

IMPACT OF CONSUMER PREFERENCES ON FOOD CHAIN CHOICE: AN EMPIRICAL STUDY OF CONSUMERS IN BRATISLAVA

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Abstract

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The objective of this paper is to highlight the use of multiple criteria evaluation methods as a tool for the rating and selection of retail chains from the customers and suppliers perspective. We provide an assessment on the attractiveness of active retail chains on the Slovak market through multiple criteria methods used for the analysis of customer preferences.

An analysis was conducted on a sample of consumers in Bratislava involving 11 389 respondents interviewed. The multi-attribute decision-making methods PROMETHEE II and V were used to assess the variants. In the first part of analysis the collected data uncover customers' preferences in the selection of retail chains. Findings suggest a ranking of evaluated retail chains and thus of customer preferences.

Based on the obtained evaluation, in the second part of analysis, a set of retail chains was chosen under constraints concerning the effectiveness of advertising, market share of sales and the maximum number of chosen retail chains and a binary linear programming model was formulated as an outcome. Proposed procedure aims to assist the decision maker in selecting which retail chain to choose for distribution of supplier's products, and thus maximize benefits, which will result from consumer preferences and service satisfaction level in retail chain.

Keywords: Consumer preferences, food chain, store choice, multi-attribute decision-making problems, binary linear programming models

INTRODUCTION

Retail markets are highly saturated which stresses the need for managers to understand the existing competitive structure for putting in place strategies, which will allow retail chains to survive (Križan, Bilková, Kita, 2014; Sinha, 2000).

An important shift in many European retail markets has been in terms of acquisitions, joint ventures and mergers in the last few years. These have made it possible for market leaders to enter countries where access was difficult. However, Slovakia has its own specifics from other central European countries. An important specificity is

the imbalance between foreign retailers and weaker national retailers (Colla, 2004).

Retailers in general focus on their effort to attain economies of scale and an improved asset utilization all with the goal of satisfying demanding needs and wishes of consumers (Thang, Tan, 2003).

Consumers on the other hand are influenced by numerous elements in their choice of a grocery store (Thang, Tan, 2003). Research realized in this area has demonstrated that their loyalty to one specific store is at a low level and their decision making process when deciding for a grocery store is not repetitive (Keng and Ehrenberg 1984; Ehrenberg, Uncles

and Goodhardt, 2004; Leszczyc and Timmermans, 1997).

Consumers' reactions to a rapidly changing retail environment will depend upon their preferences and the environment in which they are made. As stressed by Leszczyc, Sinha and Timmermans (2000), for the retailers, the problem is how to cope with the increased competition in light of the dynamics of consumer shopping behavior (see also Maryáš, *et al.* 2014). We address this topic by proposing a unique view on consumer preferences based on six factors: purchase time of customers, customers' willingness to travel to supermarkets, customers' dissatisfaction of any kind with the supermarkets (share of customers wishing for improvement), improvements noticed by customers, effectiveness of advertising through leaflets and the market share of sales. This will be made under predefined constraint assumptions on the advertising effectiveness, market share of sales and the number of chosen retail stores. As a result of the analysis of consumer preferences and service satisfaction, a recommendation to retail investors will be stated for cooperation with chosen retail chains under given constraints (Pohekar, Ramachandran, 2004). The analysis will be made through multi-attribute decision-making methods.

MATERIALS AND METHODS

The multi-attribute decision-making methods were used as the main scientific methods. Multicriteria decision-making problems can be divided into certain main groups according to the definition of the feasible set of alternatives. The first is the case when we have a finite number of criteria, but the number of feasible alternatives is infinite (the alternatives being determined by the system of the requirements constraints). These problems belong to the field of multiple criteria optimization. On the other hand, the type of problem, when the number of criteria and alternatives is finite, and the alternatives are explicitly given, are called multi-attribute decision-making problems (MDMP). The theory of MDMP is very well-established, and the possibilities of real applications (evaluation of investment alternatives, evaluation of the credibility of bank clients, the rating of companies, consumer goods evaluation and many others) are very large. We know relatively many different methods e.g. PROMETHEE, ELECTRE, (see e.g. Leyva-Lopez, Fernandez-Gonzalez, 2003; Cheng *et al.* 2014). The multi-attribute decision-making problem is usually defined by a criterion matrix as shown below:

$$\begin{matrix} & Y_1 & Y_2 & \dots & Y_k \\ \begin{matrix} X_1 \\ X_2 \\ \vdots \\ X_n \end{matrix} & \begin{bmatrix} y_{11} & y_{12} & \dots & y_{1k} \\ y_{21} & y_{22} & \dots & y_{2k} \\ \vdots & \vdots & \ddots & \vdots \\ y_{n1} & y_{n2} & \dots & y_{nk} \end{bmatrix} \end{matrix} \quad (1)$$

where $X_1, X_2, \dots, X_n$ is the set of n alternatives,
 $Y_1, Y_2, \dots, Y_k$ is the set of k criteria,
 y_{ij} is the criterion value of the alternative X_i ,
 $i = 1, 2, \dots, n, j = 1, 2, \dots, k$.

In the matrix, each column belongs to a criterion and each row describes the performance of an alternative, i.e. each element of the matrix y_{ij} is a single numerical value representing the performance of alternative i on criterion j . The essential part of the multi-attribute decision-making problem is setting the type of the criteria (minimization or maximization) and assigning weights to the criteria. The weight w_i reflects the relative importance of the criteria and is assumed to be positive. The weights of the criteria are usually determined on a subjective basis. They represent the opinion of a single decision-maker or synthesize the opinions of a group of experts using a group decision technique as well. The main goal of the multi-attribute decision-making techniques can be complete or partial ranking of alternatives.

Multi-attribute decision-making methods are based either on the Multi-attribute Utility Theory or Outranking Methods (Behzadian *et al.*, 2010). In this paper, we focus on outranking methods. These methods are based on pair-wise outranking assessments and, having determined for each pair of alternatives whether one alternative outranks another, these pair-wise outranking assessments can be combined into a partial or a complete ranking (Corrente, *et al.*, 2013). The most popular families of the outranking method are ELECTRE, TOPISIS or PROMETHEE. In this paper, PROMETHEE II and V are used for our analysis of customers' preferences and also a customers' preferences model under constraints is presented. The PROMETHEE methods used in our analysis will be briefly outlined in the following section.

The implementation of the PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluation) method requires knowledge of the criterion matrix (1), weights of the criteria and preference functions of criteria with their parameters for measuring the strength of the preference of the pairs of alternatives with respect to the given criterion. The PROMETHEE method can provide a partial ranking of alternatives (PROMETHEE I) or complete alternative rankings (PROMETHEE II, III). The procedure of the PROMETHEE II method can be summarized as follows. First, the alternatives are compared in pairs for each criterion. The preference for the alternative is expressed by a number from the interval [0, 1] (0 for no preference or indifference and 1 for strict preference). The preference function F_i relating the difference in performance to preference is selected by the decision-maker. Next, a multicriteria preference index is formed for each pair of alternatives as a weighted average of the corresponding preferences for each criterion.

The index $\pi(X_i, X_j)$ expresses the preference of alternative X_i over alternative X_j considering all criteria and can be defined as:

$$\pi(X_i, X_j) = \frac{\sum_{i=1}^k w_i F_i(X_i, X_j)}{\sum_{i=1}^k w_i} \quad (2)$$

In order to rank the alternatives, the following precedence flows are defined:

Positive outranking flow:

$$\phi^+(X_i) = \frac{1}{n-1} \sum_{j=1}^k \pi(X_i, X_j) \quad (3)$$

Negative outranking flow:

$$\phi^-(X_i) = \frac{1}{n-1} \sum_{j=1}^k \pi(X_j, X_i) \quad (4)$$

The positive outranking flow expresses how much each alternative outranks all the others. The higher the positive outranking flow, the better the alternative and it represents the power of this alternative. The negative outranking flow expresses how much each alternative is outranked by all the others. The smaller the negative flow, the better the alternative and it represents the weakness of this alternative. The PROMETHEE II method provides a complete ranking of the alternatives according to the net outranking flow which is defined as follows:

$$\phi(X_i) = \phi^+(X_i) - \phi^-(X_i) \quad (5)$$

All alternatives are now comparable, the alternative with the highest $\phi(X_i)$ can be considered as the best one. The PROMETHEE I method offers a partial ranking based on the comparison of the positive and negative outranking flows.

