \beta_0 + \sum_{j=1}^N \beta_j x_{ij}^{(\lambda_2)} + \varepsilon_i.$$

Equations (6) and (7) are thereby the equivalent to the semi-logarithmic and logarithmic specification. Equation (8) in contrast allows different parameterizations  $(\lambda_1, \lambda_2)$  of the endogenous and exogenous variables. A further generalization can be achieved by using different parameters for each variable, however, this would imply a huge sample because of the lost of degrees of freedom.

Another consequence of the Box-Cox approach is the resulting non-linear regression. A calculation using least squares regression is no longer adequate. Suitable techniques regressing non-linear equations are the non-linear least squares or the maximum likelihood estimator. In relation with optimization algorithms, like Newton-Raphson or Berndt-Hall-Hall-Hausman, one can derive the maximum of likelihood function numerical. Furthermore, the Box-Cox approach generates variables that are normally distributed, that is an assumption of the maximum likelihood estimator.

## 3 Empirical analysis

### 3.1 Hedonic prices on reader markets

The data used in this study are extracted from the internet database PZ-Online (Magazines Online). This database includes copy prices, advertising volumes, ad-rates, and other advertising information for a series of German magazines. Unfortunately, not all of the variables are available for each magazine in the database, so that our cross-section sample includes observations of 193 magazines for the year 1999. Regardless of the specification, one can describe the relation between prices and characteristics as:

$$(9) \quad P_i^L = f(AD_i/ED_i, NOP_i, SUP_i, FREQ_i, \Pi_i),$$

where  $P_i$  represents the copy price of a magazine,  $AD/ED$  the ratio of the advertising volume and the editorial,  $NOP$  the number of pages,  $SUP$  the number of inserts and  $FREQ$  the frequency of the magazine.  $\Pi$  stands for unobservable characteristics. One problem of the analysis is the high correlation between some of the variables. For example, with increasing advertising volumes the number of pages increases as well (see Table 1). A simultaneous usage of this variables is not suitable due to the hazard of multicollinearity, which is a further reason for the usage of the ratio  $AD/ED$ .

**Table 1:** Correlation matrix

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|       | ANZ    | NOP    | SUP     | AD/ED   | FREQ |
|-------|--------|--------|---------|---------|------|
| ANZ   | 1      |        |         |         |      |
| NOP   | 0.8759 | 1      |         |         |      |
| SUP   | 0.6770 | 0.5058 | 1       |         |      |
| AD/ED | 0.5646 | 0.2930 | 0.4901  | 1       |      |
| FREQ  | 0.2503 | 0.5908 | -0.0274 | -0.2536 | 1    |

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As a first approach, the hedonic price equations are tested using simple linear, semi-logarithmic, and log-linear forms (see equation 3-5). Especially, the supplements are not available for all magazines, hence, the sample reduces due to the calculation of logarithmic values. Because of the varying samples, a comparison of the results is not easily practicable. But in all of the specifications the relative share of advertising has an expected negative impact on the price (see Table 2). Furthermore, a negative shadow price of the frequency and a positive impact of the number of pages and supplements are measurable. Even if the level of significance varies with the specifications, the signs of the parameters are stable.

Similar results are derived from mean adjusted regressions. As well as in the former regressions, the direction of the influences are relatively stable for different specifications (see Table 3). Moreover, all significant parameters for  $AD/ED$  are negative.

**Table 2:** single hedonic price regressions  
(Least Squares Regressions)

| Variable     | Linear                         | Semi-log                        | Log-linear        |
|--------------|--------------------------------|---------------------------------|-------------------|
| Constant     | 8.791<br>(17.85)               | 2.228<br>(30.56)                | 2.287<br>(4.31)   |
| AD/ED        | -2.076<br>(-1.59)              | -0.420<br>(-1.92)               | -0.120<br>(-1.70) |
| FREQ         | -0.147<br>(-8.66)              | -0.033<br>(-13.77)              | -0.730<br>(-7.98) |
| NOP          | $2.08 \cdot 10^{-4}$<br>(1.37) | $7.020 \cdot 10^{-5}$<br>(1.94) | 0.120<br>(1.32)   |
| SUP          | 0.003<br>(1.05)                | 0.003<br>(1.31)                 | 0.083<br>(2.57)   |
| $\bar{R}^2$  | 0.42                           | 0.63                            | 0.55              |
| Log-Likelih. | -463.71                        | -80.71                          | -60.01            |
| Observations | 193                            | 193                             | 138               |

