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Media Bias and Advertising: (Preliminary) Evidence from German Car Magazines*

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Abstract

This paper investigates the existence of a possible media bias by analyzing the impact of automobile manufactures' advertisements on automobile reviews in German car magazines. By accounting for both endogeneity and sample selection we find a positive impact of advertising volumes on test scores. Moreover, also a home bias in terms of higher scores for German cars is observable. We account these results as some evidence for a media bias, induced by the two-sidedness of the markets.

PRELIMINARY VERSION – DO NOT QUOTE

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1 Introduction

Media bias and diversity of opinion are standard issues not only in (media) economics but also in political science and journalism. In economics both concepts have recently been rediscovered with the emergence of the concept of two sided markets (see Rochet & Tirole, 2003). Moreover, many countries such as Germany (see Dewenter & Haucap, 2008), the U.S., the UK and Australia either already have reformed or at least intensively discuss to reform the competition law with respect to media mergers. Important indicators when assessing intra-media and cross-media ownership, however, are again diversity of opinion and media bias.

Media bias or, to put differently, limited media neutrality can take several shapes. Stories, news or – generally speaking – coverage can be biased due to incorrect reproduction of facts, misreports, the selection of news or badly performed search of facts. A media bias always exists when the media are (intended or not) not objective, not completely honest or not neutral with their reporting. It is obvious that a completely unbiased coverage is very unlikely, even if it is produced incidentally. However, only a systematic bias is likely to lead to permanent too high information cost and therefore to a sustained deadweight loss.

A typical and often-cited type of bias is the so called political bias which is a form of an ideological bias and typically not profit oriented.¹ Of course, in case that a political bias follows the preferences of the recipients it is also suitable to maximize profits. A different type of profit-oriented bias arises from the interdependence of recipients and advertising markets. As advertising volumes are typically the most important source of revenues, media such as newspapers and magazines have of course incentives to increase the demand for advertising space in order to increase revenues (and *ceteris paribus* also profits). Thus, in case that coverage can be an adequate instrument to expand the demand for advertising space – e.g., by benevolent reporting – coverage is likely to be biased. From an advertising customer's point of view, biased coverage can then be seen as a kind

¹The New York Times for example has frequently been accused to have a liberal (and therefore biased and non-neutral) viewpoint. Other ideological biases are, e.g., ethnically, racially and religiously motivated.

of quality or as a kind of “free of charge advertising”. A high quality media is then suitable to increase the demand for the advertising customers’ products.

In usual one-sided markets with negligible cost of biased coverage biased reporting would always have at least a non-negative effect on profits. In two-sided markets however the effect of biased coverage can either be stronger or weaker. As long as readers like advertising (i.e., network effects from the advertising to the reader market are positive) a media bias will have stronger effects than in one-sided markets. This is due to the reinforcing impact of two-sided network effects. With higher amounts of advertising a higher demand for copies follows which in turn leads to a stronger demand for advertising volumes. In case that readers dislike advertising a trade-off between advertising and circulation exists, though. An increasing demand for advertising space (and therefore an increasing number of advertisements) would then reduce the demand for copies and vice versa. The incentives for biased coverage are of course be lower when readers are ad-haters.

Studies on media bias have a long tradition in journalism and political science (see, e.g., Glasgow University Media Group, 1982; Herman and Chomsky, 1988). Recently, especially with the heavily growing literature on two-sided markets, also more and more economic studies can be found addressing this issue. An outstanding theoretical paper on media bias from an economic perspective is Mullainathan & Shleifer (2005). The authors analyze the newspapers’ incentive to distort the news coverage under both monopolistic and competitive markets structure. It is assumed that not only newspapers are biased but also that readers have their own beliefs. Newspapers are then likely to (as Mullainathan & Shleifer (2005) put it) slant the stories toward these beliefs. Generally speaking, Mullainathan & Shleifer (2005) find that a monopolist might have a stronger incentive to bias coverage. Opposite results are provided by, e.g., Anderson & McLaren, (2007) and Gentzkow & Shapiro (2006a). In contrast to Mullainathan & Shleifer (2005) both papers find that competition is likely to reduce media bias in case that readers are not able to judge the validity of the coverage. However, most of these studies are dealing with a political media bias and only few an-

alyze the incentives to slant content toward the advertising customers' beliefs. Exceptions are Hamilton (2004) and Ellman & Germano (2005) who address the interdependence of the markets and the incentives to bias contents infavor of advertisers.

