

## INTERMEDIA EFFECTS OF ADVERTISING: AN ECONOMETRIC MODEL

Rolf Speetzen and Wilfried Wenzel, Axel Springer Verlag AG, Hamburg

---

### Introduction

This paper is different from the majority of the papers submitted here for our seventh readership research symposium. It does not deal with the difficulties of collecting "valid" readership data. In fact, it is not even based on readership data, however, since the aim of media research is to help media planners to expose the advertising economically to their target potential, this approach should not be left out.

For a few minutes we leave the usual track of empirical research and pick up what lies along the way, almost unobserved, i.e. not analysed. There we find a wealth of data such as the monitored advertising expenditure data, retail panel data for market shares by value and volume, as well as for distribution. All these data are usually being analysed separately in separate fields, however, we at the Axel Springer Publishing Company have made several attempts to weld all these data sets together in the past.

We aimed at an econometric model to predict the market share developments by analysing such marketing parameters as distribution, pricing, promotion and advertising spends by media categories, because it is always of great interest, what part of the advertising effectiveness could be attributed to the different media categories.

In the past we published our analyses under the series title "Market Mechanics". The models were based on the works of Koyk, Vidal and Wolfe. Since then the advertising landscape has dramatically changed. TV commercials are now made available on private channels 24 hours a day. New brands and new product fields have emerged. It was time to find out whether the old mechanisms were still working the same or would we have to face new influence factors?

The following paper is based on a new macro-model, sponsored and published by the German Magazine Publishers' Association VDZ, analysed by Peter Beike. Data for 195 products from 81 product categories were supplied by Nielsen and Schmidt & Pohlmann.

The bi-monthly observation periods ran from mid 1991 to mid 1994 and stated the turnover in Deutschmarks per brand and product category, the value-weighted distribution per brand and sales outlet plus the advertising spends in Deutschmarks by media categories, again per brand and product category.

### The Model

Probably the most difficult part of the analysis is the beginning. First, we have to consider what variables work in what direction, what variables depend on others? Then we have to design a model, fill it with life, i.e. the data input, analyse, re-analyse and finally check the validity.

A very basic or simple approach correlates market with advertising shares, based on the assumption, if advertising effects the market shares, then brands with large advertising shares must show large market shares and vice versa.

Looking into the data we find a **non-linear** correlation, not surprising, because it supports the almost generally accepted rule: to keep a market share, you must maintain an advertising share of roughly the same band width.

However, the correlation between market and advertising share soon turns out to be a dead-end because it does not specify the direction in which the influence factors are working. Therefore, most models are based on the development or variation of market shares from one observation period to the next, including the advertising or other marketing means working within that time span. In its simplest linear form the equation would like this:

$$\begin{aligned} \text{Market Share}_{\text{Period } t} &= b_1 * \text{Market Share}_{\text{Period } t-1} \\ &+ b_2 * \text{Print Advertising Share}_{\text{Period } t} \\ &+ b_3 * \text{TV Advertising Share}_{\text{Period } t} \\ &+ a \text{ (Intercept)} \end{aligned}$$

Thus the new market share can be explained through the market share in the previous observation period plus the influence of print and TV advertising. The results of regression analyses show the individual influence factors of the advertising and the intercept, a level constant which can only be of importance if considerable residuals could have been built up in previous periods.

To test the model, we used the data from our 36 observation periods, to find the following results:

$$\begin{aligned} \text{Market Share}_{\text{Period } t} &= 0.99 * \text{Market Share}_{\text{Period } t-1} \\ &+ 0.01 * \text{Print Advertising Share}_{\text{Period } t} \\ &+ 0.01 * \text{TV Advertising Share}_{\text{Period } t} \\ &+ 0.02 \text{ (Intercept)} \end{aligned}$$

