"ASYMMETRIC CANNIBALISM BETWEEN SUBSTITUTE ITEMS LISTED BY RETAILERS"

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ASYMMETRIC CANNIBALISM BETWEEN SUBSTITUTE ITEMS LISTED BY RETAILERS +

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Abstract

SH.A.R.P. (Bultez and Naert, 1988) aims at optimizing the allocation of a retail outlet's selling area, across the items composing its assortment. Demand interdependencies are introduced by focusing on substitution occurring within each homogeneous product category. They are modelled through an attraction-type specification of the items' share in the category's total sales volume. The latter, however, implies fully symmetric patterns of substitution.

Here, by adopting the asymmetric variant of the attraction model proposed by Vanden Abeele, Gijsbrechts and Vanhuele (1987), we generalize the SH.A.R.P. optimization rule so as to integrate the diversity of substitution effects that may be caused by brand loyalty, preference for a specific variety, or package size purchasing habits. The extended model is empirically validated on a sample of data collected during an experiment run on the canned dog-food category of a large Belgian hypermarket. Normative results point to the benefits which can be derived from using SH.A.R.P. II.
1. Introduction

A retail business is continuously confronted, more than any other firm, with the monitoring of the interdependencies generated within its multiproduct assortments. Thus retailers managing large self-service stores are facing, within each of their lines, internal competitive interactions. The jargon they use - typically, the word "cannibalism" - clearly denotes their concern for the multiple forms that substitution effects may take within their departments: competition between brands, either within or across variety-types, and vice-versa substitution between variety-types, either within or across brand lines.

In addition, positive interactions may also co-exist. Price promotions, retail advertising and special displays boost the sales of the items featured but hopefully contribute to the favorable positioning of the shop, or of the entire chain, and are likely to increase store-wide or chain-wide traffic. For illustrations of interesting approaches to these aspects of retailing, refer to e.g., Corstjens and Doyle (1981), Doyle and Saunders (1987), McGoldrick (1986) and Wilkinson et al. (1981, 1982).

Whether positive or negative, cross-product effects occurring within retailers' assortments are difficult to measure and make the planning and control of merchandising activities quite complex ... or messy. Reibstein and Gatignon's article (1984) offers evidence of the problems met by marketing model builders when trying to tackle those issues rigorously. The overwhelming number of commodities carried further compounds the retailer's task and most often prevents him from assessing their direct cost and profitability. This in turn explains the current craze for the so-called DPP systems, integrating costing and space allocation rules.
(e.g., P & G's approach to "Total System Efficiency" presented to its customers as an impartial, disinterested methodology especially designed for helping them in the audit and management of their retail operations).

However determining those "linkages" are in the retailer's "chain value" (reference to Porter's terminology appears particularly appropriate in this case), rare are the marketing scientists who have systematically explored their normative implications. Here, in this article, we focus on those which relate to shelf space allocation within superstores.

More specifically we extend SH.A.R.P., a general model developed by Bultez and Naert (1988) and experimented with some success in the allocation of the shelf space available for display of items forming homogeneous product categories. SH.A.R.P. includes sales interdependencies which take the form of symmetric substitution effects modeled through a simple attraction-type specification. Yet in many situations, brand and/or package-size loyalty e.g., may introduce asymmetries that an MCI model cannot account for. To remedy this inadequacy, we adapt SH.A.R.P. by incorporating into it a variant of the "competitive cluster asymmetry" model, proposed by Vanden Abeele, Gijsbrechts and Vanhuele (1987).

In section 2, the theoretical background of SH.A.R.P. is reviewed. Section 3 shows how asymmetry can be introduced. Generalized cross-elasticities and optimization results are then derived in sections 4 and 5, respectively. In sections 6 and 7, calibration and implementation procedures are discussed and illustrated through an application in a real setting. A sensitivity analysis aims at estimating how much ignoring asymmetry would cost to the retailer.
2. Optimal Shelf Space Allocation: Theoretical background

Bultez and Naert (1988) examine how a retailer, seeking to maximize the total profit ($\Pi$) produced by his multi-item assortment, should allocate the limited space available in his store ($S$). The assortment is defined along two dimensions: its depth ($D$), determined by the set of brands offered to the buyer, and its width ($W$), delimited by the variety of item types, i.e. the range of tastes, package forms and sizes, constituting the various brands' product lines. Thus each item is identified by both its variety-type ($v \in W$) and its brand name ($b \in D$). Each item's sales volume ($q_{vb}$) depends not only on its own visibility, hence on the space allocated specifically to itself ($s_{vb}$), but also on the other items' display ($s_{jc}$). Its contribution to profit ($\pi_{vb}$) is defined by the difference between the gross margin generated by its sales ($g_{vb} q_{vb}$) and the cost ($C_{vb}$) its handling entails.

Such a problem definition is quite general, except for the restriction that the assortment composition cannot be altered: the set of items considered is fixed a priori. Therefore the allocation rule derived therefrom presents an interesting degree of generality. Bultez and Naert (hereafter, B & N) show that the space available should be shared according to the following equations,

$$\sigma_{vb} = s_{vb}/S = (\gamma_{vb} c_{vb} + \bar{n}_{vb})/\bar{G} + \bar{N},$$  \hspace{1cm} (1)

for $v \in W$ and $b \in D$;
where: \( c_{vb} = \frac{C_{vb}}{\Pi} \), represents the ratio of the handling cost resulting from carrying brand b's item v to the assortment overall profitability^{1};

\[
\gamma_{vb} = -\left( \frac{\partial C_{vb}}{\partial s_{vb}} \bigg|_{d_{vb} = 0} \right) \left( \frac{s_{vb}}{C_{vb}} \right),
\]
stands for the absolute value of the partial elasticity of item v's handling cost with respect to the space allocated to it (at a constant sales level);

\[
\tilde{\eta}_{vb} = \sum_{c \in D} \sum_{j \in W} r_{jc} \eta(m_{jc}, s_{vb})
\]
(2)
is the weighted mean of all items' sales elasticities, \( \eta(m_{jc}, s_{vb}) \), with respect to the space allocated to brand b's item v;

with \( r_{jc} = \pi_{jc}/\Pi \), the relative contribution of brand c's item j to the assortment profitability,

and

\[
\tilde{N} = \sum_{b \in D} \sum_{v \in W} \tilde{\eta}_{vb} \quad \text{and} \quad \tilde{G} = \sum_{b \in D} \sum_{v \in W} \gamma_{vb} c_{vb},
\]

are the normalizing terms.

