

**A Time Series Analysis to Asymmetric Marketing Competition Within a Market Structure**

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## **A Time Series Analysis to Asymmetric Marketing Competition Within a Market Structure**

### **Abstract:**

As a complementary to the existing studies of competitive market structure analysis, the present paper proposed a time series methodology to provide a more detailed picture of marketing competition in relation to competitive market structure. Two major hypotheses were tested as part of this project.

First, it was found that some significant cross-lead and lag effects of marketing variables on sales between brands existed even between different submarkets. Second, it was found that high quality brands were able to have the cross-lead and lag effects on the sales of other high quality brands and low quality brands while the reverse was not true, supporting the theory of asymmetric switching or sales effects of marketing variables even for the case of durables. Scientific and managerial implications were presented and some future research directions were suggested.

**Classification system for journal articles** C190, D490, M310, M370

**Key words:** Asymmetric Switching, Automobile Market, Cross-Lag Effects, Cross-Lead Effects, Marketing, Multiple Time Series Analysis, Sales Effects.

## INTRODUCTION

There is a body of literature which address the issues of competitive market structures with the major question being "how is the structure of competition viewed by consumers?". Market structure analysis refers to the process of organizing a set of products / brands such that their interrelationships are apparent (Allenby, 1989) or decomposing product markets into managerially useful partitions (Russel and Bolton, 1988).

Since the seminal article by Day, Shocker, and Srivastava (1979), several different types of techniques or consumer models have been developed, mostly based on demand-side perception or behaviours. The demand-side issue of the identification of the competitive structure is crucial for assessing strategic opportunities, identifying competitive threats including cannibalization, developing marketing programs, and assessing market share to evaluate performance (Weitz, 1985; Vilcassim, 1989).

Although these studies contribute both theoretical and practical knowledge about market structures, they are not able to provide complete pictures of market structures and competition. A manager may require a more detailed (demand-side) picture of the market structure and competition in the short run such as ( i ) lead and lag effects <sup>1</sup> of marketing variables on demand, ( ii ) directions of competition (i.e. asymmetry). Also the supply-side issues of market structures, although important, have not been explored in this area.

The first issue, lead and lag effect of marketing variables, has been studied by several time series studies (Bass and Pilon, 1980; Hanssens, 1980; Jacobson and Nicosia, 1981; Aaker, Carman and Jacobson, 1982; Doyle and Saunders, 1985). The lead or lag

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<sup>1</sup> Current expenditures on marketing instruments usually do not have their full impact on sales in the same period. Moreover, their impact on sales may extend well into future. This is called the lag (or carryover) effect. It is also possible that consumers anticipate a marketing action and adjust their responses even before the action takes place. Therefore, sales may react to marketing efforts in the future. This is called the lead (or anticipation) effect ( Doyle and Saunders, 1985; Hanssens, Parsons, and Schultz, 1990).

effects may exist not only within a brand but also between brands or even between different sub-markets. In other words, when people anticipate that a brand will provide an incentive program ( or a price increase) in the near future, the sales of other brands may decline (or increase) in the current period.

The cross-lead and lag effects between brands have not been documented in the existing time series studies except Hanssens' (1980) in which only the cross-lag effects of a brand's marketing variables on others' sales were examined. The current study will show that there were also cross-lead effects among the competing brands within a market. Analysis of the dynamic effects including the cross-lead and lag effects of marketing variables will provide a more complete picture about competitive patterns and structures even between sub-categories.

The second issue, asymmetric switching or sales change between high quality and low quality brands, has been well documented. Empirical studies have shown that price reductions in higher quality brands attract more buyers than do price reductions in lower quality brands (Blattberg and Wisniewski, 1989; Kamakura and Russell, 1989; Allenby and Rossi, 1991). When a high quality brand price deal, it steals sales from both other high quality brands and low quality brands. However, a low quality brand takes unit sales from other low quality brands, but rarely take sales from high quality brands. More details of the empirical supports for the asymmetric switching have been summarized in table 1.

In relation to the time series issues of lead and lag effects, it could be hypothesized that high quality brands can have significant lag or lead effects on the other high quality and low quality brands while low quality brands will not have any significant lag or lead effects on high quality brands. Since the existing studies have not looked at the asymmetric lead and lag effects, an empirical support from the present study will strengthen the theory of asymmetric switching or sales changes.