The PROMETHEE II method is appropriate to select one alternative or when a ranking of alternatives is required. However, in some applications it is necessary to find an optimal selection of several alternatives, given a set of constraints. The PROMETHEE V method extends the PROMETHEE II method to this selection problem, i.e. optimization under constraints. The objective is to maximize the total net outranking flow value of the selected alternatives, at the same time being feasible to the constraints. Binary variables are introduced to represent whether an alternative is selected or not, and integer programming techniques are applied to solve the optimization problem (Figuera, Greco, Ehrgott 2005).

The PROMETHEE V method procedure can be summarized as follows:

Let $\{X_i, i=1,2,\dots,n\}$ be the set of possible alternatives and let us associate the following variables to them:

$$x_i = \begin{cases} 1 & \text{if } X_i \text{ is selected,} \\ 0 & \text{if not.} \end{cases} \quad (6)$$

The next two following steps are necessary:

STEP 1: The multicriteria problem is first considered without constraints. The PROMETHEE II ranking is obtained and computed net flows are used in the next step of the procedure.

STEP 2: The following model of linear programming is then considered in order to take into account the additional constraints:

$$\begin{aligned} & \max \left\{ \sum_{i=1}^n \phi(X_i) x_i \right\} \\ & \sum_{i=1}^n \tilde{e}_{p,i} x_i \sim \hat{a}_p \quad p = 1, 2, \dots, P \\ & x_i \in \{0, 1\} \quad i = 1, 2, \dots, n \end{aligned} \quad (7)$$

where $\sim$ holds for $=, \geq$ or $\leq$. The coefficients of the objective function (7) are the net outranking flows. The higher the net flow is, the better for the alternative. The constraints of this model can include such constraints as, e.g. budget, return, marketing, etc., and they can be related either to all alternatives or to some clusters. After having solved the formulated binary linear programming model, we obtain an alternative or a subset of alternatives satisfying the constraints and providing as much net flow as possible.

RESULTS

The purpose of this paper is to employ multi-attribute decision-making methods in customer preferences and service satisfaction analyses based on conducted survey. Analysed data are based on customer questionnaires carried out in the Bratislava region in 2011 (Grossmanová, Kita, Žambochová, 2015). To get the answers a standardized questionnaire was used. It was completed by 11 389 respondents shopping in the retail establishments located in individual parts of the town Bratislava. The respondents had to comply with the conditions – to have a permanent or temporary residence in Bratislava and to be at least 18 years old.

The PROMETHEE II method discussed above is used to analyse customers' preferences via different criteria most common retail chains operating in Slovakia in 2011 were chosen as variants. The variants chosen were the retail chains Albert, Billa, Kaufland, Jednota, Tesco – Express. The data set has an aggregated form of branches' data from

I: Input data set

Alternatives	Criteria					
	y_1	y_2	y_3	y_4	y_5	y_6
Albert	127.0968	0.7419	0.7097	0.4839	2.5806	1.7857
Billa	95.9698	0.7350	0.6500	0.4050	3.0850	34.6774
Kaufland	108.1162	0.7305	0.5988	0.4012	2.9581	9.6198
Lidl	106.4020	0.6800	0.6050	0.3300	2.7650	18.0300
Jednota	105.3500	0.7150	0.6750	0.3650	3.1550	31.1060
Tesco - expres	129.3750	0.6250	0.4583	0.2500	3.7500	2.8226
Type of criteria	max	max	min	max	min	max
Preference function	3-linear	2-quasi	1-gener	2-quasi	2-quasi	5-indif
q		0.05		0.04	5	10
p	30					15

Source: customer questionnaire carried out in the Bratislava region by the Faculty of Commerce (University of Economics in Bratislava) in 2011 and own settings

the chosen retail stores. These supermarkets cover about 98 % of market share in this region (we dismissed and excluded from our analysis large hypermarkets due to the different sizes of these premises) (see also Bilková, Križan 2015). Six criteria ($y_1 - y_6$) were chosen to express customer preferences and are defined as follows:

Purchase time of customers – average weekly time spent on purchases in supermarkets (y_1).