For notation convenience, but without loss of generality, let us consider that if a brand is not listed among the items of a specific variety-type carried by the retailer, then the corresponding variables characterizing it are all set equal to zero.

The apparent complexity of the terms entering (1) is due to the fairly general implicit functions underlying this non-linear mathematical
programming problem. Their interpretation is not too difficult, however: the space share allocated to brand b's item v should be proportional to the extent that its visibility contributes to push up the sales of the most profitable items in the category considered (\( \vec{n}_{vb} \)); it should also be increased in so far as its piling up on the shelf may reduce handling and replenishment operations (\( \gamma_{vb} \cdot c_{vb} \)).

Implementing (1) calls for the explicit specification of the handling cost and sales response. B & N assume that the cost is a constant elasticity function of the frequency of replenishment, i.e.

\[
C_{vb} = f_{vb}(q_{vb}/s_{vb})^{\gamma_{vb}},
\]

(3)

with \( f_{vb} > 0 \), a constant scaling factor. Interested in rather homogeneous product categories constituting classes of differentiated substitutes, they suggest the attraction model for the description of the competition prevailing between brands, as well as of the cannibalism which may also occur within each brand's line, i.e.

\[
m_{vb} = \alpha_{vb} \Sigma \beta_{vb}/s_{vb}/s_{vb} \Sigma \Sigma \alpha_{jc} \beta_{jc},
\]

(4)

where: \( m_{vb} = q_{vb}/Q \) denotes the share of brand b's item v in the product category total sales volume (\( Q = \Sigma \Sigma q_{vb} \), supposed to remain constant); \( \alpha_{vb}, \alpha_{jc} \) and \( \beta \) are non-negative parameters.
B & N extensively report on various tests of their model and allocation procedure. Their analyses, however, omit the distinction between the two dimensions of the retailer's assortment: items are either clustered together brandwise (i.e., they focus on the aggregate brand level: $S_b = \sum_v s_{vb}$), or their belonging to their respective brand lines is ignored (i.e., subscript $i$ is substituted for $v \times b : s_i = s_{vb}$).

Indeed the intrinsically symmetric nature of model (4) fits well in the absence of a hierarchical structure or partitioning in the retailer's assortment. It implies identical cross-elasticities of sales shares, i.e.

$$\eta(m_{jc}, s_{vb}) = \eta(m_{jb}, s_{vb}) = \eta(m_{vc}, s_{vb}) = -\beta m_{vb}.$$  

Thus when an item's visibility is increased, the sales share of any other item gets reduced by a fixed proportion, which only depends on the relative importance of the item whose visibility is enhanced (measured by $m_{vb}$, here), and not on the alternative item affected ($j,c$). Therefore substitution between variety types offered by the same brand ($j \neq v$) and competition opposing different brands ($c \neq b$) are treated similarly: both sorts of interdependencies are assumed to be of the same strength.

As a matter of fact, such an assumption is quite restrictive. Should, e.g., brand loyalty prevail, then one would expect relatively stronger substitution effects between items of the same brand than between items offered by different brands, i.e.

$$|\eta(m_{jb}, s_{vb})| > |\eta(m_{jc}, s_{vb})|.$$
3. **Asymmetric Variant of the Attraction Model**

Model (4) can be presented under the classic relative attraction form,

\[ m_{vb} = \frac{t_{vb}}{\sum \sum t_{jc}} , \]  

(5)

where each of the terms, \( t_{vb} \), stands for the attractiveness of each respective item.

Let \( a_{vb} \) be the intrinsic attraction exerted by brand b's item v, i.e. the attraction which it exerts independently of the choice context (i.e., other items bearing the same brand name, or of the same variety or package size), e.g.

\[ a_{vb} = a_{vb} s_{vb}^B . \]

If \( t_{vb} \) is assimilated to \( a_{vb} \), model (4) is obtained. This shows that its symmetry results from the fact that each of the terms, \( t_{vb} \), uniquely depends on the context-free attraction exerted by the corresponding specific item (v,b). Consequently the ratio of two items' sales shares is determined only by the ratio of their respective attractions, i.e.

\[ \frac{m_{jc}}{m_{vb}} = \frac{t_{jc}}{t_{vb}} = \frac{a_{jc}}{a_{vb}} . \]  

(6)

It appears absolutely unrelated to the visibility of any other item, whether from the same brand line (either b or c) or from the same variety type (either v or j).
In order to circumvent this limitation of the attraction model, Vanden Abeele, Gijsbrechts and Van Huele (1987) develop a generalized formulation, by making the terms, \( t_{vb} \), functions not only of the specific item's attraction, \( a_{vb} \), but also of the attraction exerted by clusters of related items, i.e. \( a_{jb} \) and/or \( a_{vc} \).

Here, adapting Vanden Abeele et al.'s suggestion, we propose to adjust the terms by the total attraction exerted by the items of the same brand line and/or of the same variety. More explicitly, we postulate that

\[
t_{vb} = \frac{a_{vb}}{(A_v A.b)}, \tag{7}
\]

where:

\[
A_v = \sum c a_{vc} \quad \text{and} \quad A.b = \sum j a_{jb}, \tag{8}
\]

account for the total attraction exerted by items of the \( v \)-th variety type and by those offered by brand \( b \), respectively; \( 0 \leq \theta_k \leq 1 \), are parameters regulating the degree of asymmetry caused by the \( k \)-th cluster of items.

Deflating the original attraction according to (7) and (8) yields the following ratios of sales shares,

\[
m_{jc}/m_{vb} = \frac{\theta_1 \theta_2}{[a_{jc}/(A_j A.c)]/[a_{vb}/(A_v A.b)]},
\]
the meaning of which becomes clear if we consider e.g. the special case
when brand loyalty is the single source of asymmetry (i.e. $\theta_1 = 0$ and
$\theta_2 = \theta$), i.e.

$$m_{jc}/m_{vb} = [a_{jc}/a_{vb}](A_{.b}/A_{.c})^\theta.$$  

The latter expression demonstrates the impact of our "deflation". In the
case of full asymmetry ($\theta = 1$), the sales shares ratio corresponds to the
ratio of the items' shares within their own brand's sales, i.e.

$$m_{jc}/m_{vb} = m_{.c}/m_{.b},$$  \hspace{1cm} (9)

where:

$$m_{.b} = a_{vb}/A_{.b}. \hspace{1cm} (10)$$

Thus full asymmetry reveals synonymous of absolute intra-brand product-line cannibalism. As illustrated further in figure 1, (9)-(10)
implies that an increase of the visibility of brand b's item v will eat up
the sales of brand b's items exclusively. At the other extreme, i.e. when
asymmetry is reduced to nil ($\theta = 0$), the degree of cannibalism within the
brand line is as strong (or as moderate) as it is across brands.