**Table 3:** Single hedonic price regressions  
(mean adjusted)

| Variable     | Linear            | Semi-log           | Log-linear        |
|--------------|-------------------|--------------------|-------------------|
| Constant     | 1.609<br>(17.62)  | 0.529<br>(7.26)    | 1.326<br>(12.09)  |
| AD/ED        | -0.118<br>(-1.81) | -0.100<br>(-1.92)  | -0.158<br>(-2.78) |
| FREQ         | -0.664<br>(-9.52) | -0.799<br>(-13.77) | -0.806<br>(-7.07) |
| NOP          | 0.147<br>(2.11)   | 0.199<br>(3.46)    | 0.299<br>(2.65)   |
| SUP          | 0.026<br>(0.88)   | 0.024<br>(1.01)    | 0.068<br>(2.79)   |
| $\bar{R}^2$  | 0.42              | 0.55               | 0.60              |
| Log-Likelih. | -132.88           | -97.37             | -84.14            |
| Observations | 193               | 193                | 138               |

Though, the influence of relative advertising volumes is problematic in a cross-sectional study because of the existence of different informational contents of the

advertisements, the coefficients of  $AD/ED$  are mostly negative. To what extent this hypothesis can be validated can be measured by the Box-Cox regressions.

The Box-Cox regression can be carried out using several specifications (see Section 2.1). Equations (6) and (7) are as mentioned above equivalents to the semi-logarithmic and logarithmic specification, whereby equation (8) allows a different parameterizations for endogenous and exogenous variables. All regressions show basically the same signs of the coefficients. The direction of the marginal willingness to pay is identical in each equation (see Table 4). Apart from two exemptions one can reject the null hypothesis “the parameter is not statistically different from zero”. Solely the constant in the Box-Cox regression I and the coefficient of the number of pages in the model III are statistically not significant (see z-statistics in Table 4). Furthermore, it is obvious that the log-linear model is superior to the other models (see log-likelihood statistic).

**Table 4:** Box-Cox regressions

| Variable          | Box-Cox I                       | Box-Cox II         | Box-Cox III       |
|-------------------|---------------------------------|--------------------|-------------------|
| Constant          | 2.557<br>(1.40)                 | 2.360<br>(7.547)   | 2.325<br>(5.329)  |
| AD/ED             | -0.639<br>(-7.23)               | -0.271<br>(-1.77)  | -0.278<br>(-1.78) |
| FREQ              | -0.041<br>-5.45                 | -0.642<br>(-8.655) | -0.614<br>(-3.57) |
| NOP               | $8.36 \cdot 10^{-05}$<br>(2.62) | 0.083<br>(2.00)    | 0.076<br>(1.465)  |
| SUP               | 0.001<br>1.663                  | 0.029<br>(2.716)   | 0.029<br>(2.784)  |
| $\lambda_1$       | 0.153                           | 0.199              | 0.189             |
| $\lambda_2$       | -                               | -                  | 0.209             |
| Log-Likelih.      | -411.44                         | -398.07            | -398.05           |
| Avg. Log-Likelih. | -2,131                          | -2.062             | -2.062            |
| Observations      | 193                             | 193                | 193               |

Seemingly, there is no obvious advantage of the specification using different Box-Cox parameters in comparison to the log-linear model. The log-likelihood statistic

is nearly identical in both models. Furthermore, a comparison of the parameters do not support the conjecture of different values ( $\lambda_1 = 0.189$  and  $\lambda_2 = 0.209$ ).

Comparable with the simple least squares regressions, the results are robust against the variation of specifications. Moreover, the identical sample allows a model selection on the basis of the statistics. Usually, the optimization algorithm reacts sensitive to a variation of the starting values, so a convergence was not be achieved in every case. Fortunately, independent of the starting values, only one maximum was calculated if the system converged. Thus, the problem of multiple maxima did not occur.

Altogether, one can state that marginal willingness to pay of the consumers is positively affected by the number of pages, as long as a high share of editorial is available. A huge relative advertising share leads to a decreasing utility, the willingness to pay subsides. The effect of doubling the relative advertising, can be figured by a price reduction of 6.4 DM at the sample means. This value is broad over the average copy price of the magazines which is about 5.5 DM. All these results stay unchanged if the editorial ( $NOP - ANZ$ ) is used instead of  $AD/ED$  as an exogenous variable. The influence of the editorial on the marginal willingness to pay of the readership is clearly positive.