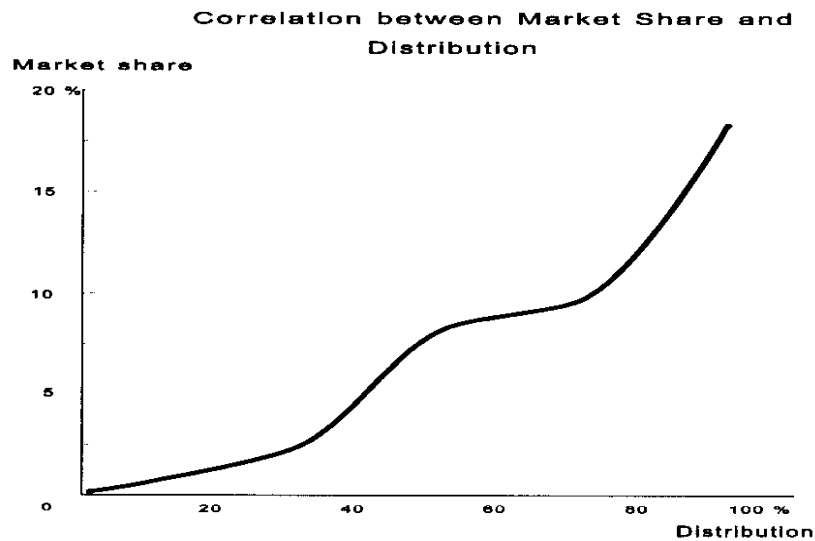
This is an amazing result. We all can lean back and relax. Even if we do not do anything at all, if we do not use the marketing tools, the market share of a brand can only decline by one percent from period to the other. Advertising can hardly influence the market share developments. So why worry?

Unfortunately, in reality the results look different. Looking into the "raw" data we find market share declines of four percent from one observation period to the other. This means, that by doing nothing, a brand would lose a quarter of its market weight over a year. And fortunately for us involved in the media and advertising business, this calls for action.

The experts will probably have found out by now, why and where our equation above is wrong or too simple. Yes, it is a linear model and the reality does not follow such simple tracks. The relationship between the market shares in the different periods is non-linear. We expect an exponent of around 0.97-0.99.

What does it mean? Large market shares are vulnerable. They tend to decrease sooner if the brands are not nursed very well. And with large market shares it becomes more and more difficult to achieve increases. A linear model over-estimates the effect of the market share achieved in the previous period.

So far another very important marketing factor has not been considered: distribution. The distribution, too, shows a non-linear relationship with the market shares as can be seen in graph 1.



Of course, the distribution varies from period to period, partly due to the fact that advertising influences the level of distribution. On average advertising raises the distribution level of a brand roughly two percent within the bi-monthly period. Without advertising that level declines approximately one percentage point within an observation period, as can be seen in the original data.

The real reason for the necessity to include the distribution in the model is the fact that the variation of the distribution level indicates what has happened to the brand besides advertising. The up and downs of the distribution level correspond to pricing and other sales promotion. And only if these marketing means per brand are considered, the model can evaluate the development of market shares correctly and can thus show the influence weights for the advertising.

Last but not least we have to discuss the consideration of the advertising. As stated above, the relationship between advertising and market shares is non-linear. Therefore, the model has to consider a non-linear function to correctly show the influence weights of advertising on market share development.

The final complex model has incorporated all these facts. It includes besides the advertising in the different media categories the distribution, too, and considers non-linear dependencies between the variables. A multiple non-linear regression analysis shows us the optimum coefficients and exponents:

$$\text{Market Share}_t = 0.97 * \text{Market Share}_{t-1}^{0.99} * \text{Distribution}_t / \text{Distribution}_{t-1} + 0.21 * \text{Print Advertising Share}_t^{0.72} + 0.20 * \text{TV Advertising Share}_t^{0.70}$$

Variance explained: 98.3%, through market shares: 93.3%, through advertising: 5.0%

**Results**

What do we learn from this equation? First, the level of the market shares in the previous period is of extreme importance for the market share in the actual period. If a brand is not advertised and if no changes in the distribution level can be registered in an actual observation period, a brand can expect to keep 97 percent of the market share in the period prior to the observation. However, the exponent of 0.99 indicates that with increasing market shares the decline is getting larger.