(Table 1 about here)

## **Major objectives**

The main purpose of this paper is to show how a time series approach could be used to analyze the above demand-side issues in relation to the competitive structure of the compact car market in the Portugal. We will attempt to examine the lead and lag effects to test the two major hypotheses associated with marketing competition within a market structure. More specifically, we will test the following hypotheses:

Hypothesis 1: Marketing variables of some brands have significant cross-lead and lag effects on sales of the other brands. This hypothesis is consistent with the existing time series studies (Hanssens, 1980;Doyle andSaunders, 1985).

Hypothesis 2: Asymmetric marketing effects on brand sales exists. More specifically, higher quality brands have significant lead and lag effects on the sales of lower quality brands, but the reverse is not true. The asymmetric effect of marketing variables (especially price) has been well documented (Carpenter et al., 1988; Cooper, 1988; Blattberg and Wisniewski, 1989; Kamakura and Russell, 1989; Allenby and Rossi, 1991). Since no existing study provides a formal test for asymmetric sales effects in durables such as cars, the result of this current project would contribute to generalizing the theory of asymmetric sales effects of marketing variables.

## **A TIME SERIES METHODOLOGY**

A multiple time series method will be employed to analyze competitive interactions among brands within a competitive market structure. More specifically, cross-correlations will be obtained to examine series interactions, using a multiple time series method.

A time series sometimes contains a upward or downward trend, seasonality, cyclical patterns, etc. (deterministic patterns), and deviations from the deterministic patterns (which may be systematic or random). If we are able to extract the deterministic and systematic patterns from the series, the remaining fluctuations would be strictly random. The series of serially uncorrelated values are called white-noise or prewhiten series. The importance of recovering white-noise series has been well documented in Hanssens (1980, page 475). The spurious correlation problem due to the deterministic and systematic factors could be handled by recovering the white-noise series. The white-noise series could be recovered by using a linear ARMA (autoregressive and moving-average) filter, and be cross-correlated with each other.

In order to analyze competitive interactions between brands within a competitive market structure, the following procedure will be employed.

1. Develop univariate ARIMA models for market shares and various marketing variables, and save the white-noise ARIMA residuals.
2. Cross-correlate the ARIMA residuals with each other for the case of interest, i.e., market share and cross-share effects, intra- and inter-brand competitive interactions.
3. Calculate chi-square values to test the significance of competitive interactions including concurrent and dynamic effects. Evaluate competitive patterns within a sub-market and between sub-markets.

More details about the time series analysis can be obtained from most econometric and time series books such as Judge et al. (1985), Granger and Newbold (1986), and Mills (1990). However, an excellent discussion in a marketing context is available in Hanssens, Parsons, and Schultz (1990). Since our multiple time series analysis involves the concept of cross-correlation function and its chi-square test, the two will be described in more details.

### The cross-correlation function

If a bivariate stochastic process  $(X_t, Y_t)$  generates successive observations over time as follows,  $(x_1, y_1), (x_2, y_2), \dots, (x_T, y_T)$ ,

and if we assume that a transformation such as differencing exists so that each series  $(x_t, y_t)$  is stationary, then we may define the sample autocovariance at lag  $k$  of  $x$  or  $y$  as

$$(1) \quad c_{yy}(k) = E(y_t - \bar{y})(y_{t-k} - \bar{y}) = N^{-1} \sum_{t=k+1}^N (y_t - \bar{y})(y_{t-k} - \bar{y}),$$

$$(2) \quad c_{xx}(k) = E(x_t - \bar{x})(x_{t-k} - \bar{x}) = N^{-1} \sum_{t=k+1}^N (x_t - \bar{x})(x_{t-k} - \bar{x}).$$

The sample cross-covariance between  $x$  and  $y$  at lag  $k$  is defined as

$$(3) \quad c_{xy}(k) = E(y_t - \bar{y})(x_{t-k} - \bar{x}) = N^{-1} \sum_{t=k+1}^N (y_t - \bar{y})(x_{t-k} - \bar{x}),$$

and the sample cross-correlation coefficient between  $x$  and  $y$  at lag  $k$  as

$$(4) \quad \begin{aligned} \mathbf{r}_{xy}(k) &= E(y_t - \bar{y})(x_{t-k} - \bar{x}) / \left\{ E(y_t - \bar{y})^2 (x_t - \bar{x})^2 \right\}^{\frac{1}{2}} \\ &= c_{xy}(k) / \left\{ c_{xx}(0) \cdot c_{yy}(0) \right\}^{\frac{1}{2}}. \end{aligned}$$

The cross-correlation function specified in equation (4) will be used for the time series analysis along with the Pierce-Haugh chi-square test statistics.

