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MODELING OF MANUFACTURER AND RETAILER COOPERATIVE INCOME CONSIDERING ADVERTISING COSTS

The paper represents logical block diagram of cooperative advertising costs adjustment in manufacturer and retailer's logistics chain. Manufacturer and retailer's joint interaction profit is considered provided linear demand function and nonlinear response function of advertising expenditures. Dimensionless variables system is introduced to form cooperative income function.

Keywords: income, optimization, dimensionless, cooperative advertising.

Introduction. Current period is characterized by rapid changes in market situation that affect business relationships and their joint construction. For example, the problem of relations between managers of supplier company if this corporate client at the same time is the main competitor of the company; or the leader's challenge to choose strategic position of the company if the situation in the individual market segments varies each quarter; or how to choose a successful approach to enter credit market for regional bank to find new sources of high customer demand.

In recent economic literature a general model of stable relationships that must consider a wide range of circumstances are developed and the need in specialized theories are determined [1].

The problem setting. Marketing optimization campaign is the driving force of market economic system effective functioning. In this regard, marketing manager's fundamental challenge is to identify wholesale and retail prices formation principles and their correlation. Thus, pricing strategy is a system of organizational, technical and financial challenges aimed at intensifying product sales, increasing its competitiveness, influence on demand and supply. This strategy provides sales and market control to maintain prices, which provide best returns.

It is embodied in the program of activities to improve the promotion, distribution and sale of products in order to ensure sustainable profits [1].

Wholesale trade evaluates behavior within the manufacturer's vertical sales system through possible independent retailers and creates conditions for different pricing schemes implementation. Discount schemes for buying large quantities of goods usually consist of two parts [2]. Since the price determines the amount of sales and income level of the enterprise, price control mechanisms should achieve coordination and synergy.

Analysis of recent studies. Research of pricing mechanisms have always been relevant in conditions of market economic relations development. Effective pricing strategy issues have largely been investigated by such foreign and domestic scholars, as Starostina A.O. [3], Moroz L.A., Chukhrai N.I.[4], Wind and Lilien [5], Yue J., Huang Z.[6], etc. They studied mainly the role of pricing in marketing and in vertical cooperative advertising, its effectiveness in cost allocation between manufacturer and seller through brand investment, local advertising costs.

Traditionally, cooperative advertising determines the level of effective coordination in the data flow channel between the manufacturer and the seller and partially or fully provides costs compensation between interacting partners. Therefore, development of new techniques for joint promotional programs is an actual problem.

Let us consider the logistics connection chain: manufacturer – company – seller, who buys goods from the manufacturer. Manufacturer is significant and large market leader and spends money on his products national advertising (TV, radio, Internet, newspapers, magazines, posters, billboards, etc.). Such enterprise's national advertising campaign is aimed at strengthening the brand image for the national market potential customers and forms their purchasing values. There are two types of advertising: national and local. National advertising gives to manufacturer the effort to promote his products in domestic market [7]. Local advertising is more utilitarian way to promote product than national one. It encourages consumers to buy goods in local store in the nearest future and creates demand only at the local level.

The main problem of active elements interaction on market is stability and permanence of relations between large enterprises – product manufacturer and retailer. The complexity of this problem is that businesses must be confident that this interaction is beneficial for them. In this regard, the urgent problem is reasonable distribution of advertising costs between manufacturer and retailer. It is assumed that market demand is not only influenced by the retail price policy, but also by an advertising level of manufacturer and its salesperson.

The aim of the paper is to consider advertising cost in the cooperative income function forming.

Basic material. For example, the channel chooses a single retailer to sell the manufacturer's product, and this retailer sells only this brand name product within the class – product [8]. Manufacturer establishes strong relationships with retailer which is caused by the establishment of x_v – manufacturer's transfer price per unit for retailer. In turn, the seller sets a price x_R – per unit based on the unit cost in retail trade, as well as manufacturer transfer price.