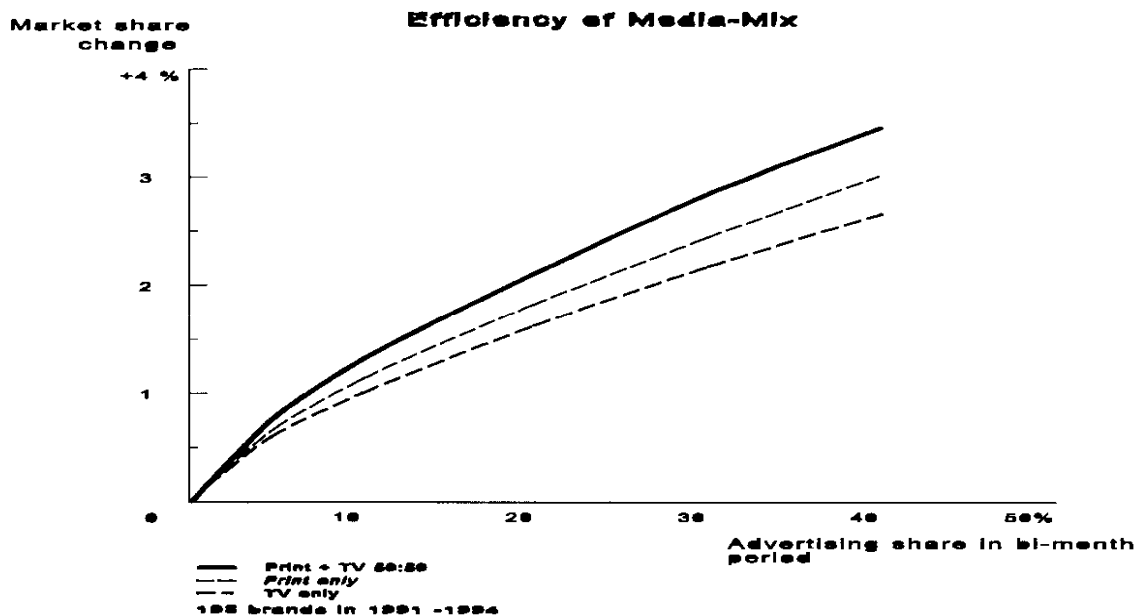
To demonstrate this fact let us look at an example from Peter Beike's German brochure: If a brand achieved a market share of 6 percent in the period prior to the observation period, then this brand can retain 5.7 percent market share in the actual period without advertising and distribution changes. That is an index of 95! However, if the market share in the previous period was 60 percent, the brand can retain 55.9 percent without advertising. That equals an index of 93!

Second, the variation of the distribution is oscillating between 85 and 115. According to the change between these anchor scores a brand can gain or loose considerably.

Third, Print and TV are almost equal. They contribute roughly 20 percent each of the advertising share towards the market share increases. If a brand spends 10 percent of all advertising in a product field in each of the two media, then this brand can expect a 2 percent increase in market shares from both media categories.

There is a handicap, however. We have seen the exponents (0.72 resp. 0.70) in the formula, which means the contribution shows considerable diminishing values with increasing advertising shares. And this is a very important finding for advertising strategies.

Let us demonstrate the consequences again with a graph:

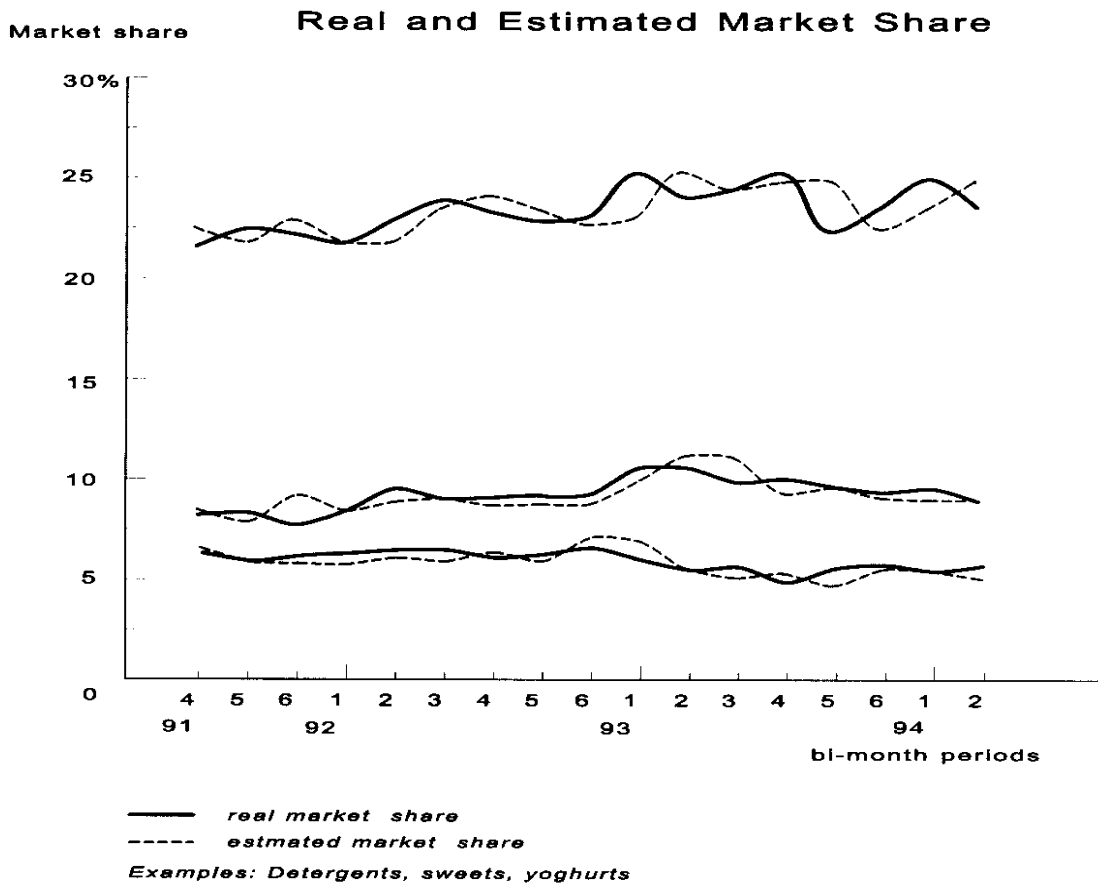


Initially both curves, the contribution of print and TV advertising shares, are similar. The slightly higher saturation effects for TV advertising account for the divergencies with larger shares. But the main issue is that both individual curves show diminishing returns at the higher end. The results are, with larger advertising shares it will pay off to split the budget. To avoid the high saturation effects, by dividing the money into two smaller shares for each of the media.

The graph demonstrates that at a 5 percent advertising share level a 50:50 media mix exceeds the individual TV contribution by 27 and the print contribution by 17 percent. At a 40 percent level the mix exceeds TV by 30 and print by 15 percent.

Finally a word about the validity of the model. 98.3 percent of the variance can be explained through the parameters of the model, 93.3 percent can be attributed to the market share developments, 5 percent to advertising. These high scores can be taken as an indicator for the validity.

But maybe it is more convincing to show the match between actual and predicted market shares? Here are three examples from the German brochure:



As can be seen, there is a close match. If we calculate the correlation between all original market shares over time and all predicted shares, we arrive at  $r=0.99$  and a mean deviation between the two series of 0.2 percent.

So far we presented a general model over all 195 brands and campaigns, however, we were also interested whether the model would work in sub-groups of the total. The total was divided into several splits:

- by market shares            under 8% versus over 8%
- by budget size             under DM 650,000 versus over DM 650,000 per observation period
- by print share              under 13% versus over 13% print share of the total advertising spending per observation period

The dividing lines represent the median for each split. We therefore have groups of 50 percent of the campaigns above and below that line. In addition we grouped the data by

time 1991/1992 versus 1993/1994

The results of these regressions are shown through the individual coefficients indicating the influence weight and the exponents, indicating the saturation level for each variable.