Similar as for the theoretical studies holds for empirical papers on media bias. Gentzkow & Shapiro (2006b) as well as DellaVigna & Kaplan (2007) and George & Waldfogel (2003) analyze the existence of a political bias from different perspectives. Again only few deal with the impact of the advertising customers' behavior (see Dyck & Zingales, 2003, and Reuter (2002) and Reuter and Zitzewitz, 2006). Both Reuter (2002) and Reuter and Zitzewitz (2006) test the impact of advertising on wine ratings and mutual fund recommendations, respectively, finding evidence for biased results. Both studies are therefore closely related to our study.

This study also aims at analyzing the existence of a possible media bias provoked by the interrelation of reader and advertising markets. However, in contrast to other studies the impact of advertising volumes on magazines' car reviews is analyzed which comes with several advantages. At first, data are disposable and can easily be collected from the magazines. Moreover, car reviews are – at least to some extent as with respect to engine performance or pollutant emission – objective measures for quality. But then again, there are also some measures which are a matter of taste or at least partly underly personal perceptions. Car reviews are therefore also well suited for a possible media bias.

2 Empirical Analysis

2.1 Identification and estimation strategy

Analyzing the impact of brands' advertising volumes on test scores bears some econometric as well as economic problems to be solved. First, as the selection of cars for the reviews does not follow a random process but most probably depends on economic characteristics (such as brands' market shares and new car releases) this non-random selection has to be taken into account to prevent a possible

selection bias (Heckman, 1979). To overcome this problem we apply a standard Heckman correction. For this purpose, we run a first stage probit regression in order to estimate the probability of a brand's models being reviewed and calculate the inverse Mills ratio which is well suited to serve as a regressor correcting for specification bias when analyzing the test scores.

Second, as we assume that brands' advertising volumes in each magazine affects the outcome of reviews also a reverse relation should exist. In case that high advertising volumes lead to higher test scores, of course, a low test score should result in a lower number of advertisements. Given this interdependence of test scores and manufacturer specific advertising volumes regressions should suffer from endogeneity bias. Moreover, regressions are also likely to suffer from spurious regression in case that advertising serves as a signal for quality (see Milgrom & Roberts, 1986). Cars' product quality will then affect both manufacturers' advertising volumes and test scores alike, however, a correlation of advertising volumes and test scores could then be mistaken as causality.

Although we cannot completely rule out that the results suffer from spurious regression when advertising serves as a signal for quality we account for this problem by using relative instead of absolute advertising volumes. In case that manufacturers offering high quality cars signal for such high quality one should measure higher advertising volumes in absolute values and also over time. Higher relative values should only exist towards low quality car manufacturers but not towards all manufacturers.

To identify the impact of brand specific advertising volumes on test scores an adequate instrument has to be found. A good instrument should of course be correlated with the endogenous explanatory variable and at the same time not (at least not directly) be affected by the left hand side variable. For this reason, we use the number of a brand's new car registrations in Europe for instrumenting advertising volumes. While new registrations are likely to coincide with new models and advertising campaigns, test scores on German car magazines should have (if any) a negligible impact on European registrations.²

²A perfect instrument here in this analysis should not only meet the standard assumptions

Third, since our left hand side variable in the second stage (test scores) simply reflects a ranking order, the underlying scale is, of course, ordinal. Hence, an ordered probit model instead of a ordinary least squares estimator would be the appropriate choice. However, since analyzing categorical (ordered) variables with endogenous regressors and non-random selection is (because of its non-linearity) neither an easy task nor is it (to our knowledge) implemented in any statistical software package, we decided to initially ignore this characteristic.³ The main idea behind this strategy are some results on the relationship between the linear probability model and Logit/Probit-models. The linear probability model is usually seen as a convenient way to approximate the response probability for a set of covariates. In most cases the linear probability model gives good estimates of the partial effects on the response probability. So the effects of some predicted values lying outside the unit intervall may not be very important.⁴ The second stage of our instrumental variable regression can therefore be interpreted as a linear probability model and should be a good approximation of the data generating process, especially as our dependent variable is not just a standard dummy variable but of ordinal scale, the differences between the linear probability model and an ordered probit regression should be even less problematic. For matters of robustness testing we will later apply an ordinary ordered probit model by approximating the endogenous regressor.