Figure 1a shows that in the case of symmetric substitution the increase in
item (1,b) sales comes equally at the expense of item (2,b) and of brand c.
In contrast, as demonstrated by figure lb, when asymmetry is present, the sales share of item (2, b) is dramatically affected while brand c's items hardly suffer.

4. Generalized Cross-Elasticities:

Economists traditionally rely on the concept of demand cross-elasticities to characterize product interdependencies and especially their degree of substitutability\(^3\). The nature and relative strengths of competitive interactions are indeed reflected in the structure of the matrix of direct and cross-elasticities. Thus we shall measure the exact incidence of introducing asymmetry into the attraction model by reference to the cross-elasticity standard.

Substituting (7) and (8) into (5), we obtain the asymmetric version of the model,

\[
m_{jc} = a_{jc} A_{j} \cdot a_{c} / \sum_{d \in D} \sum_{w \in W} a_{wd} A_{w} \cdot a_{d} .
\]

Let \( T_{j} = \sum_{d} t_{jd} \cdot T_{c} = \sum_{w} t_{wc} \) and \( T_{..} = \sum_{d} \sum_{w} t_{wd} \). Then the marginal direct/cross-effects of a variation in the visibility of brand b's item \( v \) is defined by,

\[
\frac{\partial m_{jc}}{\partial s_{vb}} = \frac{1}{T_{..}} \left[ \frac{\partial t_{jc}}{\partial s_{vb}} - m_{jc} \frac{\partial t_{wd}}{\partial s_{vb}} \right].
\]
Observing that

\[
\frac{\partial t_{jc}}{\partial s_{vb}} = \beta \frac{s_{jc}}{s_{vb}} (\delta_{vj} \delta_{bc} - a_{vb} [\delta_{vj} (\theta_1^{(1)} + \delta_{bc}(\theta_2^{(1)})], \tag{13}
\]

we deduce that

\[
\sum_{d} \sum_{w} \frac{\partial t_{wd}}{\partial s_{vb}} = \frac{\beta}{s_{vb}} (t_{vb} - a_{vb} [\delta_{vj} (\theta_1^{(1)} + \delta_{bc}(\theta_2^{(1)})]. \tag{14}
\]

Integrating (13) and (14) into (12) gives,

\[
\frac{\partial m_{jc}}{\partial s_{vb}} = \frac{1}{T} \frac{s_{jc}}{s_{vb}} (\delta_{vj} \delta_{bc} t_{jc} - a_{vb} [\delta_{vj} \theta_1^{(1)} + \delta_{bc} \theta_2^{(1)}]) t_{jc} - m_{jc} (t_{vb} - a_{vb} (\theta_1^{(1)} + \theta_2^{(1)})].
\]

By multiplying both sides by \((s_{jc}/m_{vb})\) and rearranging terms appropriately, we ultimately get a general formula for the direct as well as cross-elasticities implied by model (11) i.e.

\[
\eta(m_{jc}, s_{vb}) = \beta [(\delta_{vj} \delta_{bc} - m_{vb}) - \theta_1^{(1)} \mu_b^{(v)} (\delta_{vj} - M_v) - \theta_2^{(1)} \mu_v^{(b)} (\delta_{bc} - M_b)], \tag{15}
\]

where \(\mu_b^{(v)} = a_{vb}/A_v\) and \(\mu_v^{(b)} = a_{vb}/A_b\), represent the relative attraction of brand b's item v within the v-th variety type, and the relative attraction of that same item within brand b's line:

\[
M_b = \sum_w m_{wb} = T_b/T, \text{ and } M_v = \sum_d m_{vd} = T_v/T, \]

are brand b's aggregate sales share, and variety v's global sales share, respectively.
The various cases implied by (15) are reviewed in figure 2. Direct elasticities are displayed in the top part (i.e. (1)) of the tree-structure ($\delta_{bc}, \delta_{vj} = 1$).

Cross-elasticities measuring intra-brand cannibalism appear on the second set of branches; while the intra-variety cannibalism is illustrated by the third group. Subset (4) corresponds to cannibalism between items of various types ($\delta_{vj} = 0$), offered by distinct brands ($\delta_{bc} = 0$).

Setting both asymmetry parameters equal to zero ($\theta_1 = \theta_2 = 0$), one of course recovers the direct and cross-elasticities that the simple attraction model (4) generates, i.e.

$$\eta(m_{vb}, s_{vb}) = \beta(1 - m_{vb}); \eta(m_{jc}, s_{vb}) = -\beta m_{vb}.$$ 

Naturally, the intensity of cannibalism varies with the $\theta$'s. This is best demonstrated when comparing intra-cluster (i.e., intra-brand or intra-variety) cross-elasticities to the across-cluster ones. For example, if brand loyalty dominates preference for specific variety types so strongly that it constitutes the only source of asymmetry, $\theta_1 = 0$ and $\theta_2 = \theta \neq 0$, and figure 2 indicates that,

$$\frac{|\eta(m_{jb}, s_{vb})|}{|\eta(m_{jc}, s_{vb})|} = \frac{(1 - M_{vb})}{1 - \theta M_{vb}} = \rho_b.$$
Since $0 < \theta < 1$, then: $\rho_b \in [1, +\infty]$ and therefore,

\[ |\eta(m_{jb}, s_{vb})| \geq |\eta(m_{jc}, s_{vb})| , \]

which means that cannibalism between items of the same brand exceeds cannibalism between brands.