Fig. 1 shows the logical block diagram of logistic cooperation between manufacturer and retailer in order to maximize income from cooperative advertising costs adjustments. It shows the structure of advertising costs distribution between two companies. Enterprises are represented as a set of costs center and profit subcenters, which together represent profit

center. Transactions between entities are done due to the amount of accrued expenses. Each costs center is represented by profit center. Management in this case is done through cost control system.

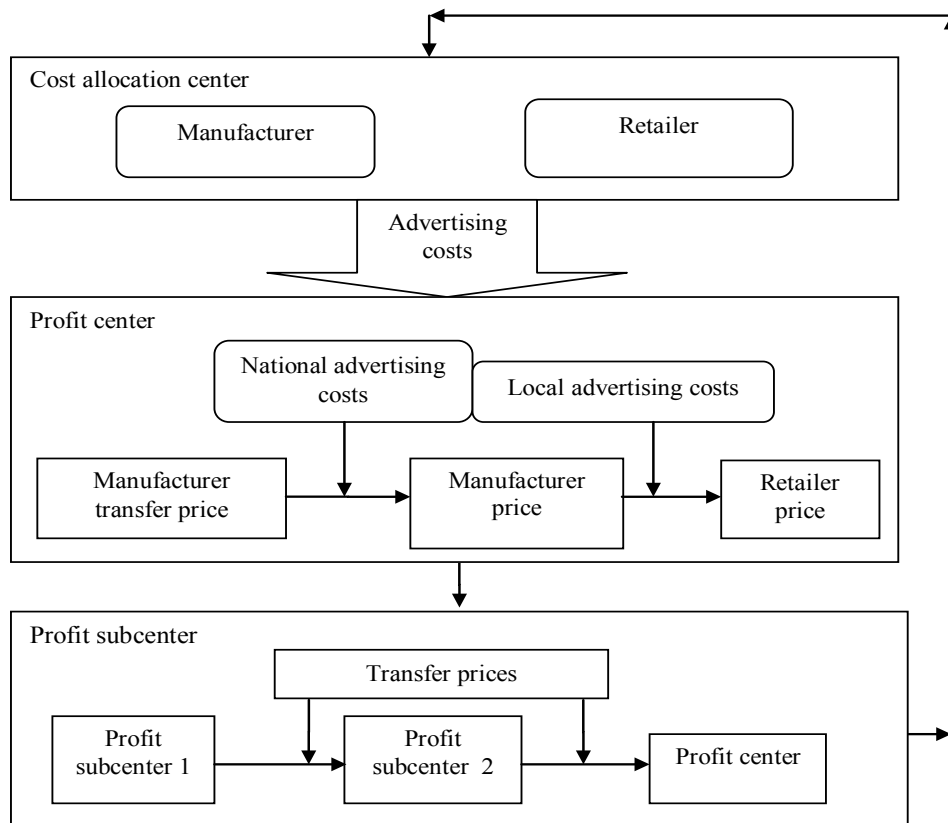


Figure 1 – Cooperative advertising costs correction in the manufacturer and retailer logistics chain

The premise supporting such relationship is that both the manufacturer and the retailer could be better off than before. Just-in-time purchasing, collaborative planning, vendor managed inventory (VMI), third party logistics (3PL), cooperative (co-op) advertising and collaborative product development are widely used as inter-organizational coordination mechanisms to improve product quality, reduce supply risk and cost and facilitate information and profit sharing [9].

Co-op advertising is an important instrument for aligning manufacturer and retailer decisions in supply chain. In this, the manufacturer announces a co-op advertising policy, i.e., a participation rate that specifies the percentage of the retailer's advertising expenditure that it will provide. In addition, it also announces the wholesale price. In response, retailer chooses his optimal advertising and pricing policies [10].

Numerical methods for qualitative analysis and coordinated policies structure participation allow the application of proposed model in many supply chain planning strategies and control methods. The relevance of the problem is that it can be used as a supplement, as optimizer for strategy planning and decision-making system.