Additionally, we will jointly take selection and endogeneity problems into account and furthermore substitute the second stage OLS regression in our instrumental variable (IV) model including an ordered probit regression as the second stage regression. We will proceed in 3 steps:

1. As the starting point we estimate the probability that a brand's model will

of a good instrument but also minimize the hazard of spurious regression. As RELREG is of course also affected by expected or actual quality spurious regression could still be an issue. However, a perfect instrument for this kind of analysis is hard to find.

³Even though, some theoretical considerations of ordered probit models with endogenous regressors exist (see Kawakatsu & Largey, 2008), we are not aware of any software package supporting these models. However, when additionally taking the sample selection problem into account not even a theoretical solution to this problem is provided up to now (see Wooldridge, 2002).

⁴For further discussion see Wooldridge, 2002: 454-455.

be reviewed by applying a standard panel probit random effects model, and calculate the inverse Mills ratio.

2. We run the first stage of a instrumental variable regression including the inverse Mills ratio in the convenient way.
3. As a third step we run an ordered probit regression including the predicted values for the endogenous explanatory variable obtained from the first stage of our IV-regression and the inverse Mills ratio as the second stage of the instrumental variable regression.

As a generated regressor adjustment, we apply bootstrapping techniques to avoid a possible bias caused by the inverse Mills ratio which may have a different variability than the other explanatory variables.

2.2 Data

To analyze the impact of advertising volumes on test scores of course information on both car manufacturers and motor magazines is required. To cover the most important part of the car magazine market we collected data from the the two largest German consumer car magazines, *Auto Bild* (AB) and *Auto Motor und Sport* (AMS) over the period of 1995–2002 and 1992–2007, respectively (see Table 1 and Table 2). By this way we obtained information on over 412 (416) issues and on 31 (39) car manufacturers as well as on their advertising volumes and test scores from AutoBILD (and Auto Motor und Sport, respectively).⁵ During these periods more than 700 (600) models have been reviewed in AB and AMS using single reviews and about 1130 (in AB) and about 2140 models (in AMS) have been reviewed in a benchmark test. For several reasons we have restricted our analysis to benchmark tests up to now.

Given that models of each manufacturer can potentially be reviewed in each issue of the magazines information on over 16000 and 12000 reviews (and non-reviews) are available for AB and AMS, respectively. However, in order to account

⁵Manufacturers which have placed less than 20 advertising pages overall have been dropped from the sample.

for effects occurring not contemporarily but over time we decided to aggregate the data on a monthly basis. For this reason both samples were considerably reduced such that a panel of 2976 (7488) observations for AB (AMS) remained.

As described above a probit analysis is conducted to prevent a selection bias in a first stage regression. For this purpose a dummy variable (TEST) is generated which is equal to one when one of the car manufacturer i 's models has been reviewed in issue t (see Table 3 for some descriptive statistics) and zero otherwise.

Further dependent variables are the average test score (ASCORE) and the absolute test score (SCORE) which are used for the second stage instrumental variable regression and the ordered probit regression, respectively. Both variables are collected on a manufacturer level or, i.e., both variables accumulate the total/mean scores over all models of a manufacturer per month. The total score by review thereby reflects the rank of each manufacturer's model in benchmark test. As a benchmark test reviews at most 12 different models we decided to assign 12 scores for the first rank, 11 scores for the second rank, and so on. As there is neither a consistent scoring over time nor between both magazines we had to apply this ordinal scale instead of a cardinal or quasi cardinal one.

We use further variables such ADS (RELADS) which is the total (average) number of advertising pages of each automobile manufacturer per month, CARADS which is the total number of advertising pages by car manufacturer per month, ALLADS which is the total number of non-car advertising pages per month, EDIT which is the total number of editorial pages per month and GERMAN which is a dummy variable equal to one for German car manufacturers.

Further manufacturer specific variables are SHARE which is a manufacturer's market share per month, REG which is the total number of a manufacturer's new car registrations per month in Europe and RELREG which is the manufacturers' share of European new registrations per month, respectively. We also use various time and manufacturer dummies as further controls.