Visits to the supermarkets – customers' willingness to travel to supermarkets by car or by bus - the share of customers willing to travel to the supermarket (y_2).

Dissatisfaction with the supermarkets - different factors such as prices, lack of service, product range, product quality, purity, opening hours, parking, etc. - the share of customers wishing to improve something (y_3).

Improvements recorded by customers - the share of customers who recently recorded some improvements in the supermarkets (y_4).

Advertising - the effectiveness of leaflets – 5-point scale, 1 to 5 points being awarded according to the leaflets' influence – from high to low (y_5).

Market share of sales – the share of customers according to the questionnaire (y_6).

The criteria values are listed in Tab. I (Input data set). We supposed the same importance of all criteria and all calculations originating from

SANNA (System for Analysis of Alternative) (Virginio Cavalcante, *et al.* 2010). The PROMETHEE II method is based on the principle of evaluating alternatives based on preference relations. The selected preference functions of criteria, with their parameters (preference thresholds – p and indifference thresholds – q) for measuring the strength of preference of the pairs of alternatives with respect to the given criterion, are also given in Tab. I. Six different types of preference function are proposed in the original PROMETHEE definition. In our analysis, we chose four different types of preference functions for our criteria. Based on this information, and according to our formula (2), multicriteria preference indices were calculated (see Tab. II). Following the net flow values (see Tab. II) calculated according to our formulas (3), (4) and (5), we obtained a complete ranking of retail chains (see Tab. II). The retail chains are ranked in the following order from first to sixth order: Billa, Kaufland, Albert, Jednota, Lidl and Tesco-Expres.

DISCUSSION

The results of PROMETHEE II are a starting point for the main part of our study, i.e., as a formulation of a binary linear programming model following the PROMETHEE V method. Let us consider the situation when a potential retail investor is

II: Multicriteria preference indices, outranking flows and ranks of alternatives

	Albert	Billa	Kaufland	Lidl	Jednota	Tesco - Expres	$\phi^+(y^i)$	$\phi^-(y^i)$	Alt. rank
Albert	0.00000	0.33333	0.27211	0.44830	0.28748	0.33333	0.33491	0.06572	3.
Billa	0.33333	0.00000	0.16667	0.50000	0.33333	0.50000	0.36667	0.13116	1.
Kaufland	0.16667	0.23415	0.00000	0.50952	0.18203	0.33333	0.28514	0.10710	2.
Lidl	0.33333	0.22462	0.00000	0.00000	0.17251	0.50000	0.24609	-0.12484	5.
Jednota	0.33333	0.05211	0.16667	0.10253	0.00000	0.50000	0.23093	-0.02417	4.
Tesco - Expres	0.17932	0.33333	0.28477	0.29429	0.30014	0.00000	0.27837	-0.15496	6.
$\phi^-(y^i)$	0.26920	0.23551	0.17804	0.37093	0.25510	0.43333			

Source: own

about to offer their regional products to existing retail chains. Due to the fact that these regional products are widely in demand, all retail chains are agreeable to cooperating and selling these products. However our retail investor also has three additional requirements:

Advertising effectiveness – as a potential retail investor would like to advertise their products in chosen retail chains' leaflets, it is required that the total effectiveness of the chains' leaflets must be higher than 9 points.

Market share of sales – it is required that the total number of market share of sales must be higher than 20 %.

Number of retail chains – according to marketing and financial analyses, the retail investor defined that the chosen number of retail chains cannot exceed three.

