

$$AA(L)y_t - A\Phi d_t = Be_t \tag{5}$$

and the VMA representation becomes

$$y_t = A(L)^{-1}\Phi d_t + A(L)^{-1}A^{-1}Be_t \tag{6}$$

$$y_t = \Psi(L)d_t + \sum_{j=0}^{\infty} \tilde{C}_j e_{t-j} \tag{7}$$

where \tilde{C}_j contains the coefficients \tilde{c}_{lij} , which are the new impulse response functions.

This specification induces a transformation on the u_t disturbance vector in the (4), which can be conceived as being generated by linear combination of independent (ortho-normal) disturbances e_t .

Thus, the specification enables us to explicitly model the instantaneous relations between endogenous variables. In fact, the matrix A in (4) explains the instantaneous interactions. The impulse response functions, given by estimating the effect of these ortho-normal shocks at each time, trace the combined results over a chain of reactions initiated by a single shock. The cumulative responses are given by accumulating effects of these ortho-normal shocks protracted in time. SVAR models are therefore suitable to measure immediate simultaneous market responses and competitive reactions, as well as for assessing the implications of complex feedback.

4 Data and estimations

Data for the two brands with the highest market shares in the Italian laundry-cleaning additive market are considered. Data provided by Zenith Optimedia were collected weekly from June 2004 to May 2011 (362 observations).

Within the laundry-cleaning additive category, the eight largest national brands for the Italian market were monitored. The first two brands collectively represent 60% of the sales in this category, which represents a concentrated oligopoly. We will assign leader and follower labels to brand 1 and 2, respectively. In Table 1, variable sales, advertising pressures and promotional efforts are summarised.

Sales are measured by weekly sales in deflated values, and advertising pressures are measured in Gross Rating Points (GRPs), which are given by the sum of percents of the target audience reached by advertisements during a specified period. Promotional pressure is approximated by the percent of promotional sales, which may be considered an indirect measure of the effort spent on promotions.

Table 1. Descriptive statistics of leader's and follower's sales and marketing efforts

	Leader		Follower	
	Mean	Std.dev	Mean	Std.dev
Sales	587.9	76.33	424.4	70.0
GRPs	67.6	113.7	83.1	117.5
% of active GRPs	29.2	-	38.4	-
GRPs if active	230.9	79.7	216.3	84.1
Promotional sales %	35.6	11.4	32.3	14.4
Weighted distribution	98.4	0.6	94.0	4.5

Fig.1 Sales and GRPs for the leader versus time (weekly data).

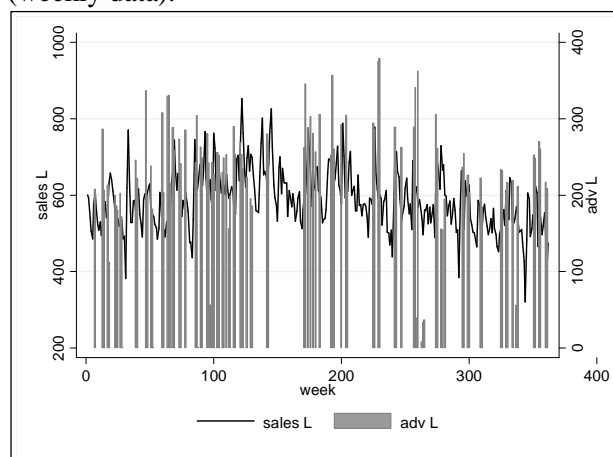
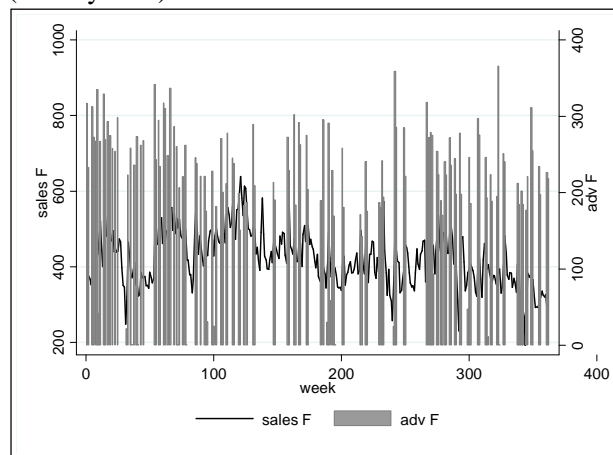


Fig.2 Sales and GRPs for the follower versus time (weekly data).