2.3 Heckman Selection Model

As mentioned above a random effects probit regression is carried out as a first stage in order to account for a possible selection bias. As one can see from Table 4 (1st stage regression) the probability of being reviewed in AMS and AB strongly depends on a car manufacturer's market share. Of course, this is not very surprising as readers are likely to prefer reviews of popular models. Hence, to meet the readers' expectations market shares should have a positive impact on model choice. Interestingly, although we are controlling for automobile market structure the "Germany dummy" is also statistically significant and positive in both regressions. Cars by German manufacturers are therefore more likely to be reviewed than one would expect from the manufacturers' market shares. We consider this result as some evidence for a "home bias". The coefficients of other control variables, i.e., total advertising volumes, advertisements by car manufacturers and editorial contents, are either statistically non-significant or negligible.

In a second step instrumental variable least squares regressions are used to analyze the impact of advertising on test scores (ASCORES). For this purpose we regress the test scores from both magazines on the relative advertising pages of the manufacturers being reviewed, the Germany dummy, other car manufacturers advertising pages, other advertising volumes and editorial volumes. To account for the possible endogeneity RELADS is instrumented by a manufacturers relative number of new registrations in Europe.⁶

As one can see from the lower part of Table 4 (2nd stage regression) the relative number of advertising pages placed by the manufacturers being reviewed is positive and statistically significant in both regressions. Moreover, the Wu-Hausman test as well as the F-statistic analyzing the joint influence of the instruments indicate both the endogeneity of RELADS and that the instruments used are not weak. A higher amount of advertising therefore seems to increase the probability

⁶Note that the number of observations is now considerably lower. While in the first stage a panel analysis is conducted where describe the probability of being reviewed now only the car reviews are under consideration.

of a manufacturers' test score.

Furthermore, also the Germany dummy is statistically significant in both regressions. With respect to AMS however its influence is rather weak. Nevertheless, not only a higher probability of being tested but also a higher test score for German cars seems to be evident which we consider this as some kind of home bias.⁷

Again, control variables are either statistically not significant or negligible. The inverse Mills ratio is positive but statistically not significant. On the one hand, this can be considered as some evidence against the existence of a selection bias. On the other hand, this result might also be driven by a rather poor specification of the first stage regressions. Beside the markets shares also variables such as new model releases and other factors should be responsible for the model choice.

2.4 Count Data Analysis

Finally, for matters of robustness testing a count data analysis is carried out instead of the second stage 2SLS regression. In order to account for a possible endogeneity of advertisements the instrumental variable (RELREG) is directly used used as a regressor. In case that “new European registrations” is a good proxy for advertisements a problem of endogeneity no longer exists and therefore a categorial variable analysis is an appropriate method. We think that there is little reason to assume that RELREG is not well suited for approximating advertising. Again, predicted values from a first stage probit regression have been used to calculate the inverse Mills ratio in order to account for a possible selection bias.

As one can see from Table 5 results do not differ qualitatively from 2SLS regressions – at least not with respect to advertising volumes. However, the inverse Mills ratio is now statistically significant in the AMS regression (despite

⁷Of course, one has to be careful with interpretation here. A higher probability of being reviewed can simply be driven by the readers' preferences for German car reviews. Moreover, the reasoning behind higher test scores for German cars could also be evidence for higher product quality.

of its poor specification). We consider this as a kind of evidence for the existence of a sample selection problem.

Overall, the results from the ordered probit model support the outcomes from the standard 2SLS regressions. A possible bias caused by ignoring the ordinal scale of our left hand side variable seems however not to be relevant. This result is supported in the last step of our analysis substituting the second stage of the 2SLS regression by an ordered probit regression (see table 6).⁸ Even in this model setting, taking account of the selection problem, the endogeneity problem, and the ordinal scale of our dependent variable, our results obtained from the previous steps still hold which underlines the robustness of our results.

3 Conclusions and Outlook

This study analyzes a possible media bias in German motor magazines caused by car manufacturers' advertisements. Dealing with a number of statistical and economic challenges (such as endogeneity and selection biases) we find a positive impact of car manufacturers' advertising volumes on test scores.