The frequency of the magazines has, as expected, a negative shadow price. The reason could be an only hardly achievable constant quality of high frequency magazines. An increase of the frequency at one unit leads, therefore, to reduction of the shadow price of about 0.14 DM. Also the willingness to pay for supplements is very low. A reason could be the informational content that varies over the cross-section. Moreover, each additional page of the supplements would lead to an increase of the shadow price of about 0.26 Pfennig.

### **3.2 Hedonic prices on advertising markets**

After determining the marginal willingness to pay on the reader market, the focus is now on the advertising market. From the advertisers point of view it is not the magazines which are of interest, but the characteristics of the target group. The

question if a specific target group is consistent with the readership of a magazine determines the demand for advertising space. A measure for this conformity is the socio-demography of the readers. Variables like gender, age or income provide information on how far the readers corresponds the target group and determine some kind of quality measure.

The core question is, however, to what extent the characteristics allow a higher price for the advertising, independently of the circulation of a magazine. Accordingly, not the ad-rate is the left hand side variable, but the ad-rate per contacts (i.e. circulation) ( $P_i^A$ ). As relevant characteristics the gender, the age, the monthly income and a variable *CHILD* are used which specifies households with children under 14 years.

All sociodemographic variables are extracted from the Media-Analyse'99 for magazines. Due to matching of both sources<sup>1</sup> the sample includes 152 observations. All sociodemographic variables are percentage values (e.g. the percentage of readers which are 14-19 years old). Therefore, it is not necessary to use logarithms of the data. The attributes age and income are summed into two groups, high and low respectively. Thus, the variables are: *INC1* (0-3000 DM) and *INC2* (over 3000 DM) resp. *AGE1* (14-39 years) and *AGE2* (over 39 years). The variable *WOMAN* indicates the percentage of the readers which are women. Table 5 includes the correlation coefficients of the variables.

**Table 5:** Correlation matrix

|         | $P_i^A$ | AGE1    | AGE2    | INC1    | INC2    | CHILD  |
|---------|---------|---------|---------|---------|---------|--------|
| $P_i^A$ | 1       |         |         |         |         |        |
| AGE1    | 0.2406  | 1       |         |         |         |        |
| AGE2    | -0.2418 | -0.9976 | 1       |         |         |        |
| INC1    | -0.1144 | -0.2553 | 0.2546  | 1       |         |        |
| INC2    | 0.2371  | 0.5565  | -0.5573 | -0.4033 | 1       |        |
| CHILD   | -0.0222 | 0.4949  | -0.4921 | -0.1783 | 0.3819  | 1      |
| WOMAN   | -0.3984 | -0.2378 | 0.2402  | 0.1291  | -0.3925 | 0.0899 |

<sup>1</sup>Ad-rates are also extracted from the database PZ-Online.



Again, also in this case, the specification is unclear. Several forms are tested using the following basically context:

$$(10) \quad P_i^A = f(AGE1_i, AGE2_i, INC1_i, INC2_i, CHILD_i, WOMAN_i, \Lambda_i),$$

where  $\Lambda$  specifies unobservable influences. As in the analysis of the reader market, a linear specification is used at first. Since the exogenous variables are in percentage values, there is no need to take logarithms. Therefore, the equations is a quasi-semi-logarithmic form. In a second specification the ad-rates are taken in logarithms, so that a quasi log-linear form is present. Both equations are regressed using the White approach correcting for heteroscedastic standard errors (see Table 6).

**Table 6:** Hedonic price regressions of the advertising-rates

| Variable      | $P_i^A$           | $P_i^A$           | $P_i^A$           | $P_i^A$           |
|---------------|-------------------|-------------------|-------------------|-------------------|
| Specification | Semi-log          | Quasi-log I       | Quasi-log II      | Quasi-log III     |
| Constant      | 200.40<br>(0.67)  | 6.205<br>(1.84)   | 2.320<br>(4,821)  | 4.367<br>(6.48)   |
| CHILD         | -1.312<br>(-2.52) | -0.014<br>(-2.78) | -0.014<br>(-2.81) | -0.014<br>(-2.83) |
| INC1          | -0.154<br>(-4.03) | -0.002<br>(-9.35) | -0.002<br>(-9.21) | -0.002<br>(-9.25) |
| INC2          | 0.421<br>(0.54)   | 0.019<br>(2.86)   | 0.019<br>(2.89)   | 0.019<br>(2.87)   |
| AGE1          | 0.546<br>(0.14)   | -0.018<br>(-0.55) | 0.020<br>(5.27)   | -<br>-            |
| AGE2          | -0.858<br>(-0.28) | -0.038<br>(-1.16) | -<br>-            | -0.020<br>(-5.34) |
| WOMAN         | -1.820<br>(-2.36) | -0.012<br>(-4.30) | -0.012<br>(-4.27) | -0.012<br>(-4.29) |
| $\bar{R}^2$   | 0.18              | 0.49              | 0.49              | 0.49              |
| Log-Likelih.  | -946.62           | -157.01           | -157.97           | -157.63           |
| Observations  | 152               | 152               | 152               | 152               |