Moreover,

\[ \lim_{\theta \to 1} [\eta(m_{jc}, s_{vb})] = 0 , \]

and

\[ \lim_{\theta \to 1} [\eta(m_{jb}, s_{vb})] = -\beta[m_{vb}/m_{jb}] = -\beta \cdot m_{vb}/m_{jb} . \]

Thus extreme asymmetry in cannibalism relationships leads to complete independence between items offered by different brands; substitution occurs only within brands (also refer to our comment on (9)). From a pragmatic market research point of view it should be realized that such an extreme situation ($\theta = 1$) disqualifies the application to the whole product category of the attraction model (whether in its symmetric or asymmetric form). If $\theta$ gets close to one, the latter should be split into distinct sub-categories which should then be analyzed separately.

The situation in which consumers' preference for specific variety-types takes precedence of their brand attachment up to a point that it constitutes the only source of asymmetry (i.e., $\theta_1 = 9$ and $\theta_2 = 0$) can be interpreted analogously.
5. SH.A.R.P. II

Extending SH.A.R.P. to take into account asymmetric substitution effects of cannibalism within the product categories carried by a retailer requires the substitution of the generalized cross-elasticities (15) in optimization rule (1). Focusing on the only terms involving elasticities, we note that according to (2) and (15),

\[ \tilde{\eta}_{vb} = \beta \sum_j \sum_{vc} r_{jc} \left[ (\delta_{vj} \delta_{bc} - m_{vb}) - \theta_{1w} |v| (\delta_{vj} - M_{v.}) - \theta_{2w} |.b (\delta_{bc} - M_{b.}) \right], \]

but since \( \sum_j \sum_{vc} r_{jc} = 1 \), this reduces to

\[ \tilde{\eta}_{vb} = \beta [r_{vb} - m_{vb}] - \theta_{1w} |v| (R_{v.} - M_{v.}) - \theta_{2w} |.b (R_{b.} - M_{b.})], \tag{16} \]

where \( R_{v.} = \sum_{vc} r_{vc} \) and \( R_{b.} = \sum_j r_{jb} \), denote variety-type \( v \)'s \( (R_{v.}) \) and brand \( b \)'s \( (R_{b.}) \) aggregate relative contribution to the profitability of the product category.

Summing (16) over \( v \) and \( b \),

\[ \bar{N} = \sum_v \sum_b \tilde{\eta}_{vb} = \beta [\sum_v \sum_b r_{vb} - \sum_v m_{vb} - \theta_{1w} \sum_v (R_{v.} - M_{v.}) \sum_b |.b], \]

\[ - \theta_{2w} \sum_b (R_{b.} - M_{b.}) \sum_v |.b], \]

yet because \( \sum_b |.b] = \sum_b a_{vb} / A_{v.} = A_{v.} / A_{v.} = 1 \) and similarly \( \sum_v |.b] = 1 \),

\[ \bar{N} = \beta [1 - 1 - \theta_{1w} \sum_v (R_{v.} - M_{v.}) - \theta_{2w} \sum_b (R_{b.} - M_{b.})] = 0. \]
This result is not unexpected. The nil "balance" of the competitive interactions derives from the consistency of the attraction model: what is gained by an item comes at the expense of another within the same category.

Using (16) and keeping in mind that \( \bar{N} = 0 \), we easily see that rule (1) can be generalized to,

\[
\sigma_{vb} = c^*_{vb} + \beta^* \left[ (r_{vb} - m_{vb}) - \theta_1 \beta_v \nu. (R_v - M_v) - \theta_2 \beta_{vb} \nu. (R_b - M_b) \right],
\]

(17)

where \( c^*_{vb} = \gamma_{vb} c_{vb} / \tilde{c} \) and \( \beta^* = \beta / \tilde{c} \).

The various cases encompassed by (17) are enumerated in figure 3. The space share allocated to a brand's entire line, \( S_b \), is determined by adding the shares obtained by the items that make it up, i.e.

\[
S_b = \sum_{vb} \sigma_{vb}.
\]

Likewise, the portion of the gondola to be saved for a variety-type, \( S_v \), is obtained by summing over brands that offer items of that same type, i.e.

\[
S_v = \sum_{vb} \sigma_{vb}.
\]

The extent to which asymmetry alters the distribution of shelf space can be evaluated by comparing the new formulas, II, with the original one, I, at the aggregate brand (or variety type) level. Let us concentrate on an example:

\[
S_{II}^b = C_b + (1 - \theta) \beta^* (R_b - M_b).
\]

(18)
Not too surprisingly, $\theta$ makes the difference: it operates as a factor damping down the primary effect of the item's visibility on the buyer's choice (i.e., $\beta^*$). The larger the $\theta$, the higher the relative importance attached to handling cost considerations in dividing up the product category's selling area. Intuitively, this can be justified by realizing that as $\theta$ approaches unity, brands' sales shares tend to stabilize: because substitution gets restricted within the limits of each brand's line and does no longer extend across brands. Therefore no discernible impact on the brands' sales distribution is produced by reallocating space.

6. **Empirical illustration:**

Since its development in 1983, SH.A.R.P.I has been tested on four different product assortments and in five large grocery stores. We use here the data collected by Alen (1986) during the most recent of the experiments designed by B & N, on which no result has yet been reported. It took place over a 20-week period during the Spring of 1986, in the largest Belgian hypermarket, the 16,440 sq. mt. CORA-DISTRIMAS, located in Rocourt (Liège, 54 check-out cash-registers) and owned by the medium-sized FRADIS chain (ranked 7th among Belgian retailers). Highly decentralized as compared with its retailing competitors, FRADIS operates 6 hypermarkets and 3 groups of supermarket franchisees (Choc-Discount, Courthéoux and Match). Its annual sales revenue amounts to BF 15 billion and its gross margin reaches 14%.

The experiment was run on the 20-item canned dog food assortment carried by CORA-DISTRIMAS. The product category examined was selected for its high turnover (or to be more precise its high sales-to-inventory ratio, facilitating the rapid observation of the impact produced by changes in merchandising), for the stability of its total sales volume, and last but
not least, because the buyers are not the consumers so that the purchasing behavior is likely to be influenced significantly by the items' visibility. It included 6 national brands and one private label, essentially offered in large package sizes (basically in 0.8 and 1.2 kgs; only two 0.4 kg-items were listed). Weekly observations on sales volume, allocated shelf space and promotions were gathered for all items. Three distinct space arrangements were considered, hence three periods can be distinguished in the analysis.