### Pierce-Haugh chi-squared test

The basic tenet of the Pierce-Haugh test is that if X does not Granger cause Y, then the cross-correlations between filtered Y and lagged values of filtered X should, as a group, be insignificantly different from zero. If a marketing variable (e.g., advertising) does not cause sales, the statistic

$$(5) \quad Q = N^2 \sum_{k=1}^m (N - k)^{-1} \cdot \mathbf{r}_k^2 ,$$

where: N is the number of observations,

m is the number of correlations to be summed,

k is the lag period, and

$\mathbf{r}_k = \mathbf{r}_{xy}(k)$  is the sample cross-correlation with lag k,

should be asymptotically distributed as chi-square with m degrees of freedom. The chi-square statistics will be used to test the lead and lag effects and the asymmetry.

## DATA

The data base used for this study is a time series sample of sales, and two marketing mix variables, for the period 1988:1-1993:12 in the compact car market in the Portugal. The marketing mix variables included retail prices, and total advertising expenditures (TV, Radio, and Newspaper) for the six major brands in the compact car market <sup>2</sup>. Table 2 shows the major competitors in the market, their average monthly sales, and average marketing activities, their standard deviations, and their coefficient of variation during the period 1988:1-1993:12.

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<sup>2</sup> The major variables, their measurement, and specific data sources are described in detail below Table 2. Since the data set is time series in nature, all the nominal values must be deflated appropriately.

The advertising data create some problems. The data are thousands of escudos of advertising, not gross rating points, which would be a measure of physical quantity of advertising. All escudos are current escudos for both prices and advertising. One might argue intuitively that deflating advertising to constant escudos is appropriate, but same times, both theory and empirical evidence suggest otherwise. On the theoretical side, we have no reliable deflator for advertising ; an incorrect one may do more harm than good. On the empirical side, Schmelensee's (1972) analysis of the relationship between consumption and advertising at the national level gave the same result with both constant and current dollars. Picconi and Olson (1978) found current dollar advertising expenditures were superior to the constant dollar form.

(Table 2 about here)

All brands selected had substantial levels of both marketing variables and sales and also substantial variation in marketing variables and sales over time. Table 2 indicates that compact car brands are not homogenous in terms of price and advertising expenditures. On average, low priced brands spent more advertising money than higher priced brands.

Since Table 2 shows monthly figures of sales and marketing activities during the period, it would be more interesting to look at the variations of volume sales, across the periods during the years. Figure 1 plots, across time, the brands sales. Short-run brand sales are shown to fluctuate across time, producing peaks and valleys. The current study will explore how each brand sales is affected by both its own and competitors' marketing variables. The seemingly complicated pictures will be analyzed from the perspective of the theories of asymmetric effects, discussed above.

(Figure 1 about here)

## **EMPIRICAL APPLICATION**

A time series cross-correlation analysis was performed according to the procedure discussed above. First, each time series were prewhitened using the univariate ARIMA filters. The prewhitened residuals for each series were cross-correlated and chi-square statistics were calculated to evaluate the significance of the lead or lag effects of the marketing variables.

### **Univariate analysis for prewhitening**

For the present study, in order to prewhiten each series, first differencing to handle trends, and twelve differencing to deal with seasonality were tried. It was found that the above two methods produced no better results than no differencing. Therefore, it was decided to use natural logarithms of the data, to handle nonstationarity in variance, i.e., heteroscedasticity.

Analysis of the patterns of autocorrelation functions (ACF) and partial autocorrelation functions (PACF) indicated that most series had followed ARIMA(1,0) processes. The series which had not followed ARIMA(1,0) were prewhitened by applying other appropriate ARIMA filters.