According to the Log-Likelihood statistics the (*Quasi-log I*) regression produces a better fit than the (*Semi-log*). Apart from the age variables all coefficients are statistically significant. This problem could be due to the fact that *AGE1* and *AGE2* are highly correlated. To prevent collinearity two other specifications are tested with only variable *AGE1* or *AGE2*, respectively.

Overall, the results can be interpreted as follows: The marginal willingness to pay for readers that have children under 14 is negative. An increase of one percent of this readers leads to a decrease of the willingness to pay of 0.35 Pfennig. One reason could be a different consumer behavior of those readers. For an advertiser which target group is identified by exactly this attribute, the shadow price should of course be positive.

A readership with a low income has, not surprisingly, a negative shadow price as well. Thus, the marginal willingness to pay regarding a high (low) income readership is positive, even though, the shadow prices of an increase of one percent of high income readers are low (0.16 and -0.05 Pfennig). A different result is expected using a more precisely delimitation of the income groups.

The willingness to pay for the characteristic “women” is also negative, even if the shadow price is relatively low. Seemingly, a male readership is the target for slightly more expensive advertising. An alternative explanation could be that male consumers demand higher quantities of the respective products.

However, using only one variable with regard to the age of the consumers, the respective coefficients are statistically significant. Although, one would expect that older consumers have a higher income, the shadow price for readers over 39 is negative. In contrast the marginal willingness to pay for younger readers is positive. A one-percent change in age leads to an reduction (increase) of the willingness to pay of -0.22 (0.25). This result indicates that advertisers expect higher consumption when readers are under 39 years old. At least advertising on TV and magazines seems to support this conjecture, due to obviously younger target groups.

### 3.3 Simultaneous analysis of copies and advertisements

As mentioned above, the rational publisher decides simultaneously by setting copy and advertising rates. For this reason, there are two distinct groups of magazines. On the one hand, there is a number of products which have a relative high copy price and, therefore, revenues out of the reader market are also relatively high. One would expect that the number of copies sold and, thus, the revenues from the advertising market in such markets is rather low. On the other hand, there are magazines which have a large number of readers due to low copy prices and, therefore, realize relative high revenues from the advertising market. To choose the dominant strategy, the media firm has to know the willingness to pay or more exact the price elasticities from both markets.

Taking this fact into account, one has to model both markets simultaneously to prevent the hazard of spurious regression that could occur only because of the interrelationship of reader and advertising markets. But because of the small number of information that is available from both markets for the same magazines, the actual sample is not suitable for a simultaneous analysis. For this reason a new sample was selected including a higher number of observations. Moreover, there are additional variables which were not included in the first sample. All prices, sales and circulations are, therefore, extracted from the “IVW Analysis” from the first quarter of 2001. Further information like sociodemographic variables are taken from the Media-Analysis 2001.

To enable comparability of the results the first step was to run single regressions of both markets. In contrast to the previous procedure, however, a distinction of different age distributions of the readership with respect to their subjective attitude to advertising has been carried out. For this purpose, two variables ( $D1420$  and  $D5060$ ) were generated which are equal to one, if at least 50% of the readership is 14-20 and 50-60 years old. These dummies are multiplied with the relative advertising share to determine if and what differences exist between the groups.