Experimental changes were implemented over three consecutive 4-week periods. During the first period, it was striven for the equi-repartition of the available shelf space; only items on promotion were allocated relatively more space. At the beginning of the second period, the visibility of some high-margin national brands was increased at the expense of the low-margin private label. On the contrary, in period 3 the allocation was reversed so as to favor low-priced items. Given that the purpose was the validation of SH.A.R.P.I, possibilities of asymmetry were ignored and the analysis was restricted to aggregate effects at the brand-level (see Alen, 1986). No systematic variation along the package-size dimension was planned. In period 2, however, one such variation happened to occur. Weekly observations were averaged out per period; hence, we deal with a combination of 2 pre-test-post-test cross-sections of 20 items each: period 2 vs. period 1 and period 3 vs. period 2.

Since the promotional activities under the control of the manufacturers could not be stopped, a promotion covariate has to be introduced into the specification of the intrinsic attraction exerted by
each item, i.e.

\[ a_{vb,\tau} = s_{vb,\tau}^\beta e^{YP_{vb,\tau}}, \]  

(19)

with \( v = 0.4, 0.8 \) or 1.2 kg (i.e., package sizes);

\( b = \) Bonzo, Chappi, Fido, Loyal, Pal, Pluto or Produits Francs (i.e., brands);

\( \tau = 1, 2, 3 \) or 4 (i.e., time periods);

and where the promotion variable, \( p_{vb,\tau} \), is determined by both the monetary value of the price-cut and the duration of the promotion.

Taking into account the specific nature of the product, we hypothesize a priori that asymmetry in cannibalism results from the buyer's preference for a specific package-size. For dog food (as opposed to cat food) the size of the dog itself appears to be a key-determinant of the buyer's choice. Note also that the major axes along which brands diversify their lines are the package sizes for dogs, and food components (e.g., fish vs. meat) for cats. Thus we assume \( \theta_2 = 0 \) and \( \theta_1 = 0 \). Accordingly, the attractiveness terms (7) are defined by

\[ t_{vb,\tau} = a_{vb,\tau}/A_{v,.\tau}, \]  

(20)

where \( A_{v,.\tau} = \sum_b (s_{vb,\tau}^\beta e^{YP_{vb,\tau}}) \).

Let us observe that the variation of an item's sales share can be studied under the ratio form,
\[
\frac{m_{vb,\tau+1}}{m_{vb,\tau}} = (a_{vb,\tau+1}/a_{vb,\tau})(A_{v,\tau}/A_{v,\tau+1})^\theta(T_{..,\tau}/T_{..,\tau+1}).
\]

Transforming this ratio into logarithms yields the following equation,

\[
y_{vb,\tau} = \beta.[\ln s_{vb,\tau+1} - \ln s_{vb,\tau}] + \gamma.[p_{vb,\tau+1} - p_{vb,\tau}]
+ \delta.[\ln A_{v,\tau} - \ln A_{v,\tau+1}] + \sum_{L=1}^{3} d_L \delta_{L,\tau}; \tag{21}
\]

where: \( y_{vb,\tau} = \ln \frac{m_{vb,\tau+1}}{m_{vb,\tau}}, \tau = 1, 2, 3; \)
\( d_L \) stands for \([\ln T_{..,L} - \ln T_{..,L+1}]; \)
\( \delta_{L,\tau} \) denotes a dummy variable equal to one if \( L = \tau \), and to zero otherwise (introduced to capture the variation over time of the denominator of the attraction model).

In the absence of asymmetry (\( \theta = 0 \)), equation (21) is linear in the parameters. Thus our linearization reveals similar to Nakanishi and Cooper's (1982) structural transformation of the MCI model into a dummy variable multiple regression equation. As \( \theta \) is the remaining cause of non-linearity, we propose the following iterative estimation procedure.

**Step # 0**: Assume \( \theta = 0 \) and estimate \( \beta \) and \( \gamma \) by applying the OLS method to the so-reduced form of equation (21). Then set \( h = 1 \).

**Step # h**: Use the estimates obtained for \( \beta \) and \( \gamma \) in the previous step (i.e., \( h-1 \)) to determine the attraction of each item and the total attraction exerted by items of the same package size \((A_{v,\tau})\). Then re-estimate \( \beta, \gamma \), together with \( \theta \), by applying OLS to the full form of equation (21). Set \( h = h + 1 \) and return to step # h. Stop when convergence occurs, i.e. when the difference observed between the new
set of estimates just obtained and the one derived at the previous stage becomes negligible.

Simulation experiments run by Gijsbrechts and Vanden Abeele (1988) prove that an equivalent iterative process converges quickly to unbiased estimates.

Table 1 summarizes the results we obtained when applying this stepwise method to our sample. Standard errors (in parentheses) and t-ratios are reported below the OLS-estimates. Package-size asymmetry shows up as significantly as the item visibility effect. The alternative hypothesis, i.e. whether asymmetry could be caused by brand loyalty, was also tested but as expected, it was rejected.

The estimates of \( \gamma \) and \( \beta \) reveal remarkably stable. Furthermore, given the transversal nature of our sample, the goodness-of-fit measure \( R^2 \) indicates that the model offers a fairly reliable description of the cannibalism prevailing within the retailer's assortment.

7. Normative Implications

Introducing a couple of simplifying assumptions can greatly help in the process of reconciling theory with practice. Those are indeed necessary to relate allocation formula (17) to the rules-of-thumb commonly employed by retailers to determine the shelf-arrangement. Referring to the
the replenishment cost function (3), let us regard it as a linear function of the frequency of the handling operations. This amounts to setting \( \gamma_{vb} = 1 \). Then if we consider that the available space is equally distributed among items (i.e., \( s_{vb} = S/n = s \)),

\[
C_{vb} = f_{vb}(q_{vb}/s),
\]

and

\[
c^*_{vb} = C_{vb}/\Sigma \Sigma C_{jc} = f_{vb} M_{vb}/\Sigma \Sigma f_{jc} m_{jc}. \]

But if we further recognize that product handling operations essentially depend on the packaging of the goods and not so much on the brand concerned, then \( f_{vb} = f_v \) and

\[
c^*_v = m_{vb}/\Sigma f_j M_j. \]

In that case the relative cost of handling items of the \( v \)-th variety type can be written,

\[
C^*_v = \frac{\Sigma c^*_v}{b} = \frac{\Sigma f_v m_{vb}/\Sigma f_j M_j}{b} = f_v M_v/\varphi, \tag{22}
\]

where \( \varphi \) stands for the weighted mean of the unit costs of replenishment.
Substituting (22) into the formula for the space to be allocated to the \( v \)-th variety-type, defined by \( S_{v}^{II} \) in figure 3, we get

\[
S_{v} = (f_{v}/\phi)M_{v} + (1 - \theta) \beta^{*} (R_{v} - M_{v}),
\]

where \( \beta^{*} = \beta/(\sum b c_{vb}) = \beta(s/P Q) \).