In [11] it is proposed to consider demand function as a liner with statistically determined parameters:

$$f(x_R) = a - \beta \cdot x_R, \quad a, \beta \in R. \quad (1)$$

In [12] advertising assignments reaction function $\varphi(a, q)$ with two variables was proposed: q – manufacturer national advertising costs; a – seller's level of advertising costs:

$$\begin{cases} \varphi(a, q) = A - \frac{B}{a^\gamma q^\delta}, & A, B > 0, \\ a, q > 0, \\ \gamma + \delta = 1. \end{cases} \quad (2)$$

The parameters $\alpha, \beta, B, \gamma, \delta$ are positive constants, and $A > 0$ is the sales saturate asymptote. Where $\alpha - \beta \cdot x_R$ is the dependence of demand on retailer price and $A - \frac{B}{a^\gamma q^\delta}$ is the influence of advertising level on sales.

Thus, we have the income formula for the manufacturer D_v (formula 3) and for retailer D_R (formula 4):

$$D_v = (x_v - c) \cdot (a - \beta \cdot x_R) \cdot \left(A - \frac{B}{a^\gamma q^\delta} \right) - t \cdot a - q, \quad (3)$$

$$D_R = (x_R - x_v - d) \cdot (a - \beta \cdot x_R) \cdot \left(A - \frac{B}{a^\gamma q^\delta} \right) - (1 - t) \cdot a. \quad (4)$$

In this formulas t is advertising costs, which the manufacturer agrees to share with the seller; c – manufacturer unit cost; d – the retailer's unit cost incurred in addition to the purchasing cost.

Let us consider manufacture and retailers cooperation profit $D_v + D_R$ in two ways (formulas 5 and 6):

$$\begin{aligned} D_{v+R} &= (x_v - c) \cdot (a - \beta \cdot x_R) \cdot \left(A - \frac{B}{a^\gamma q^\delta} \right) - t \cdot a - q + (x_R - x_v - d) \cdot (a - \beta \cdot x_R) \cdot \left(A - \frac{B}{a^\gamma q^\delta} \right) - \\ &- (1 - t) \cdot a = (x_R - c + x_v - d) \cdot (a - \beta \cdot x_R) \cdot \left(A - \frac{B}{a^\gamma q^\delta} \right) - t \cdot a - q - a + t \cdot a; \end{aligned} \quad (5)$$

$$D_{v+R} = (x_v - c - d) \cdot (a - \beta \cdot x_R) \cdot \left(A - \frac{B}{a^\gamma q^\delta} \right) - a - q. \quad (6)$$

Let us introduce the following system:

$$\left\{ \begin{array}{l} a' = \alpha - \beta \cdot (c+d), \quad x'_R = \frac{\beta}{\alpha} (x_R - (c+d)), \\ x'_V = \frac{\beta}{\alpha} (x_V - c), \\ q' = q \cdot (B')^{\frac{1}{\gamma+\delta+1}}; \quad a' = \alpha \cdot (B')^{\frac{1}{\gamma+\delta+1}}; \\ D'_V = D_V \cdot (B')^{\frac{1}{\gamma+\delta+1}}; \quad D'_V = D_V \cdot (B')^{\frac{1}{\gamma+\delta+1}}; \\ \frac{\alpha^2}{\beta} A = A'; \quad \frac{\alpha^2}{\beta} B = B'. \end{array} \right. \quad (7)$$

Applying formula (7) to formula (3), we obtain a manufacturer income function in dimensionless form:

$$D'_V = x'_V \cdot (1 - x'_R) \cdot \left(\frac{A'}{(B')^{\frac{1}{\gamma+\delta+1}}} - \frac{1}{a^\gamma q^\delta} \right) - t \cdot a' - q'. \quad (8)$$

Applying formula (7) to formula (4), we obtain a retailers income function in dimensionless form:

$$D'_R = (x'_R - x'_V) \cdot \left(\frac{A'}{(B')^{\frac{1}{\gamma+\delta+1}}} - \frac{1}{a^\gamma q^\delta} \right) - (1 - t) \cdot a'. \quad (9)$$

Regarding joint income function, we multiply left and right parts of formula (5) at $(B')^{\frac{1}{\gamma+\delta+1}}$. Then we have:

$$D \cdot (B')^{\frac{1}{\gamma+\delta+1}} = \left((x_V - c - d) \cdot (\alpha - \beta \cdot x_R) \cdot \left(A - \frac{B}{a^\gamma q^\delta} \right) - \alpha - q \right) \cdot (B')^{\frac{1}{\gamma+\delta+1}}. \quad (10)$$