**Table 7:** Simultaneous price regressions

| Variable    | Copy price           | Ad rate             | Copy price          | ad rate             |
|-------------|----------------------|---------------------|---------------------|---------------------|
| Method      | OLS                  | OLS                 | 2SLS                | 2SLS                |
| Constant    | 0.659<br>(0.60)      | 3.448*<br>(5.35)    | 1.789<br>(0.90)     | 3.925*<br>(9.23)    |
| D1420*AD/ED | -0.158***<br>(-1.71) | -                   | -0.567*<br>(-2.91)  | -                   |
| D5060*AD/ED | -0.088***<br>(-1.89) | -                   | 0.098<br>(0.63)     | -                   |
| FREQ        | -0.846*<br>(-4.55)   | -0.086**<br>(-2.28) | -1.316*<br>(-4.11)  | -0.186**<br>(-2.22) |
| EDIT        | 0.381**<br>(2.04)    | -                   | 0.920*<br>(2.94)    | -                   |
| DSUP        | -0.047<br>(-0.42)    | -0.010<br>(-0.18)   | -0.366**<br>(-2.21) | 0.057<br>(0.76)     |
| CHILD       | -0.007<br>(-1.19)    | -0.005**<br>(-2.12) | 0.002<br>(0.36)     | -0.003<br>(-0.72)   |
| INC1        | -0.017**<br>(-2.34)  | -0.034*<br>(-8.18)  | 0.006<br>(0.39)     | -0.023*<br>(-3.67)  |
| AGE1        | -0.007***<br>(-1.93) | 0.003**<br>(-2.49)  | -0.015*<br>(-2.63)  | 0.005**<br>(2.55)   |
| MAN         | -0.001<br>(-0.34)    | -0.002<br>(-2.31)** | 0.004<br>(0.18)     | -0.001<br>(-0.95)   |
| N1          | -                    | 0.012*<br>(3.19)    | -                   | 0.2427*<br>(2.92)   |
| N2          | -                    | 0.003**<br>(2.25)   | -                   | 0.2196*<br>(2.82)   |
| N3          | -                    | 0.010<br>(1.51)     | -                   | 0.2069*<br>(2.74)   |
| N4          | -                    | 0.003<br>(0.44)     | -                   | 0.2080*<br>(2.61)   |
| N5          | -                    | 0.021*<br>(3.39)    | -                   | 0.055<br>(0.68)     |
| N6          | -                    | 0.010**<br>(2.03)   | -                   | 0.1978*<br>(2.80)   |
| RANGE       | -                    | -0.344*<br>(-14.43) | -                   | -0.440*<br>(-9.37)  |
| AD/ED       | 0.152<br>(1.66)      | -                   | 0.891**<br>(2.21)   | -                   |
| $P_i^c$     | -                    | -                   | -                   | -0.080<br>(-0.87)   |
| $P_i^a$     | -                    | -                   | -0.366*<br>(-4.24)  | -                   |
| $R^2$       | 0.59                 | 0.75                | 0.34                | 0.73                |
| Obs         | 101                  | 204                 | 101                 | 101                 |

\*, \*\*, \*\*\* describe significant parameters at the 1%, 5% and 10% level.

Furthermore, the variables  $N1-N6$  were introduced to determine the percentage distribution of the magazines in 7 different geographical areas (the so called Nielsen areas). The Nielsen area 7 is used as a control area. Furthermore, to prevent the problem of multicollinearity, only the age groups  $AGE1$  and the income group  $INC1$  have been used. The variable  $EDIT$  measures the share of editorial contents within a magazine. And  $DSUP$  a dummy variable that is equal to one, if supplements are distributed with the magazines, is used instead of the number of supplements, so that a regression using the Box-Cox transformation is not necessary.  $RANGE$  determines the overall range of a magazine that is not only the copies sold but additionally free copies and the number of contacts. All variables apart from the dummies are in logarithms or in percentage form. In the following only the results of the log-linear model are presented, because of its good fit.

As one can see from Table 7 the consideration of different age structures leads to quite different results in comparison to the first sample. As in simple OLS regressions both groups show negative but insignificant values. In the 2SLS system only younger reader value advertising negatively, whereby, the influence of the advertising share on older readers is statistically insignificant. For the other readers (aged over 20 and under 50) instead, the marginal willingness to pay is positive. A considerable difference to the first sample using only the measure  $AD/ED$  for relative advertising, is that a positive willingness to pay seems to be present.<sup>2</sup>

High frequency magazines, show negative values in both regressions, that is consistent with the first sample results and is not very surprising. The editorial content of a magazine is on average positively valued by the reader. Apart from the products where advertising is the most important content, this an expected result, because of the information expressed by the editorial. Regarding the supplements only the 2SLS regression shows a significant and negative willingness to pay. This result is contrary to the first sample but consistent with the outcomes regarding the relative advertising. Hence, supplements are, of course, only one

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<sup>2</sup>These results are not reported here but can be requested from the author.

possible kind of advertising. Families with children under 14 years old, do not differ from families without children or singles. The income seems not to have any influence on copy prices regarding 2SLS estimates. The willingness to pay for magazines with younger readers is positive in contrast to magazines for older readers. The gender seems to have no influence on the copy price.