Let us start with the time grouping:

	1991/1992	1993/1994
Coefficient $b_{\text{print}}$	0.20	0.24
Exponent $\text{print}$	0.78	0.73
Coefficient $b_{\text{tv}}$	0.20	0.20
Exponent $\text{tv}$	0.63	0.68

Print and TV show contrary developments. The influence of print advertising on market shares increased moderately over time: from 0.20 in 1991/1992 to 0.24 in 1993/1994. That is the good news for print, however, the declining marginal utilities of 0.78 resp. 0.73 show that saturation is now being reached sooner than in the earlier stages.

TV could maintain the influence weight and improve the marginal utilities. Thus the saturation level of both, print and TV is getting closer, the marginal utilities are obviously converging.

The reason for this development remains to be discussed. It is probably due to the fact that advertising activities in Germany have increased in total with changing print shares. Therefore, it is extremely important to arrive at a well balanced mix, avoiding the overdose through large shares in one medium, being punished by the high saturation effects.

Our next split: Brands with smaller versus larger market shares

	Market Share	
	Below Average	Above
Coefficient $\text{Market Share } t-1$	0.93	0.97
Exponent $\text{Market Share } t-1$	0.98	0.99

A change of parameters, here the market share of the previous observation period demonstrates a very interesting fact. Brands with a smaller market share do not have such steady positions as the larger brands. The influence of the previous market share is of lesser importance than with larger brands. This is also true for the saturation, indicating that at a low level we see possibilities of considerable variations, up or down, for the brands.

## Sub-groups by budget size:

	Budget Size	
	Below	Above
	Average	
Coefficient $b_{\text{print}}$	0.21	0.22
Exponent $t_{\text{print}}$	0.79	0.78
Coefficient $t_{\text{TV}}$	0.22	0.22
Exponent $t_{\text{TV}}$	0.73	0.62

There is hardly any variation in the print scores for the two sub-groups, due to the fact that larger budgets usually means larger TV budgets, whereas the print share remains the same in both groups. Therefore TV reaches a saturation point much sooner, especially true for the heavily advertised brands.

That calls for an analysis of different print shares within the advertising spend.

	Print Share	
	Below	Above
	Average	
Coefficient $b_{\text{print}}$	0.36	0.21
Exponent $t_{\text{print}}$	0.62	0.68
Coefficient $t_{\text{TV}}$	0.20	0.21
Exponent $t_{\text{TV}}$	0.60	0.67

Campaigns with a low print share show an extreme sensitiveness towards print. Usually they reflect large, but TV dominated brands. Print ads thus are unusual and extraordinary and in addition reach new target potentials. The influence weight of print decreases with the larger print proportions, but the saturation level is being pushed back, because in general the budget sizes with large print shares are the smaller budgets in total.

The TV scores do not vary between the two groups except for the saturation point which again shows an improvement for campaigns with an above average print share. The reason is the same as before, the budgets are generally smaller.

### Conclusion

The analysis of the general findings and the top-line results for the sub-groups gives us some insight into the intermedia effects of advertising expenditures. It cannot serve as the final key to optimum media planning, but it provides guidelines how to spend advertising money more effective under given conditions. The findings are far from being static and definitive, even the comparison of the first and the second half of our relatively short and recent time series shows considerable variations, due to the changing media and advertising environments. Re-analyses and follow-ups are necessary.

However, it can be generalized that advertising in print and on TV plays an important role to build up or maintain market shares. The weight of the two media is almost equal under the given circumstances. Going into depth, we find cases where one of the two media becomes more important than the other. This is mainly the case when one medium shows wear-out effects through supersaturation. In this case it would be better to split the budget, shift some of the money into another medium to use a mix to avoid saturation. The importance of the mix is also backed up by the fact that with increasing budgets the marginal utilities are declining, i.e. the effect of advertising on the market share development is getting less with increasing budgets. This is true for both media categories. A split into a media mix can reduce the extreme saturation effects building up in a single medium campaign.