### **Cross-correlation analysis and chi-square test**

In order to examine how the marketing variables affects the demand-side brand sales, the prewhitened series of brand sales were cross-correlated with those of the two marketing variables (i.e., prices and advertising expenditures).

By so doing, we could explore the issues of the lag or lead effects even between brands, and the asymmetric sales effects of the marketing variables within the context of a competitive market structure.

Chi-square values were calculated according to the Pierce-Haugh test statistics. The version used in this study was one suggested by Ljung and Box (1978), which was also used for the study of Aaker, Carmen, and Jacobson (1982). For each pair of variables, we test two null hypotheses:

$H_0^1 = AD_{t-k} \text{ or } (P_{t-k}) \rightarrow S_t$  and  $H_0^2 = S_{t-k} \rightarrow AD_t \text{ or } (P_t)$ . Chi-square values which are significant at the 0.05 level are marked with a star, while t-values significant at the 0.05 level are underlined. For example, the underlined values at lag 0 indicate that cross-correlations of two marketing variables are significant in the current period. Technically, t-value for the correlation is significant at 0.05 level (two-sided test). The correlations with a positive lag represent causal flows from advertising (price) to sales and those with a negative lag (a lead) represent a causal flow from sales to advertising (price). Under the null hypothesis of no relation, the correlations are known to be asymptotically, independently, normally distributed with zero mean and variance  $1/N$ , where  $N$  is the sample size. If a chi-square value turns out significant at 0.05 level, a variable has a significant effect on the other (Aaker, Carmen, and Jacobson, 1982; Batra and Vanhonacker, 1988; Hanssens, Parsons, and Schultz, 1990).

## **MAJOR FINDINGS**

Overall, the results from Tables 3-4 showed that the compact car brands competed in a complicated way, so that generalizable patterns could hardly be identified regarding the market responses. However, the time series analysis produced some important generalizable findings concerning the issues of lead and lag effects, asymmetric sales effects in relation to the competitive market structure. The above major findings will be reported in tables and discussed sequentially.

### **Lag and lead effects**

Table 3 reports the cross-correlations between the two major marketing variables, P1 (prices), AD1 (advertising), of *Renault 5 / Clio* and the sales of major brands in the compact car market <sup>3</sup>. The chi-square test statistics shows that *R5 and Clio's* marketing efforts did not have any significant effects on its own sales. However, its marketing efforts had significant lag effects on the sales of other brands ( **Brand 3, 5, and 6**); the chi-square statistics are significant at the 0.05 level, i.e., 21.2\*, 22.3\*, and 27.8\*. The cross-correlations at lag 4 shows that B3 and B6 (two brands of higher quality) were significantly and positively affected by *R5 and Clio's* advertising expenditures (the cross-correlations with B3 and B6 at lag 4 are very high, i.e., 0.45 and 0.51), while the cross-correlations at lags 2, 3, and 6 shows that B5 (a lower quality brand) is significantly and negatively affected by the advertising efforts of B1 (the cross-correlations are -0.28, -0.25, and -0.24 respectively).

(Table 3 about here)

Another important finding is that *R5 and Clio's* marketing efforts have some significant lead effects on the sales of the other brands (see the underlined positive cross-correlations between P1 and S2, P1 and S3, P1 and S4, P1 and S5, and P1 and S6. This shows that if people anticipated an increase in *R5 and Clio's* prices in the near future, then the sales of the other brands (Brand 2, 3, 4, 5, and 6) increased in the current period because of the future's price increase anticipation.

### **Asymmetric sales effects**

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<sup>3</sup> In fact, the cross-correlations are between filtered series.

Since the lead and lag effects were found to work in two directions in the *R5 and Clio's* case, i.e., from a higher brand to both other higher brands and a lower quality brand, we carefully examined the directions of lead and lag effects among all the brands to see if the asymmetric sales effects could be generalizable in this market. Our analysis in this direction showed that the theory of asymmetric effects of price variations appears to be generalizable in the compact car market. Because of the overwhelming volume of time series tables for all the six brands <sup>4</sup>, we decided to further address the issue of the asymmetric sales effects by using the case of *Citroen AX*, one of the lowest quality brands (according to ' *Guia do Automóvel* ' ), which heavily invested in advertising and price manipulations as shown in Table 2.