Now if we let \( \omega_{1} = (1 - \theta) \beta^{*} \) and \( \omega_{2} = (f_{v}/\phi) - \omega_{1} \), the following relationship is arrived at,

\[
S_{v} = \omega_{1} R_{v} + \omega_{2} M_{v}.
\]

Since (24) is derived from (17) on the basis of the equi-repartition of the selling area, it constitutes a reasonable approximation to the optimal allocation. As will be shown numerically hereafter, it will in fact provide us with a solution close to the best one.

Thus (24) throws light on a rather simple and interesting interpretation of the optimization result. It now appears as a **linear combination of the two most regularly used rules-of-thumb** : on one hand the allocation strictly proportional to the relative contribution to the assortment profitability \( (R_{v}) \), and on the other hand the allocation determined in direct proportion to the relative sales volume \( (M_{v}) \). On examining the coefficients, one realizes that \( \omega_{1} \) will most often lie in the \([0,1]\)-range and in cases where variations in the packaging of the goods are negligible (i.e. when \( f_{v} = \phi \)), they will add up to one so that (24) can almost be assimilated with a weighted mean of the two ratios.
The incidence of the degree of asymmetry is quite clear: the higher it is, the heavier the relative weight attached to the sales share ratio. This confirms the emerging pre-eminence of handling cost effects as asymmetry becomes more pronounced.

Actual determination of the true optimum calls for sophisticated techniques designed for solving complex systems of non-linear equations. To circumvent a similar difficulty met with SH.A.R.P.I, B & N have suggested a heuristic approach which, adapted to our problem, consists of exploring system (17) iteratively, with the equi-repartition as the arbitrary initial allocation: the allocation derived at one stage is fed back into the formula to determine the next (hopefully better) allocation. However rudimentary such a heuristic might seem, it was proved to converge rapidly towards excellent solutions.

When extended and applied in our case, it performs reasonably well. Table 2 introduces an hypothetical, yet fairly realistic, example of a 12-item assortment, with 4 brands each presented in 3 different variety-types. The values chosen for the key-parameters, $\beta$ and $\theta$, are those estimated for CORA-DISTRIMAS.

In order to make the meaning of the results intuitively obvious, the basic attraction coefficients ($\alpha_{vb}$), determining the item's sales shares when their visibility is identical to each other's, have all been set equal to 1.00. Only the unit gross margins are differentiated, and by quite a
substantial amount, in fact. Although the cost figure used for all variety-types may appear large when compared with profit, it represents slightly more than 63% of the net margin (in practice it might well exceed 70%).

The optimal space allocations produced by three different vectors \([\hat{\theta}, \theta]\) of parameter estimates are compared in table 3. The top one (bold-face) is generated by the unbiased estimates: \([\hat{\theta} = 0.38; \theta = 0.61]\); the second and third allocations correspond to cases where the retailer ignores the existence of asymmetries and either uses all the information available: \([\hat{\theta} = 0.524; \theta = 0]\), or only a subsample: \([\hat{\theta} = 0.698; \theta = 0]\). Starting by focusing on the third allocation, one easily verifies that the most profitable items get the largest space shares; i.e., those offered by the fourth brand (which gets 32.4% against 23.1% for brand 1) and of the third variety-type (which gets 58.2% against 14.9% for type 1). A similar pattern of space repartition is, of course, observed in both other cases but as the visibility parameter \(\theta\) decreases and asymmetry takes place the dispersion of the space distribution gets reduced (smoothing effect). Thus the third variety-type obtains only 35.3% of the available space when asymmetry enters the picture, instead of the 45.8% it would be entitled to if asymmetry could be disregarded.

Insert table 3 about here

Similarly to what B & N observed with SH.A.R.P. I the allocation derived from the first iteration already defines a satisfactory solution: it yields 70.4% of the total profit increment to be expected from the optimization. Yet, from a pragmatic point of view the question must be
raised whether it pays for a retailer to care at all about asymmetry. This issue is addressed in table 4 where we measure the opportunity loss incurred by a "myopic" retailer - i.e., a retailer who completely neglects the asymmetry.

The first row in this table gives the maximum profit that would be reached when implementing the truly optimal allocation, i.e. based on the best, unbiased estimated derived from the experiment. In contrast, other rows show at which levels the retailer's profit would be limited should he allocate the space available using the less reliable estimates. Thus if asymmetry prevails as significantly as in the CORA-DISTRIMAS case, the retailer's "myopism" could cost him between 3.5 % and 20 % of his net profit. The relative importance of this opportunity loss can best be evaluated by comparison to the negligible incidence of the sampling error, reflected in the 0.07 % difference observed when only the first half of the data collected during the experiment is used.

8. Conclusion

Even though the experiment from which the data was drawn was not designed specifically for this purpose, the detected impact of asymmetry was not only statistically significant but it also affected the space allocation to a non-negligible extent. Therefore we believe that additional experiments, deliberately designed for capturing the effects of asymmetries, are likely to substantiate our first conclusions.
As a direction for future research, let us suggest a thorough examination of rules-of-thumb currently used by retailers for space allocation purposes. To be sure, B & N (1988) have clearly established that SH.A.R.P. I optimal allocation formula outperforms proportionality-to-sales (or to profit-margins) norms ... at least, in cases where asymmetry can safely be assumed away! But since we have just demonstrated here that asymmetry smoothes (or dampens down) the allocation, one may wonder whether such simplistic rules might be rehabilitated in some instances.
SALES DISTRIBUTION

Visibility = 2.0  Asymmetry = 0.9

Figure 1a
Figure 1b

SALES DISTRIBUTION

Visibility=2.0  Asymmetry=0.75

[Graph showing the sales distribution with specific data points and lines representing different items and brands.]
Figure 2. Structure of Elasticities and Cross-elasticities