From the advertising customers point of view is a high frequency magazine a negative characteristic. The effect of advertising is probably assumed to be low if readers consume the magazines with high frequency. Both, OLS and 2SLS regressions show equal results. Whether a supplement market exists or not does not influence the marginal willingness to pay for advertising. None of the coefficient is statistically different from zero at any common level of significance. Interestingly, also the variable CHILD is statistically insignificant using 2SLS regressions. Regarding the OLS estimates one can measure a negative impact only at the 10% level. A lower income is, as expected, negative in advertising rates regressions. Advertising for costly products is of course more expensive as advertising for low-cost products. Hence, one can assume that a readership with relative high income leads to a strengthened volume of advertising with respect to costly goods. Gender, again, is insignificant. The results from the first sample are contradicted.

The Nielsen-areas show weak evidence for a different assessment. The areas are connected with similar but significant coefficients regarding the magnitudes, on average. The control area N7 and the area N5 seems to generate a lower willingness to pay. That is not very surprising because N7 is an area with a low purchasing power (Thuringia and Saxony) and N5 (Berlin) is an area with a relatively low population compared to the other areas. RANGE is, as expected, negative. Because it is already included in the ad rate per reader. Hence, the marginal utility of a growing readership is decreasing. Both prices in the 2SLS regressions are negative, even if only the ad rate is significant. One can interpret this as evidence for the interrelationship between the markets that was discussed above.

Overall, the simultaneous model yields that some of the results of the single

OLS estimates are not supported, regarding both samples. Especially, variables like gender (MAN, WOMEN) or CHILD seems to be less interesting for advertising customers as supposed from the single equations. Overall, the results from both models are very similar. The same is true for the reader market, most of the hypotheses are supported by the simultaneous model. Though, the most important question, whether the attitude toward advertising is positive or negative, could be specified due to the usage of different age groups. While the first and the second sample produce non-uniform results with respect to the single equations, the 2SLS model yields further insights. Of course, a cross-section analysis can merely produce results that hold only on average over many different magazines and genres, but the analysis demonstrates that different from newspapers, where advertising contains a whole lot of information, the existence of some kind of circulation-advertising spiral is not granted.

## 4 Conclusions

Hedonic prices are computed for both, copy prices and ad-rates of German magazines, using simple OLS regressions, the non-linear Box-Cox approach and a simultaneous model using 2SLS. Thus, marginal willingness to pay of the consumers could be determined for different quality characteristics of the magazines, like the number of pages, the advertising, the editorial, the number of supplements or the frequency. Furthermore, shadow prices are computed for ad-rates using sociodemographic attributes of the readership, like age, income or gender.

As expected it is not the absolute value of advertising that is important to the readership, but the relative share. Notwithstanding of the heterogenous sample of magazines, due to different target groups, one can well interpret the results of the analysis. Even if log-likelihood statistics prefer a log-linear specification the mainly results do not differ using different specifications or different samples. The same is true for regressions regarding the ad-rates. Not surprisingly, the marginal willingness to pay increases with higher income. In contrast the shadow price for younger readers is positive and that for older readers negative. A result that

is surprising but supported by advertisement practice. Families or singles with children under 14 years are seemingly not a special target groups for advertisers on average. More important than female readers are male reader, however, this is only true for the single equation analysis from the first sample. Also the influence of a third market, the supplement market, declines in the second sample. On the other hand readers have seemingly a negative attitude for supplements. The shadow price of higher frequencies is negative in all respects.

Altogether, the second sample supports the results from the first sample. In contrast to the first data sample the sociodemographic variables could be used as control variables for the analysis of the reader market, to determine the marginal willingness to pay of different groups. A further advantage lies in the sample size. Therefore, a simultaneous model of both markets could be possible. As mentioned above the considerable influence of the age structure was an important feature. Only few of the results were disproved.

The results from the study on hand are very useful for the theoretical modelling mass-media markets with respect to the interrelationship of the distinct products. Not only the absolute advertising volumes are deciding factors for the demand but also the relative quantities. For the newspaper or magazine publisher this means that the optimization process has to take into account whether a self-reinforcing process is present or not. Furthermore, sociodemographic factors are of special importance for modelling media or, more exact, advertising markets. Moreover, the readership can not be considered as a whole, because younger consumers seems to have different attitudes. A more distinct analysis could lead to further insights in this respect. But this could only be carried out using disaggregated data on basis of single consumers.



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