Table 4 reports the cross-correlations between *AX's* marketing efforts, AD5 (advertising) and P5 (price) and the sales of major brands in the market. Overall, no lag and lead structures are evident, as in the study of Aaker, Carmen, and Jacobson (1982). First, the cross-correlations at lags 4 and 6 ( 0.28 and 0.45 ) show that *AX* has significant effects only on some brands of equal (lowest) quality ( B2) but did not have any significant effects on other higher quality brands, supporting the idea of asymmetric sales effects by the price manipulations. Chi-square statistics show that the brand had a significant lag effect only on the other brands of the same quality, not on the sales of higher quality brands ( B1, B3, B4, and B6).

When it comes to the lead effects, the marketing efforts by *AX* had a few lead effects compared with *R5 and Clio's*. The only significant lead effects are on the brands of equal (lowest) quality ( B2 and B5); the chi-square statistics values of 26.1\*, 22.1\*, 21.9\*, and 20.7\* confirm these findings. Again, it could not have a significant lead effect on the sales of higher quality brands. Since this phenomenon was consistently found in the other

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<sup>4</sup> The complete set of the cross-correlation tables for the all six brands is available from the author on request.

brand cases including the *R5 and Clio's* case discussed above, it is concluded that generally the price manipulations of higher quality brands have the lead and lag effects on lower quality brands, not vice versa. This finding from a time series analysis supports the idea of asymmetric sales changes or symmetric switching, which has been well documented in marketing literature (Blattberg and Wisniewski, 1989; Kamakura and Russell, 1989; Allenby and Rossi, 1991).

(Table 4 about here)

## **DISCUSSIONS AND CONCLUSIONS**

As a complementary to the existing studies of competitive market structure analysis, the present paper proposed a time series methodology to provide a more detailed picture of marketing competition in relation to a competitive market structure. Two major hypothesis were tested as part of this project.

First, it was found that some significant cross-lead and lag effects of marketing variables on sales between brands existed even between different submarkets. In relation to the first hypothesis, second, it was found that high quality brands were able to have the cross-lead and lag effects on the sales of other high quality brands and low quality brands while the reverse was not true, supporting the theory of asymmetric switching or sales effects of marketing variables using the time series analysis. Although the asymmetric effects have been well documented for frequently purchased goods, no existing study has investigated the effects for durables.

### **Major contributions**

First, this current study provides a methodological contribution to market structure

analysis in marketing. As indicated, this approach will give a detailed picture of marketing competition within a market structure. The approach is methodologically sound in that it incorporates lag and lead effects which have been disregarded in market structure analysis. Second, the test results of the asymmetric lead and lag effects will make the theories more generalizable. Especially an empirical support for the asymmetric lead and lag effects in a durable case will make the theory of asymmetric sales effects stronger and more generalizable. This effort will be very important in enhancing marketing knowledge in that there have only been a few studies that have stressed the generalizations (Leone and Schultz, 1980; Zaltman et al., 1982, page 6).

This study also provides important managerial implications for practitioners (e.g., marketing managers). First, our methodology could be applied in order to develop detailed pictures of marketing competition in a market, which will thereby help managers in developing effective marketing strategies. Second, the results of asymmetric sales effects are also important to managers. First, a manager of a low quality brand should not do price manipulations to compete against high quality brands. It has been documented that a price manipulation (e.g., a price reduction) by a low quality brand will not take sales from high quality brands, although it would steal sales from other low quality brands or lower quality brands.