During the analysed period, the observable advertising schedules are quite homogeneous. The follower advertises its product 38.4% of the weeks with a pressure of approximately 216 GRPs a week, and the leader advertises its product less frequently (29.2% of the weeks surveyed) with a pressure slightly higher than 231 GRPs a week. The two major brands have more than 30% of promotional sales and weighted distributions which overcome 90% of stores. Figures 1 and 2 depict the dynamics of advertising pressures and sales and show that for

each brand the advertising pressure is followed by increases of sales levels, which decays over time.

We estimate that, for the dataset in question with maximum likelihood, a six equation VAR model where the endogenous variables are sales, the percent share of promotional sales and advertising GRPs of leader and follower brands. The specification also includes intercepts and monthly dummies as exogenous variables. The choice of lag specification is jointly guided in light of informative criteria and of the standard residual-based misspecification analysis. After estimating many specifications, we selected a VAR(12) specification.

Table 2 Wald test on lag exclusion.

lag	χ^2	Prob > χ^2	lag	χ^2	Prob > χ^2
1	767.1	0.000	8	62.2	0.004
2	168.5	0.000	10	74.6	0.000
3	85.8	0.000	11	75.2	0.000
4	63.0	0.004	12	56.5	0.016
7	68.2	0.001			

Table 3 Tests of Normality, skewness and kurtosis. (p-values)

Variable	Normality	Skewness	Kurtosis
L [#] sales	0.008	0.022	0.037
F [§] sales	0.619	0.527	0.455
L advertising	0.000	0.000	0.182
F advertising	0.015	0.019	0.090
L promotional sales	0.136	0.093	0.278
F promotional sales	0.161	0.943	0.056
All series	0.000		

#L:=leader §F:=follower *significant at 95%

The lag order choice of a VAR with $p=12$ means that autocorrelations have been retrieved at 3 months lags, which makes sense if we consider that the analysed product may be stockpiled and is characterised by a long inter-purchase time. To gain degrees of freedom for estimation, some lags have been excluded on the basis of results of the Wald tests for lag exclusion. We may exclude from the specification lags 5, 6 and 9, while all the other lags are all significant (Tab. 2). The chosen specification satisfies the stability condition, as all the eigenvalues lie inside the unit circle. The residuals are not auto-correlated, according to the Lagrange Multiplier test until the lag of order 12, and are not jointly normally distributed (Tab. 3). In fact, the normality hypothesis over residuals was not rejected for three out of six series, whereas normality hypotheses were rejected for advertisings series and leader sales. As a whole, the proposed model overcomes the specification analysis.

Afterwards, the structural relations of (4) to (6) are identified by imposing restrictions on matrices A and B. Matrix B is specified as diagonal because, in the present framework, disturbances are simply assumed as idiosyncratic shocks, not having any a priori knowledge about their interactions. In matrix A, the variables are ordered in the system to account for the cascade of transmission mechanisms of the impulse and to impose regular sales last in the sequence, as a priori knowledge of endogeneity makes intuitive sense and are the analysed elements. Thus, first within marketing instruments, and then within sales, the variables are ordered from less to more caused series in terms of Granger-exogeneity test statistics (Tab. 4). The imposed order is: follower's advertising and promotional sales, leader's promotional sales and advertising, and then leader's sales followed by follower's sales.

The SVAR parameters of matrices A and B are estimated by FIML, assuming the innovations are multivariate normal. The log-likelihood is maximised by the method of scoring, where the gradient and expected information matrix are evaluated analytically. See Amisano and Giannini [2] for the analytical expressions of derivatives. The final structure of matrix A (Table 5) has been obtained by starting from the specification of A as a lower triangular matrix and successively deleting coefficients not significantly different from zero. The LR test does not reject the identification restrictions.

Table 4 Granger-causality tests (H0: variable in column does not Granger-cause variable in row)

	Sales L [#]	Sales F [§]	Adv. L	Adv. F	Prom L	Prom F
Sales L	-	55.0*	16.9*	5.7*	25.2*	15.2
Sales F	23.5*	-	14.9	6.3	19.4*	23.1*
Adv. L	19.7*	44.0*	-	9.9	9.8	21.1*
Adv. F	13.6	9.1	23.9*	-	18.7*	9.7
Prom. L	23.0*	32.5*	21.7*	9.8	-	12.5*
Prom. F	14.6	41.9*	12.1	2.9	14.4	-
ALL	128.6*	171.3*	92.2*	47.1	92.2*	74.9*