To make a decision concerning proper retail chain selection, we employ the PROMETHEE V method which enables us to take into account the results of PROMETHEE II (preference ranking of chains) and, at the same time, to take into account defined constraints. The calculated net outranking flows (from Tab. II) are used as inputs in the objection function of the binary linear programming model formulated in (7). Three constraints of this model are formulated based on defined retail investor requirements and the binary variables represent the retail chains. Let binary variable x_1 represents retail chain Albert, x_2 Billa, x_3 Kaufland, x_4 Lidl, x_5 Jednota, x_6 Tesco – Expres. Model of binary linear programming can be formulated as follows:

$$\begin{aligned} \max f(x) &= 0,06572x_1 + 0,13116x_2 + 0,10710x_3 - 0,12484x_4 - 0,02417x_5 - 0,15496x_6 \\ 2,5806x_1 + 3,0850x_2 + 2,9581x_3 + 2,7650x_4 + 3,1550x_5 + 3,7500x_6 &\geq 9 \\ 1,78573x_1 + 4,6774x_2 + 9,61981x_3 + 8,03003x_4 + 1,1060x_5 + 2,8226x_6 &\geq 20 \\ x_1 + x_2 + x_3 + x_4 + x_5 + x_6 &\leq 3 \\ x_i &\in \{0;1\} \quad i=1,2,3,4,5,6 \end{aligned}$$

The optimal solution and optimal objection function values of above formulated problem are $x^* = (0; 1; 1; 0; 1; 0)$ and $f(x^*) = 0,21408$. PROMETHEE V is used to assist the decision maker in selecting a set of feasible alternatives. The decision problem is to choose which retail chain to choose for distribution of retail investor's products, and thus maximize benefits, which will result from consumer preferences and service satisfaction level in retail chain. If retail investors take into consideration the obtained results of the PROMETHEE V method, it is optimal to cooperate with these retail chains: Billa – x_2 , Kaufland – x_3 and Jednota – x_5 . Obtained solution maximizes benefits represented by objective function (outrank flow) and at the same time meets all the given constraints for advertising effectiveness, required market share of sales and maximum number of selected retail chains.

Our results correspond to previous findings in store choice, such as McGee and Peterson (2000) which found that service image, including quality of the service, handling of customer complaints, and store image, had been the strongest correlated construct with the performance construct: 'more highly performing local retailers are likely to be keenly aware of the ingredients of customer value and are likely to emphasize a quality image for their store through customer service'. Furthermore, Watkin (1986) concludes that focusing on such a service image can implies the retailers understands the linkage between its own value chain and the value-seeking behaviour of the consumer.

CONCLUSION

It is crucial for retail investors to evaluate the retail chains on the market when deciding for cooperation in a globalized and competitive environment where regional markets and consumers keep their specifics. We provide in this paper an example of the application of multi-attribute decision-making methods in the context of an analysis of customers' preferences and service satisfaction in the retail sector. As a result, a complete ranking of the evaluated retail chains is given in the following order from first to sixth position: Billa, Kaufland, Albert, Jednota, Lidl and Tesco – Expres. Furthermore, binary linear programming models were put to use for the illustration of issues with the selection of a convenient retail chain under pre-defined constraints related to the effectiveness of advertising, to the market share of sales and to the maximum number of selected retail chains. In this framework, constraints are the conditions given by the investor for considering to cooperate with a chosen retail chain. The retail chains Billa, Kaufland and Jednota were selected in conducted analysis. The result of the research is a proposed procedure to support decision making process of selecting which retail chain to choose for distribution of supplier's products. It means that future steps in application of Promethee methods contribute to supplier tier because the food retail chains are differentiated by certain level of brands, price, services or other components from the point of view of consumer's perception in evaluating of their offer. Consequently, it might be constructed supply chain network performance measures for the full supply chain and the individual firm levels that assess the efficiency of the supply chain or firm, respectively, and also allow to identify and rank the importance of suppliers as well as the components of suppliers with respect to the full supply chain for retail chains in according to their marketing strategy.

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