We furthermore find some evidence for a home bias. German cars show a higher probability of being reviewed (even when controlled for markets shares) as well as a higher average test score. Although we are not aware whether this result is due to a bias induced by manufacturers, editors or readers. We interpret this as some evidence for biased contents.

However, some other puzzles have not been solved yet. There is, for example, still a hazard of spurious regression when advertising serves as a signal for quality. In case that car manufacturers advertise high quality cars more than others test scores will of course correlate with advertising volumes. Furthermore, a joint estimation of a selection model with endogenous regressors and categorical variables is still missing.

Further research should therefore focus on a number of important issues: (i) more information is needed on the heterogeneity of car manufacturers as well as of

⁸Table 6 presents the results for Autobild exemplarily.

models and qualities. The number of controls (in both stages) should therefore be expanded. (ii) Since identification is of major importance in this study, it is also necessary to consider a broader sample of instrumental variables. Econometric techniques (iii) as well as sampling (iv) has to be improved. Moreover, also (iv) lagged effects of advertising can be an issue.

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Table 1: Circulation of German Car Magazines

| Magazine | Frequency | Circulation per month | Publisher |
|----------------------|-------------|--------------------------|------------------------|
| AutoBILD | weekly | 2.45m | Springer Verlag |
| Auto Motor und Sport | fortnightly | 953000 | Motor Presse Stuttgart |
| Auto-Zeitung | fortnightly | 414000 | Bauer Verlagsgruppe |
| AUTOSTrassenverkehr | fortnightly | 380000 | Motor Presse Stuttgart |
| auto TESTS | monthly | 213000 | Springer Verlag |

Source: Publikumszeitschriften Online (www.pz-online.de)

Table 2: Samples

| | Auto Motor und Sport | AutoBILD |
|--------------------|--|--|
| Observation period | 1 st /1992 – 26 th /2007 | 1 st /1995 – 52 nd /2002 |
| Issues | 416 | 412 |
| Manufacturer | 39 | 31 |
| Single tests | 622 | 708 |
| Comparison test | 2138 | 1132 |

Table 3: Data

| Variable | Mean AB/AMS | Min AB/AMS | Max AB/AMS | Description |
|--|----------------|---------------|---------------|---|
| <i>Magazine specific variables</i> | | | | |
| ASORES | 7.74/9.66 | 1/1 | 12/12 | Test scores |
| SCORES | 5.85/7.74 | 1/1 | 56/56 | Average test scores |
| ADS | 2.88/2.54 | 0/0 | 18/18 | Advertising pages by brands per issue/month |
| RELADAS | 0.04/0.04 | 0.00/0.00 | 0.24/0.37 | Advertising pages by brands per issue/month relative to all brand per issue/month |
| CARADS | 62.53/57.86 | 0/0 | 115/127.5 | Number of all car advertising pages per issue/month |
| ALLADS | 94.00/164.22 | 26.50/ 75.9 | 188.5/300.4 | Number of all non-car advertising pages per issue/month |
| TEST | 0.41/0.42 | 0/0 | 1/1 | Dummy variable equal to one when a brand's car is reviewed in a specific issue |
| GERMAN | 0.29/0.41 | 0/0 | 1/1 | Dummy variable for German manufacturers |
| EDIT | 227.79/259.61 | 98.70/74.34 | 353.1/447.6 | Number editorial pages |
| <i>Car manufacturer specific variables</i> | | | | |
| SHARE | 0.04 | 0.00 | 0.13 | Manufacturers' market shares |
| REG | 51479.5 | 0 | 188965 | European motor vehicle registrations |
| RELREG | 0.04 | 0 | 0.14 | Relative European motor vehicle registrations |
| <i>Time and manufacturer dummies</i> | | | | |
| TD | - | 0 | 1 | Various time dummies on monthly, quarterly and yearly basis |
| MD | - | 0 | 1 | Manufacturer dummies |