#L:=leader §F:=follower *significant at 95%

Table 5 Instantaneous coefficients (Matrix A)

from to	Adv. F [§]	Prom. F	Prom. L [#]	Adv. L	Sales L
Adv. F	1	0	0	0	0
Prom. F	0	1	0	0	0
Prom. L	-0.007*	0	1	0	0
Adv. L	0	0	0	1	0
Sales L	0.032*	0	3.912*	0.072*	1
Sales F	0.118*	1.886*	-1.986*	-0.036*	-0.427*

#L:=leader §F:=follower * significant at 95%

LR test for over-identification: $\chi^2(6)=8.1$ Probability:0.230

We find (Tab. 5) that all coefficients of competitive reactions are not significant with the exclusion of a significant decrease in promotional sales of leader in response to an advertising pressure by the follower, while sales simultaneously react to both own- and cross-marketing efforts. Promotional effects at time 0, impressed either by the leader or by the follower, show the expected signs: positive own sales and negative competitor sales. Instead, asymmetric responses may be retrieved with respect to advertising. In fact, advertising pressure on the follower's product has significant positive effects on follower's sales, but significant and negative effects on leader's sales. Furthermore, advertising pressure on the leader's product significantly and positively affects both the leader's and follower's sales. Finally, shocks to the leader's sales improve even the follower's sales.

The initial feedbacks, which are described by impulse response functions at the first four lags, are presented in Table 6. Among competitive reactions,

only the follower's advertising implies significant negative reactions, whereas the leader, acting as defender, accommodates for these changes by reacting through promotional sales during the following month. In fact, when the leader defends itself through advertising, it switches off the advertising pressure in the first weeks and then switches advertising on again in the third week (even if it produces no significant effect). In regard to the market responses in the first weeks, when promotion sales of one brand are shocked, it is initially observed the expected promotional bump that is followed by a diminishing carryover effect that results from the stockpiling of product. The opposite pattern interferes with the sales of the competitor as an initial decrease is followed by a recovery of sales. Advertising implies a positive impact on the sales of advertised brand and a temporary negative impact on sales of the competitor's brand.

Table 6 Impulse response functions of competitive reactions (standard errors in parentheses)..

	Reactions of leader via				Reactions of follower via			
	advertising		promotions		advertising		promotions	
	to attacks of follower via		to attacks of leader via		to attacks of follower via		to attacks of leader via	
	advertising	promotions	advertising	promotions	advertising	promotions	advertising	promotions
1	0.000 (0.00)	0.000 (0.00)	-0.83 (0.42)	0.000 (0.00)	0.000 (0.00)	0.000 (0.00)	0.000 (0.00)	0.000 (0.00)
2	-18.25 (5.90)	-4.969 (5.75)	-1.191 (0.54)	0.302 (0.45)	-0.112 (6.56)	-3.725 (6.68)	-0.557 (0.38)	-0.57 (0.39)
3	2.599 (6.09)	-1.348 (5.89)	-0.928 (0.55)	0.602 (0.54)	-2.477 (6.48)	-3.637 (6.35)	-0.456 (0.50)	0.067 (0.50)
4	2.525 (6.24)	-6.652 (5.84)	-0.867 (0.57)	0.658 (0.54)	4.082 (6.64)	-3.842 (6.23)	-0.555 (0.52)	0.259 (0.49)

Table 7 Impulse response functions of market responses (standard errors in parentheses).

	Responses of follower's sales				Responses of leader's sales			
	to own		to competitor's		to own		to competitor's	
	advertising	promotions	advertising	promotions	advertising	promotions	advertising	promotions
1	15.455 (1.50)	12.562 (1.25)	-2.450 (1.38)	-0.465 (1.38)	30.330 (2.10)	7.185 (1.78)	0.443 (2.39)	0.000 (0.00)
2	10.566 (2.09)	10.733 (2.06)	0.074 (2.02)	-1.608 (1.99)	19.718 (2.79)	10.216 (2.67)	-5.925 (2.94)	2.362 (2.63)
3	2.646 (2.26)	-2.562 (2.21)	1.369 (2.13)	4.401 (2.16)	-0.564 (2.87)	8.287 (2.93)	-7.100 (3.06)	1.695 (2.98)
4	0.964 (2.35)	-5.683 (2.23)	-0.159 (2.10)	4.783 (2.23)	-4.170 (2.85)	5.540 (3.03)	-1.853 (3.18)	0.117 (3.00)