## **Limitations and future research directions**

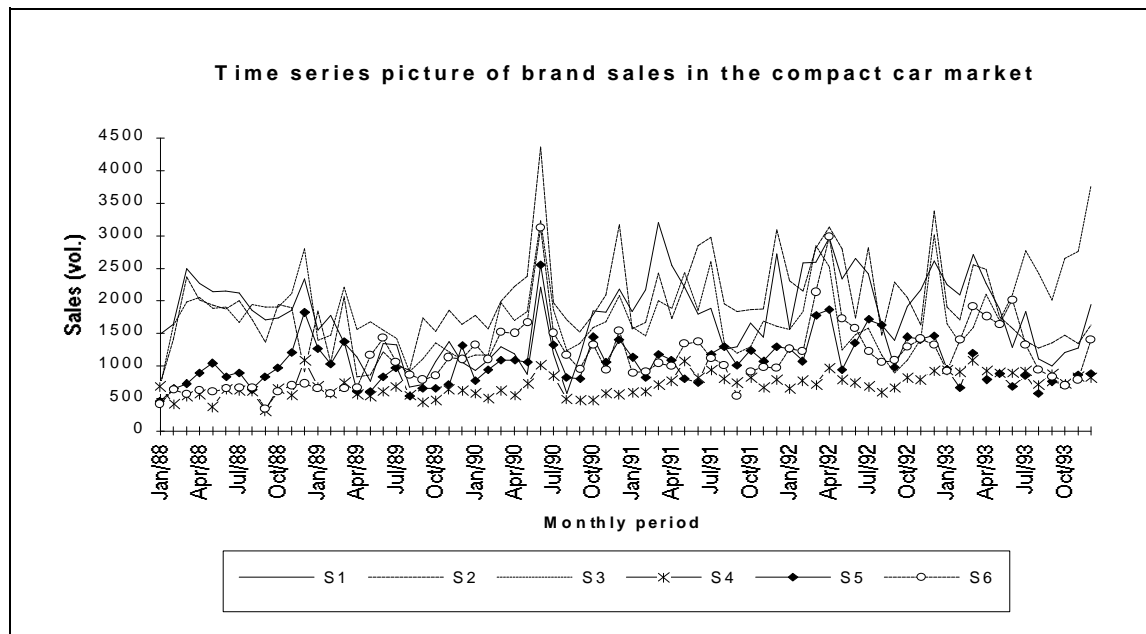
Although the current study provides empirical support for the asymmetric cross-lead and lag effects between brands within a market structure, the theory of asymmetric effects needs to be tested in other car market segments (e.g., medium-size market) to be established as a strong theory. Since our study could not provide any theoretical reasons why the asymmetric effects (including lead and lag effects) arise, an attempt needs to be made to relate the asymmetry to consumers' underlying wants.

Another important direction is to analyze the supply-side marketing interactions between brands by cross-correlating key marketing variables across brands within a competitive market structure, as Hanssens (1980) did. The issue of asymmetry could be examined in the context of the supply-side marketing interactions or reactions.

Another important direction is to analyze the endogeneity of the marketing variables, using the proposed time series approach. Simply, the effects of brand sales on the marketing variables could be tested by time series cross-correlation analysis, using the Granger test (Granger, 1969; Hanssens, Parsons, and Schultz, 1990). This will make an important contribution since several estimation results from demand models including MCI (multiplicative competitive interaction) model and MNL (multinomial logit) model are expected to be biased if they treated some endogenous variables as exogenous.

As a conclusion, the time series approach to marketing competition and market structures produced the important findings and appears to have a promising future. The theories tested in the present study (especially of asymmetric sales effects) are expected to be tested in other markets.

Figure 1



**Table 1**  
**Empirical evidences and explanations for price-induced asymmetric switching**

<b>Authors</b>	<b>Product Category/Data Method</b>	<b>Findings</b>	<b>Explanations</b>	
Carpenter et al. (1988)	Australian household product (11 brands) (consumer panel)	An asymmetric attraction model	Economy brands are vulnerable to each other's price cuts, but, have little impact on other (supermarket) brands	1. Unique features of brandstrategy, e.g., reputation, brand 2. periodic variation in marketing mix
Blattberg and Wisniewski (1989)	Flour, margarine, bathroom tissue, and Tune (28 brands) (IRI scanner data)	Model of price tiers with utility model	When higher-price brands price deal, they steal sales from their own tier and the tier below	Due to both bimodal preference distribution and the location of the price indifference point
Kamakura and Russell (1989)	A food item (4 brands) (IRI scanner data)	A probabilistic choice model	Private labels have little impact on national brands, but are strongly affected by national brands price changes	No specific explanation refer to the price tier theory
Allenby and Rossi (1991)	Stick and tub margarine (10 brands) (A.C. Nielson scanner data)	A nonhomothetic choice model	A higher quality brand will have a higher price elasticity than a lower quality brand with the same market share	Due to the interaction between income and substitution effects

Table 2  
Major competing brands, and their monthly averages, standard deviations and coefficient of variation of marketing variables