<table>
<thead>
<tr>
<th>Brands</th>
<th>Variety types</th>
<th>Source of asymmetry</th>
<th>Elasticities/Cross-elasticities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>General: $\theta_1 \neq 0, \theta_2 \neq 0$</td>
<td>$\beta[(1 - m_{vb}) - \theta_1 \mu_{vb} + \theta_2 \mu_{v}.b(1 - M_.b)]$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brand: $\theta_1 = 0, \theta_2 = 0$</td>
<td>$\beta[(1 - m_{vb}) - \theta_1 \mu_{vb} + \frac{1}{M_.b}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Variety: $\theta_1 = 0, \theta_2 = 0$</td>
<td>$\beta[(1 - m_{vb}) - \theta_1 \mu_{vb} + \frac{1}{M_.b}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>General: $\theta_1 \neq 0, \theta_2 \neq 0$</td>
<td>$-\beta[m_{vb} - \theta_1 \mu_{vb} + \frac{1}{M_.b} \mu_{v}.b(1 - M_.b)]$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brand: $\theta_1 = 0, \theta_2 = 0$</td>
<td>$-\beta m_{vb} [1 + \theta {(1 - M_.b)/M_.b]$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Variety: $\theta_1 = 0, \theta_2 = 0$</td>
<td>$-\beta m_{vb} [1 - \theta]$</td>
</tr>
<tr>
<td>Brands</td>
<td>Variety types</td>
<td>Source of asymmetry</td>
<td>Elasticities/Cross-elasticities</td>
</tr>
<tr>
<td>--------</td>
<td>---------------</td>
<td>---------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>General: $\theta_1 \neq 0, \theta_2 \neq 0$</td>
<td>$-\beta_{vb} + \theta_1 \mu_b[v_v(1 - M_v) - \theta_2 \mu_v].b M.b]$</td>
</tr>
<tr>
<td></td>
<td>$v = j$</td>
<td>Brand: $\theta_1 = 0, \theta_2 = 0$</td>
<td>$-\beta_{vb}[1 - \theta]$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Variety: $\theta_1 = 0, \theta_2 = 0$</td>
<td>$-\beta_{vb}[1 + 0 ((1 - M_v)/M_v)]$</td>
</tr>
<tr>
<td>$b \neq c$</td>
<td></td>
<td>General: $\theta_1 \neq 0, \theta_2 \neq 0$</td>
<td>$-\beta_{vb} - \theta_1 \mu_b[v_v M_v - \theta_2 \mu_v].b M.b]$</td>
</tr>
<tr>
<td>$v \neq j$</td>
<td></td>
<td>Brand: $\theta_1 = 0, \theta_2 = 0$</td>
<td>$-\beta_{vb}[1 - \theta]$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Variety: $\theta_1 = 0, \theta_2 = 0$</td>
<td>$-\beta_{vb}[1 - \theta]$</td>
</tr>
</tbody>
</table>
Table 1. Econometric Analysis of Experimental Results
Package-size asymmetry

Table 1a. Pooled 3-period sample (n=40)

<table>
<thead>
<tr>
<th>Promotion</th>
<th>Visibility</th>
<th>Asymmetry</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\gamma$</td>
<td>$\beta$</td>
<td>$\theta$</td>
<td></td>
</tr>
<tr>
<td>No asymmetry</td>
<td>0.0341</td>
<td>0.5240</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0.0046)</td>
<td>(0.1509)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.4549</td>
<td>3.4718</td>
<td></td>
</tr>
<tr>
<td>Final iteration</td>
<td>0.0399</td>
<td>0.3799</td>
<td>0.6120</td>
</tr>
<tr>
<td></td>
<td>(0.0048)</td>
<td>(0.1512)</td>
<td>(0.2321)</td>
</tr>
<tr>
<td></td>
<td>8.2396</td>
<td>2.5123</td>
<td>2.6369</td>
</tr>
</tbody>
</table>

Table 1b. Period 2 versus period 1 (n = 20)

<table>
<thead>
<tr>
<th>Promotion</th>
<th>Visibility</th>
<th>Asymmetry</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\gamma$</td>
<td>$\beta$</td>
<td>$\theta$</td>
<td></td>
</tr>
<tr>
<td>No asymmetry</td>
<td>0.0257</td>
<td>0.6981</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0.0054)</td>
<td>(0.2625)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.7598</td>
<td>2.6589</td>
<td></td>
</tr>
<tr>
<td>Final iteration</td>
<td>0.0345</td>
<td>0.4814</td>
<td>0.8426</td>
</tr>
<tr>
<td></td>
<td>(0.0058)</td>
<td>(0.2467)</td>
<td>(0.2988)</td>
</tr>
<tr>
<td></td>
<td>5.9857</td>
<td>1.9518</td>
<td>2.8199</td>
</tr>
</tbody>
</table>
Table 2. Values Assigned to the Fixed Parameters

1. Assortment: 12 items, i.e. 4 brands x 3 variety types

### Unit Gross Margins

\( (g_{vb}) \)

### Assortment's width

<table>
<thead>
<tr>
<th>Variety type (v)</th>
<th>Brand (b)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Brand's mean (( \tilde{g}_b ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variety's mean</td>
<td>( \tilde{g}_v )</td>
<td>11.5</td>
<td>15.5</td>
<td>19.5</td>
<td>15.5</td>
</tr>
</tbody>
</table>

2. Preference factors: \( a_{vb} = 1.00 \), for all \( v \)'s and \( b \)'s
3. Replenishment costs: \( f_v = 5,000 \), for all \( v \)'s
4. Unbiased estimates of the visibility and asymmetry parameters: \( \beta = 0.38 \) and \( \theta = 0.61 \)
Table 3. Comparison of Allocations