Or considering formula (7):

$$\begin{aligned} D' &= \frac{\beta}{\alpha} (x_R - c - d) \cdot \frac{\alpha - \beta x_R}{\alpha} \cdot \frac{\alpha^2}{\beta} \left(A \cdot (B')^{\frac{1}{\gamma+\delta+1}} - \frac{B \cdot (B')^{\frac{1}{\gamma+\delta+1}}}{a^\gamma q^\delta} \right) - \alpha \cdot (B')^{\frac{1}{\gamma+\delta+1}} - q \cdot (B')^{\frac{1}{\gamma+\delta+1}} = \\ &= x'_R \left(\frac{\alpha}{\alpha'} - \frac{\beta}{\alpha'} \cdot x_R + \frac{\beta}{\alpha'} (c+d) - \frac{\beta}{\alpha'} (c+d) \right) \cdot \left(\frac{A'}{(B')^{\frac{1}{\gamma+\delta+1}}} - \frac{1}{a^\gamma q^\delta} \right) - a' - q' = \\ &= x'_R \left(\frac{\alpha - \beta(c+d)}{\alpha'} - \frac{\beta}{\alpha'} \cdot (x'_R - (c+d)) \right) \cdot \left(\frac{A'}{(B')^{\frac{1}{\gamma+\delta+1}}} - \frac{1}{a^\gamma q^\delta} \right) - a' - q'. \end{aligned} \quad (11)$$

The final manufacturer and retailer joint income function in dimensionless form looks like:

$$D' = x'_R (I - x'_R) \cdot \left(\frac{A'}{(B')^{\gamma + \delta + 1}} - \frac{I}{a^\delta q^\delta} \right) - a' \cdot q'. \quad (12)$$

Thus, due to the introduction of dimensionless variables (7), manufacturer and retailer income functions, as far as joint income functions in dimensionless form are represented by formulas (8), (9), (12).

Conclusions. Basing on the manufacturer and retailer joint income function in dimensionless form, we can solve the problem of choosing parameter values for profit maximization. The main result of cooperative advertising is trademark securing and increasing of sales in short terms.

Described model presents the interaction of advertising costs and transfer prices aimed at efficient work of profit subcenters. This is achieved by setting transfer prices for product to be handed from one profit subcenter to another. As a result – there is a challenge for each profit subcenter. Consequently, the result for subcenters managers is profit forming that allows to formulate the priorities in costs management.

Prospects for the next studies is in search of geometric solution in form of two variables surface, ways to maximize profit for specific enterprises using not only national advertising but also cooperative one with retailer.

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А.О. Завірюха, Т.В. Блудова. Моделювання кооперативного прибутку виробника та рітейлера з урахуванням рекламних витрат

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Моделювання кооперативного прибутку виробника та рітейлера з урахуванням рекламних витрат

У статті приведена логічно-структурна схема корегування сумісних витрат на рекламу в логістичному ланцюжку підприємства-виробника та підприємства роздрібної торгівлі. Розглянуто прибуток сумісної взаємодії підприємства-виробника та підприємства роздрібної торгівлі за умови лінійності функції попиту та нелінійної функції реакції рекламних асигнувань. Уведено систему безрозмірних змінних для формування функції сумісного доходу.

Ключові слова: прибуток, оптимізація, безрозмірний, кооперативна реклама.

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Моделирование кооперативной прибыли производителя и ритейлера с учетом рекламных отчислений

В статье приведена логическая структурная схема корректировки совместных затрат на рекламу в логистической цепочке предприятия-изготовителя и предприятия розничной торговли. Рассмотрены прибыль совместного взаимодействия предприятия-изготовителя и предприятия розничной торговли при условии линейности функции спроса и нелинейной функции реакции рекламных ассигнований. Введена система безразмерных переменных для формирования функции совместного дохода.

Ключевые слова: прибыль, оптимизация, безразмерный, кооперативная реклама.

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