Brand Name	Sales ( S )			Advertising ( AD )			Price ( P )		
	mean	s.d.	c.v.	mean	s.d.	c.v.	mean	s.d.	c.v.
1 Renault 5 /Clio	1751	594	33.9	21776	16659	76.5	1876.3	171.1	9.1
2 Fiat Uno	1923	648	33.7	14771	18243	123.5	1612.1	137.6	8.5
3 Opel Corsa	1791	578	32.3	11258	10550	93.7	1628.1	94.1	8.8
4 Peugeot 205 / 106	706	171	24.2	11283	12749	112.9	2131.9	489.4	22.9
5 Citroen AX	1051	366	34.8	17627	14295	81.1	1532.2	127.6	8.3
6 Ford Fiesta	1140	507	44.5	13479	11789	87.5	1748.6	149.3	8.5

Notes: AD is advertising expenditures in thousands of escudos, S is sales in volume, and P is price in thousands of escudos. Data for sales, and price was obtained from ' Guia do Automóvel '. Advertising was collected from ' Sabatina '. The above escudo terms have been adjusted to indicate real values, using the consumer price index ( CPI ). The coefficient of variation is defined as (s.d./m)·100.

Table 3 - Cross-Sales Effects of Brand 1( R5 / Clio )

Variables		Lead												Lag												Chi-square		
		-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	Statistic	
S1	AD1	,22	,02	-,08	<u>,31</u>	,21	,00	-,10	-,04	,11	-,11	,00	-,01	-,04	,02	,02	,15	,21	-,14	,01	-,06	-,05	-,10	-,03	-,17	,09	11.1 - 18.6	
S1	P1	-,13	-,14	,08	,09	,00	,12	-,07	,05	,22	,06	,05	-,08	,07	-,11	,05	-,09	,06	,06	-,17	<u>,26</u>	,14	,13	-,05	,10	,19	17.2 - 11.1	
S2	AD1	-,10	-,02	,06	,04	<u>,25</u>	-,03	-,07	,05	-,02	,10	,10	-,14	-,05	,02	-,18	,09	,18	,03	-,02	-,06	-,19	,16	-,04	-,11	-,03	12.7 - 9.7	
S2	P1	-,15	,06	-,08	,01	,13	,18	<u>,26</u>	-,09	,08	-,01	,20	<u>,25</u>	,13	,02	-,18	,09	-,05	,22	-,11	,13	,09	,10	,00	-,03	,11	12.5 - 20.9*	
S3	AD1	,00	-,08	-,09	,11	<u>,24</u>	-,06	-,06	-,03	,07	-,02	-,09	-,08	-,11	-,06	-,14	,00	<u>,45</u>	,10	,04	-,16	-,10	,15	-,08	-,02	,18	21.2* - 9.0	
S3	P1	-,04	-,02	-,02	,00	-,05	,05	,19	-,14	<u>,25</u>	-,03	<u>,27</u>	-,08	,14	,04	-,08	-,04	,00	,00	-,12	,22	,13	,15	-,12	,11	,08	12.4 - 20.5*	
S4	AD1	-,09	-,08	-,16	,15	<u>,32</u>	,09	-,04	-,01	,06	-,04	-,08	-,13	-,16	-,05	-,18	,03	,16	-,07	,20	-,02	-,04	,05	-,07	-,06	-,05	9.8 - 16.7	
S4	P1	,05	-,12	-,10	-,12	,05	-,09	-,08	-,21	,22	-,02	<u>,34</u>	-,19	,21	,07	,06	-,11	-,16	-,02	-,22	,03	-,04	,18	-,03	-,07	,00	11.0 - 24.4 *	
S5	AD1	,09	,00	-,09	,03	<u>,32</u>	-,06	-,10	,00	,00	,06	,03	,02	,08	,02	<u>-,28</u>	<u>-,25</u>	,07	-,12	<u>-,24</u>	-,14	-,15	,10	-,06	-,16	,01	22.3* - 11.6	
S5	P1	-,03	-,12	-,11	,08	,14	,03	-,06	,15	,02	<u>,27</u>	-,06	<u>,31</u>	,03	,09	-,11	,01	-,13	,03	-,04	,07	,21	,08	-,08	-,10	,12	10.8 - 22.2*	
S6	AD1	-,12	-,17	-,07	,10	<u>,31</u>	-,20	,02	,04	,10	,08	,03	-,13	-,07	,02	,13	,00	<u>,51</u>	-,02	,05	,10	-,20	,04	-,09	-,15	,06	27.8 * - 18.3	
S6	P1	-,04	,04	-,07	,16	-,08	,06	-,05	,18	<u>,25</u>	-,10	<u>,26</u>	-,03	,10	,08	-,15	,13	-,10	-,08	,07	,09	,11	,17	-,06	,01	-,02	10.0 - 21.3*	