<table>
<thead>
<tr>
<th>Variety type (v)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>$S_{vb}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brand (b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.0727</td>
<td>0.0770</td>
<td>0.0816</td>
<td>0.2313</td>
</tr>
<tr>
<td></td>
<td>0.0501</td>
<td>0.0690</td>
<td>0.0987</td>
<td>0.2178</td>
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<tr>
<td></td>
<td>0.0307</td>
<td>0.0515</td>
<td>0.1040</td>
<td>0.1862</td>
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<tr>
<td>2</td>
<td>0.0765</td>
<td>0.0810</td>
<td>0.0858</td>
<td>0.2433</td>
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<tr>
<td></td>
<td>0.0540</td>
<td>0.0752</td>
<td>0.1085</td>
<td>0.2377</td>
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<tr>
<td></td>
<td>0.0344</td>
<td>0.0603</td>
<td>0.1274</td>
<td>0.2221</td>
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<tr>
<td>3</td>
<td>0.0804</td>
<td>0.0852</td>
<td>0.0903</td>
<td>0.2559</td>
</tr>
<tr>
<td></td>
<td>0.0585</td>
<td>0.0822</td>
<td>0.1193</td>
<td>0.2600</td>
</tr>
<tr>
<td></td>
<td>0.0389</td>
<td>0.0715</td>
<td>0.1570</td>
<td>0.2674</td>
</tr>
<tr>
<td>4</td>
<td>0.0847</td>
<td>0.0897</td>
<td>0.0951</td>
<td>0.2695</td>
</tr>
<tr>
<td></td>
<td>0.0634</td>
<td>0.0900</td>
<td>0.1312</td>
<td>0.2846</td>
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<td></td>
<td>0.0445</td>
<td>0.0858</td>
<td>0.1940</td>
<td>0.3243</td>
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</table>

$S_{v}$.  

<table>
<thead>
<tr>
<th></th>
<th>0.3143</th>
<th>0.3329</th>
<th>0.3528</th>
<th>1.000</th>
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<tr>
<td></td>
<td>0.2260</td>
<td>0.3164</td>
<td>0.4577</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.1485</td>
<td>0.2691</td>
<td>0.5824</td>
<td></td>
</tr>
<tr>
<td>Assumed parameter estimates</td>
<td>Profit/cost</td>
<td>Opportunity loss</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------------------</td>
<td>------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1. Unbiased estimates using the full information available</td>
<td>$\beta = 0.38 ; \theta = 0.61$</td>
<td>190,471.0/120,469.5</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>1.2. Estimates derived from the first two periods</td>
<td>$\beta = 0.48 ; \theta = 0.84$</td>
<td>190,343.1/120,603.8</td>
<td>0.067 Z</td>
<td></td>
</tr>
<tr>
<td>2. Myopism in the full information case</td>
<td>$\beta = 0.524 ; \theta = 0.00$</td>
<td>184,152.2/129,465.7</td>
<td>3.431 Z</td>
<td></td>
</tr>
<tr>
<td>3. Myopism in the limited information case</td>
<td>$\beta = 0.698 ; \theta = 0.00$</td>
<td>158,486.7/158,501.0</td>
<td>20.181 Z</td>
<td></td>
</tr>
</tbody>
</table>
FOOTNOTES

1 As defined by B & N, \( \Pi \) differs from the actual profit in that the marginal handling cost gets substituted for its average (per unit sold). Of course, the items' sales volumes have to be measured in homogeneous "equivalent" units (taking into account differences in product forms and package sizes).

2 While for a manufacturer, cannibalism usually means substitution between items within his own brand's line, for a retailer it covers also the struggle between the competitive brands supplied by the various manufacturers with whom he is dealing.

3 To typify the various competitive market situations, see e.g., Triffin (1940), Bishop (1952, 1955) and Hieser (1955). It should be noted, however, that their conception of asymmetry differs from ours: while we consider that it implies \( \eta(m_{jb}, s_{vb}) \neq \eta(m_{vc}, s_{vb}) \), they usually mean that \( \eta(m_{jb}, s_{vb}) \neq \eta(m_{vb}, s_{jb}) \). Note that were we to adopt their idea, the simple basic attraction model (i.e. \( \theta_1 = \theta_2 = 0 \)) would have to be regarded as an asymmetric specification.

4 Usually high \( R^2 \) are obtained in time series analyses and lower ones for cross-sections. It should further be realized that we voluntarily opted for a transformation which should clear out the estimates of the spurious correlation that across-item differences (within a given period) might produce: \((21) \) really catches hold of the causal relationship between over-time action changes and sales response.

5 All profit levels are calculated under the assumption that \( \beta = 0.38 \) and \( \theta = 0.61 \) are the true parameter values.
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Triffin, Robert (1941), Monopolistic Competition and General Equilibrium Theory, Harvard University Press (Cambridge, Mass.).


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<tr>
<th>Year</th>
<th>Author(s)</th>
<th>Title</th>
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<td>1986</td>
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<tr>
<td>86/01</td>
<td>Arnoud DE MEYER</td>
<td>&quot;The R &amp; D/Production interface&quot;.</td>
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<td>86/02</td>
<td>Philippe A. NAERT and Marcel WEVERBERGH and Guido VERSWIJVEL</td>
<td>&quot;Subjective estimation in integrating communication budget and allocation decisions: a case study&quot;, January 1986.</td>
</tr>
<tr>
<td>86/03</td>
<td>Michael BRIM</td>
<td>&quot;Sponsorship and the diffusion of organizational innovation: a preliminary view&quot;.</td>
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<td>Spyros MAKRIDAKIS and Michèle BIDON</td>
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<td>86/08</td>
<td>José de la TORRE and David H. NECKAR</td>
<td>&quot;Forecasting political risks for international operations&quot;, Second Draft: March 3, 1986.</td>
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<td>86/10</td>
<td>R. MOENART, Arnoud DE MEYER, J. BARBE and D. DESCHOOLMEESTER.</td>
<td>&quot;Analyzing the issues concerning technological de-maturity&quot;.</td>
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<td>86/11</td>
<td>Philippe A. NAERT and Alain BULTEZ</td>
<td>&quot;From &quot;Lydiametry&quot; to &quot;Pinkhamization&quot;: misspecifying advertising dynamics rarely affects profitability&quot;.</td>
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<td>86/12</td>
<td>Roger BEANTCOURT and David GAUTSCHI</td>
<td>&quot;The economics of retail firms&quot;, Revised April 1986.</td>
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<td>S.P. ANDERSON and Damien J. NEVEN</td>
<td>&quot;Spatial competition à la Cournot&quot;.</td>
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<td>&quot;How the managerial attitudes of firms with FMS differ from other manufacturing firms&quot;.</td>
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