The accumulated competitive reactions to promotional sales and advertising impulses are shown in Figure 3. The accumulated responses are plotted without confidence intervals, which are usually very large and often include zero such that

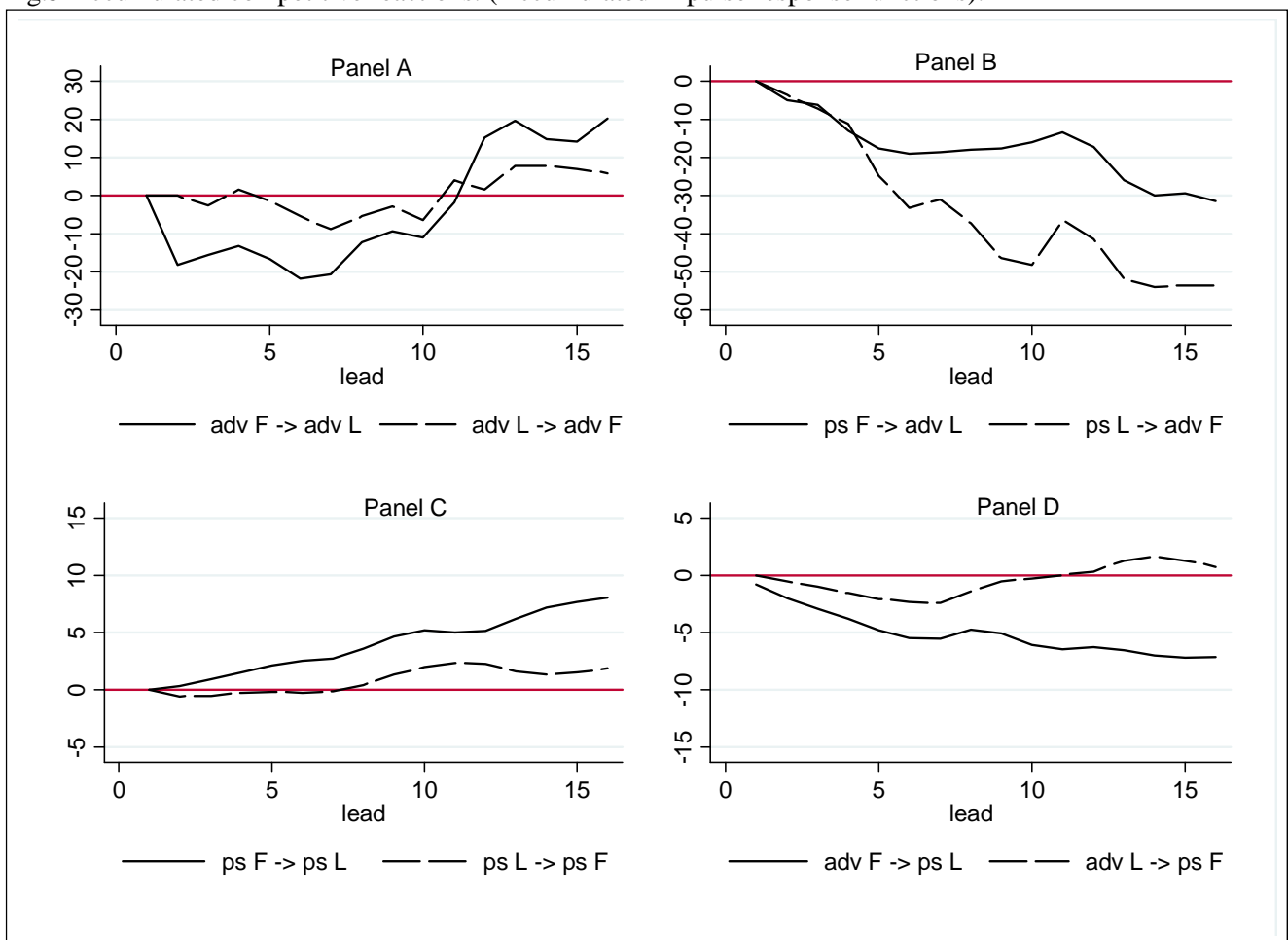
the results are often not significant yet interesting in term of qualitative findings. The competitive reactions to promotions are symmetric across brands and either simple (i.e., promotion itself in response to an attack via promotion itself), or complex (i.e.,

providing a response to an attack via another instrument) (Fig. 3: Panel C and B, respectively). Simple reactions are retaliatory, in that defenders respond to promotional attacks by increasing promotions. Complex reactions are accommodating, in that defenders respond to promotional attacks by decreasing advertising pressure. A lower level of symmetry may be observed when looking at competitive reactions to pressures on advertising. Simple reactions to advertising are symmetric (Fig. 3: Panel A). When the attacker increases advertising expenditure, reactions of the defender are absent or negative during the first weeks and become positive thereafter. Over the long-term, reactions to advertising may be classified as accommodating. Complex reactions of promotional sales to advertising pressure are always negative, and therefore accommodating, when the leader acts as the defender. When the follower acts as defender, its

responses to advertising pressures are initially negative and become positive in the following weeks and are therefore retaliatory (Fig. 3: panel D).