Table 4: Heckman selection model

| Variable | AMS | P > z | AB | P > z |
|---|--------|----------|---------|--------|
| <i>1st stage: Random effects probit regression dependent variable: TEST</i> | | | | |
| SHARE | 15.56 | (0.00) | 11.01 | (0.00) |
| GERMAN | 0.614 | (0.00) | 0.5306 | (0.01) |
| CARADS | 0.002 | (0.88) | -0.0019 | (0.47) |
| ALLADS | 0.003 | (0.01) | -0.0005 | (0.81) |
| EDIT | 0.001 | (0.16) | 0.0063 | (0.00) |
| Constant | -2.20 | (-12.15) | -2.65 | (0.00) |
| Time Dummies | YES | - | YES | - |
| Nobs | 7488 | | 2976 | |
| Groups | 39 | | 31 | |
| Wald χ^2 | 410.56 | (0.00) | 124.30 | (0.00) |
| <i>2nd stage: 2SLS Instrumental variable regression dependent variable: ASCORES</i> | | | | |
| RELADS | 0.85 | (0.01) | 0.36 | (0.01) |
| GERMAN | 0.022 | (0.04) | 1.26 | (0.00) |
| CARADS | -0.001 | (0.77) | -0.031 | (0.00) |
| ALLADS | 0.001 | (0.98) | 0.01 | (0.88) |
| EDIT | -0.001 | (0.01) | 0.003 | (0.17) |
| Constant | 0.022 | (0.65) | 9.33 | (0.00) |
| Inverse Mills Ratio | 0.019 | (0.16) | 1.14 | (0.12) |
| Time dummies | YES | - | YES | - |
| Manufacturer dummies | YES | - | YES | - |
| Wu-Hausman | 17.82 | (0.00) | 7.26 | (0.01) |
| F-Test (first stage) | 31.45 | (0.00) | 40.95 | (0.00) |
| Nobs | 1699 | - | 902 | - |

Table 5: Heckman selection model: Ordered probit regression (2nd stage)

| Variable | AMS | P > z | AB | P > z |
|-----------------------------------|------------|-------------------|-----------|-------------------|
| <i>dependent variable: SCORES</i> | | | | |
| RELREG | 20.96 | (0.01) | 10.51 | (0.01) |
| GERMAN | 1.76 | (0.01) | 0.64 | (0.01) |
| CARADS | 0.026 | (0.28) | -0.027 | (0.28) |
| ALLADS | 0.003 | (0.03) | 0.01 | (0.48) |
| EDIT | -0.001 | (0.34) | 0.002 | (0.13) |
| Inverse Mills Ratio | 1.48 | (0.01) | 0.26 | (0.59) |
| Time dummies | YES | - | YES | - |
| Manufacturer dummies | YES | - | YES | - |
| Nobs | 1699 | - | 902 | - |

Table 6: Ordered-Probit IV-Regression

| Variable | AMS | P > z | AB | P > z |
|---|--------|----------|---------|---------|
| <i>1st stage: Random effects probit regression dependent variable: TEST</i> | | | | |
| SHARE | 15.56 | (0.00) | 11.01 | (0.00) |
| GERMAN | 0.614 | (0.00) | 0.5306 | (0.01) |
| CARADS | 0.002 | (0.88) | -0.0019 | (0.47) |
| ALLADS | 0.003 | (0.01) | -0.0005 | (0.81) |
| EDIT | 0.001 | (0.16) | 0.0063 | (0.00) |
| Constant | -2.20 | (-12.15) | -2.65 | (0.00) |
| Time Dummies | YES | - | YES | - |
| Nobs | 7488 | | 2976 | |
| Groups | 39 | | 31 | |
| Wald χ^2 | 410.56 | (0.00) | 124.30 | (0.00) |
| <i>2nd stage: Ordered probit Instrumental variable regression dependent variable: ASCORES</i> | | | | |
| RELADS | - | - | 91.573 | (0.00) |
| GERMAN | - | - | 0.849 | (0.00) |
| CARADS | - | - | -0.120 | (0.001) |
| ALLADS | - | - | 0.011 | (0.001) |
| EDIT | - | - | 0.024 | (0.002) |
| Constant | - | - | - | - |
| Inverse Mills Ratio | - | - | 5.55 | (0.002) |
| Time dummies | - | - | YES | - |
| Manufacturer dummies | - | - | YES | - |
| Wu-Hausman F-Test (first stage) | - | - | - | - |
| | - | - | 8.20 | (0.00) |
| Nobs | - | - | 902 | - |