Table 4- Cross-Market Sales Effects of Brand 5 ( AX )

Variables		Lead												Lag												Chi-square Statistic	
		-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11		12
S1	AD5	,00	,14	,18	,21	-,10	-,11	-,07	,11	,06	-,06	-,05	,14	-,05	,06	-,02	,13	-,05	,02	<u>-,25</u>	-,03	-,03	-,07	-,05	-,03	-,06	8.37 - 16.2
S1	P5	,13	-,03	-,03	-,03	-,14	,02	,16	-,16	,17	,02	-,02	-,11	<u>,24</u>	-,04	-,14	,07	-,19	,01	,14	,02	-,07	,21	-,11	-,04	-,04	12.3 - 11.1
S2	AD5	-,16	<u>,25</u>	<u>,36</u>	,09	,13	,04	<u>,24</u>	-,03	,18	,01	,01	-,01	-,05	-,16	-,08	,06	,12	-,16	-,14	-,19	-,04	-,08	-,09	-,11	,02	13.1 - 26.1*
S2	P5	,17	-,09	-,08	,13	-,18	,08	,19	,17	,19	<u>,24</u>	,01	<u>,28</u>	,07	-,03	-,11	,00	<u>,28</u>	-,04	<u>,45</u>	-,05	,04	,05	-,06	-,16	,19	29.7*-22.1*
S3	AD5	-,16	-,15	,09	,13	,07	-,04	-,12	-,03	,02	,01	,05	-,11	-,03	-,03	-,01	,16	,17	,01	-,01	,02	,08	-,02	-,09	,08	,19	10.1 - 9.9
S3	P5	,00	,05	-,09	-,01	-,15	,13	,01	-,09	,08	,01	,01	-,10	,21	-,10	,07	-,04	-,17	-,17	,21	-,05	-,07	,00	-,05	-,21	,01	17.6 - 6.3
S4	AD5	-,13	<u>-,27</u>	,04	,15	<u>-,24</u>	-,01	-,10	,02	-,05	-,01	,05	-,14	-,10	,00	-,02	,17	,05	,02	,00	-,08	,00	,08	-,07	-,13	,07	6.1 - 17.6
S4	P5	,01	,07	,03	-,08	-,11	-,06	,12	-,07	,16	-,08	,07	-,06	,06	,05	-,05	,00	-,13	-,06	-,03	,15	-,07	,20	-,11	-,07	-,08	10.1 - 7.6
S5	AD5	-,22	<u>,30</u>	,05	<u>,31</u>	,09	-,05	-,05	,03	,00	,02	,03	-,01	,01	,08	-,10	-,02	-,07	,01	-,08	-,11	-,09	,04	<u>,29</u>	,01	,13	11.8 - 21.9*
S5	P5	-,04	,01	-,01	,12	-,08	-,05	,17	-,20	<u>-,24</u>	,09	,05	<u>-,26</u>	,10	,04	,03	,00	-,12	-,18	,11	,14	-,19	,11	-,09	-,08	-,11	13.1 - 20.7*
S6	AD5	<u>-,26</u>	-,09	,12	,21	-,06	,07	-,16	,01	,04	,08	,07	,03	-,19	,09	-,10	<u>,26</u>	,11	-,19	-,07	-,07	-,03	,09	<u>,26</u>	-,07	,03	18.4 - 16.1
S6	P5	-,06	-,09	,01	-,04	,16	-,10	,03	-,02	,00	-,05	-,03	-,04	-,08	-,21	,07	,00	-,03	,07	-,08	,18	-,05	-,02	-,05	,13	,08	10.4 - 4.8

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