In summary, simple reactions are found to be symmetric and accommodating to advertising whilst they are symmetric and retaliatory to promotions. Complex reactions tend to be of the accommodating type. In fact, complex reactions to both advertising and promotions are all accommodating unless the assault is driven by the leader through advertising. Moreover, in three out of four cases (Fig. 3: panel A, C, D), reactions driven by the leader to assaults of the follower are more intense than reactions by the follower to leader's assaults. Conversely, the follower reacts weakly to the leader's assault with the exception of the strong decrease of advertising pressure in response to a promotional attack by the leader.

Fig.3 Accumulated competitive reactions. (Accumulated impulse response functions).



As a whole, competitive reactions (either simple or complex, either accommodating or retaliatory) show dynamic patterns that are symmetric across brands. The follower nearly always exhibits

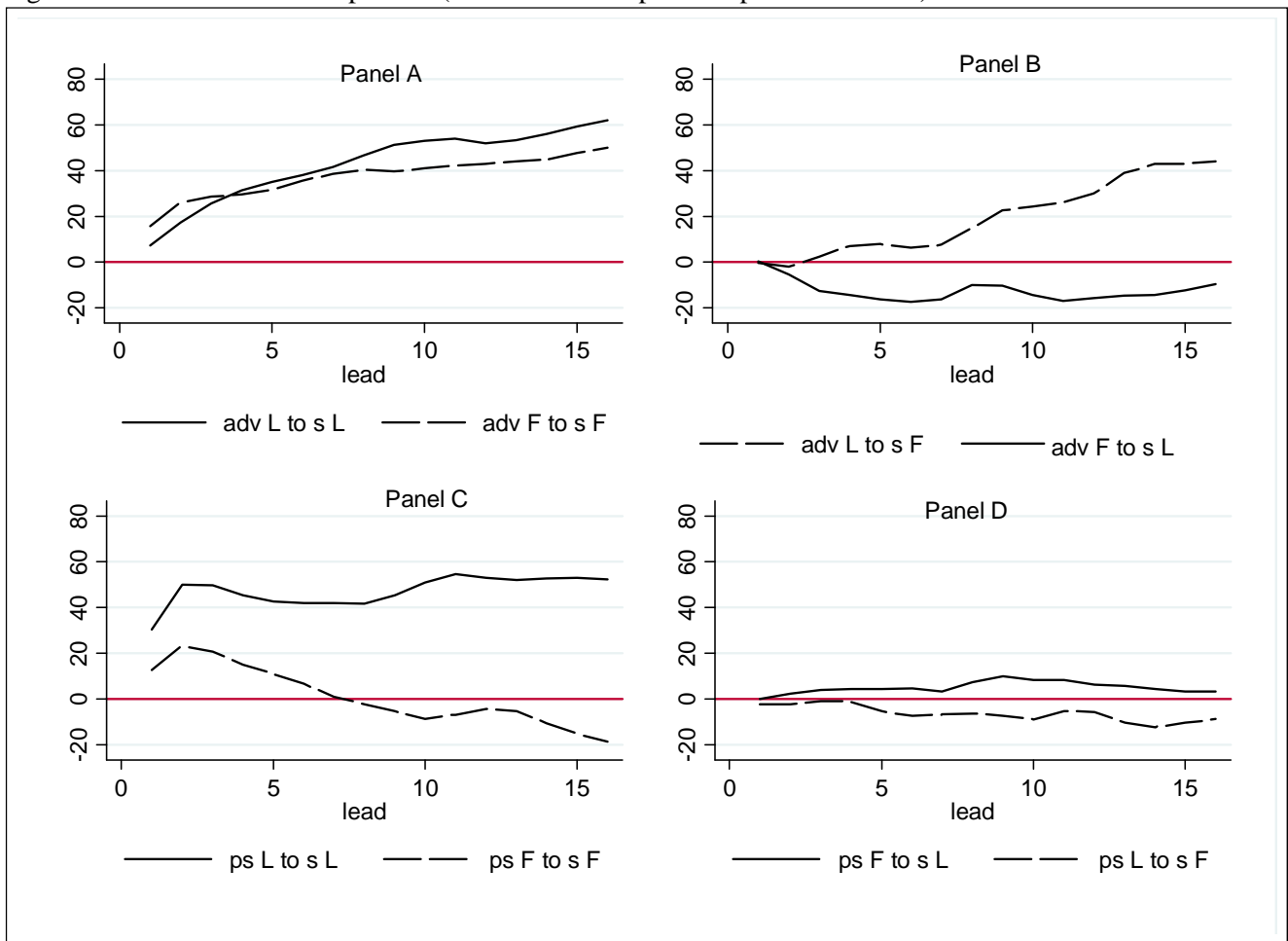
reactions weaker than the leader, and the main deviation from these homogeneous behaviours is determined by the way the follower uses advertising. On one side, the follower strongly

decreases its advertising pressure when attacked through promotions; conversely when the follower moves an assault through advertising, the leader reacts by significantly decreasing its marketing efforts. In Figure 4, the accumulated impulse response functions of sales are traced. Advertising effects are confirmed as positive when accumulated responses are considered. Leader's advertising induces positive responses from its own sales as well as sales of the competitor. Advertising by the follower produces increases only its own sales, so we surmise that advertising by the leader primarily affects the sales of the whole category (Fig. 4: panel A and B). The leader's promotions induce positive responses from its own sales and negative impacts on the competitor's sales, while the follower's promotions induce a positive initial response of its own sales, which in a second time decreases to negative cumulated values (Fig. C: panel C and D). It is worth noting that one impulse in the follower's

promotions does not cut the leader's sales. Additionally, the competitive cross-effects of sales show asymmetric behaviours as the follower's sales increase with the leader's sales, while the opposite is not true.

By accounting for all the dynamic feedbacks across series, we observed a large variety of reactions and responses even for this small-size category. We found evidence for simple retaliatory reactions through promotions and simple accommodating reactions through advertising. Complex reactions were more retaliatory than accommodating. In most cases, reactions are symmetric and the stronger reactions are the ones opposed by the leading brand. In regard to market responses, advertising and promotions by the leader induce positive accumulated responses of the followers' sales. Moreover, the more growth of the leader's sales, the more the follower's sales grow with a positive effect on the demand-category.

Fig.4 Accumulated market responses. (Accumulated impulse response functions).



These findings leads us to consider that the leader drives the markets and that the nature of competition

of this market deviates from a symmetric behaviours towards a dominant-fringe pattern where the leader

firm is retaliatory and the follower is accommodating or passive.

5 Conclusions

In this paper, we examine the nature of competition between two leading brands within the Italian laundry-cleaning additive market from an econometric viewpoint. We first analyse competitive conducts by specifying a SVAR model [2]. The outcome of the investigation adds to case-studies of the literature on competitive dynamics in small markets. By accounting for all the complex feedbacks of actions and reactions, we may examine which is the nature of reactions from each firm. Furthermore, we identify whether coupled reactions to a single instrument are symmetric or asymmetric and thus identify the type of competition that occurs in the market.

This study offers the following insights. Within this market, defenders usually rejoin to assaults through simple instruments. Simple reactions are symmetrical, retaliatory to promotional sales and accommodating to advertising. Complex reactions tend to be of the accommodating type. Reactions driven by the leader to the assaults of the follower are more intense than reactions of the follower to assaults by the leader. Conversely, the follower rarely reacts to the leader's assault, with the exclusions of a strong decrease of its advertising pressure in response to a promotional attack by the leader. Further, we find that the brand with the biggest market share is the true effective leader, as both own and competitor sales are positively affected by its own advertising. Moreover, impulses in the leader's sales increase sales for itself and its competitor with a positive effect on primary demand of category. These findings collectively suggest that the leader drives the markets and that the nature of competition in said market deviates from symmetric behaviours towards a dominant-fringe pattern where the leader firm is retaliatory and the follower is accommodating or passive.

This study examined the competitive dynamics of only one particular market; however, the study contributes to the literature on marketing dynamics in that it shows the utility of the econometric approach for describing competitive dynamics. Specifically, the SVAR approach provides insight into the complex exchange of feedback between firms, helps managers to understand the complexity of competitive dynamics, and provides a method to project ways to specify firms' competitive conduct to derive sustainable advantages.

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