Providing a framework for evaluating the advertising efficiency using data envelopment analysis technique

Armin Ejlal and Maysam Shafiee Roodposhti*

Department of Management,
Faculty of Management and Accounting,
University of Tehran,
Farabi Campus, Iran
Email: armin.ejlal@ut.ac.ir
Email: maysam.shafiee@ut.ac.ir
*Corresponding author

Abstract: Advertising plays an important role in the marketing strategy and a considerable amount of budgets has been allocated for advertising every year. However, the proportion of advertisement campaign achievements to those designated for their design, or in other words, its efficiency, is questionable. This study was conducted to assess the efficiency of the food industry’s advertising brands using data envelopment analysis (DEA). The duration of the campaign and budget as input and brand familiarity, attractiveness of implementation and sale were used as an output for the evaluation. The results of the study indicated that there are inefficiencies in this industry, thus in an attempt to improve the situation of the advertising efficiency, some solutions was provided to managers. Also, the most important variables affecting the efficiency of the food industry was identified by sensitivity analysis.

Keywords: efficiency; data envelopment analysis; DEA; advertising.


Biographical notes: Armin Ejlal completed his Master’s in International Business from the University of Tehran in 2018. He received his Bachelor’s in Business Management in 2015 from the Islamic Azad University of Urmia. He also received his Associate’s degree in Information Technology from the University of Applied Science and Technology in 2011.

Maysam Shafiee Roodposhti completed his PhD in International Marketing from the Tarbiat Modares University. He is an Assistant Professor in the Department of Management of the University of Tehran who teaches marketing and management. His research interests focus on integration between marketing fields and he studies about to compose of marketing structure with emphasis on integrated concepts.


1 Introduction

With the arrival of industries and the advancement of technology, there has been rise in competition among manufacturers. In addition to innovating and developing products, the managers who make decisions use other tools such as marketing. According to Kotler et al. (1991), the most difficult business decisions are made in the field of marketing.

Product, price, place (distribution) and promotion are considered as marketing mix or 4p; the marketing mix is a set of marketing tools that are used by a company to achieve its aims in the market (Kotler, 1997). With regard to marketing, promotional measures are perceived as the forefront of marketing efforts (Michell et al., 1998).

Advertising as one of the promotional actions, plays an extremely important role in corporate marketing strategies and policies, such as customer relationship, new product introduction, and changing the audience mindset towards the company. The practice of introducing and familiarising the company and its products are facilitated by advertising. Thus, the adjustment of advertising-type, scheduling, its multiplicity, the content, and the medium from which this message is to be transmitted are of profound importance (Pratkanis and Aronson, 2001). Media planning is a problem-solving process for delivering messages to the target audiences in the most effective way. It should be noted that media is not exclusively enough for advertising and selection from different media depends on the audience, purpose, message, and the budget of a company (Solomon and Stuart, 2000). There are many advertising methods and approaches; however, resources as a limiting factor have made managers to find a way to choose the best combination of resources and to achieve the best results. These observations show that despite the huge spending on advertising and the increase in sales, the ratio of output to input is at a low level.

Several studies, already have pointed out the existence of the inefficiencies in advertising (e.g., Aaker and Carman, 1982; Bass, 1979; Luo and Donthu, 2005). In 1979, Bass in his research found that the loss of allocated funds on advertising could be up to 407% of net income. High levels of inefficiencies in advertising, which are referred to as sales declines due to the inefficiency of funds spent in advertising, could be detrimental to business and, also would make the managers discomfort and upset (Aaker and Carman, 1982; Luo and Donthu, 2005; Smith and Park, 1992).

The economic definition of efficiency indicated that a company will be completely cost-effective, whenever it is efficient in terms of technically and allocatively (allocative efficiency). In other words, it should minimises the cost and the expenses to achieve any level of output (Tajeddini, 2011). Effectiveness is measured based on the achievements of profit growth, sales growth and market share growth, while efficiency is measured based on the achievements profitability, return-on-investment gains, return-on-sales and return-on-assets (Auh and Menguc, 2005; Tajeddini, 2015). Effectiveness and efficiency are naturally two different for performance evaluation and should not be taken as a same concept (Tajeddini et al., 2013). Effectiveness means that, how much of the current activities are according to goals set and efficiency means the ratio of output to input.

It is widely believed that any phenomenon can be improved only if it can be measured and evaluated. This fact makes it even clearer that it is essential to measure the efficiency to improve performance. Therefore, today, the evaluation of organisational
Providing a framework for evaluating the advertising efficiency

Performances is one of the widely-discussed topics that have attracted the attention of industrialised world.

Different techniques have been introduced and used to measure efficiency. Among these techniques, data envelopment analysis (DEA) is the most appropriate method, because it is specially designed for this task and its various levels are the most effective to measure efficiency in different organisations, evaluating efficiency in all government departments or welfare organisations, such as hospitals, etc. are widely used. For DEA models, there is no difference between goods and services and this technique can evaluate various organisations, whether manufacturing or delivering service, and advertising campaigns that have multiple input-output variables introduced to assess the extent to which the allocated resources influence the corporate profits. The DEA allows managers to evaluate efficiency without the need to know what functional relationship exists between input and output variables (Luo and Donthu, 2005).

Looking at the literature, several researches in which DEA techniques have been used to evaluate efficiency are reviewed. Some of these noteworthy studies are introduced subsequently. At first, Charnes et al. (1985) in their study proposed the potential use of DEA in sales area. Moreover, a DEA was suggested to evaluate the efficiency of vendors by Boles et al. (1995). In a study by Horsky and Nelson (1996), the size of sales force and productivity were evaluated and benchmarked using DEA. Two years later, a DEA was used to assess the productivity of retail stores by Donthu and Yoo (1998). The efficiencies of 552 private stores for (owned by) multi-market, multichannel retailers, were also computed using DEA by Thomas et al. (1998). In a study by Yoo et al. (1998), the operational efficiencies of franchisee and non-franchisee were compared. Utilising the characteristics of the domain obtained from the retail business census, Pilling et al. (1999) used DEA to regulate sales performance. The use of DEA in assessing the efficiency of diverse advertising campaigns with multiple inputs and outputs was investigated by Luo and Donthu (2001). Färe et al. (2004) measured the efficiency to convert advertising message into sales by employing DEA technique to evaluate the efficiency of six US breweries. Luo and Donthu (2005) evaluated the inefficiency of the expenditures of the top 100 advertising media with both non-parametric DEA approach and parametric approach of stochastic frontier analysis. In the work of Büschken (2007), the efficiency of 35 brands of the German machinery industry was first measured; using DEA, and then a model was proposed to determine the inefficiencies of advertising. In a research conducted by Pergelova et al. (2010), the role of the internet in the efficiency enhancement of the advertisement was investigated in whole and, an example of Spanish automobile industry has been evaluated, using the non-parametric DEA method. Employing DEA for a group of large companies, Raithel et al. (2011) assessed which companies spent their dollars more efficiently and examined how this advertising efficiency affected investor behaviours and stock. Vejacka (2012) evaluated the efficiency of the Facebook advertising campaign using the DEA techniques and stochastic frontier analysis. Yang et al. (2013) suggested a decision-making framework that shows how to allocate advertising funds to both internet and institutional platforms based on the long-term and short-term advertising revenue gained. Thus, they evaluated a number of possible advertising investment scheme, using DEA.
Due to the widespread use of DEA in measuring efficiency, this study was conducted to evaluate the efficiency of 15 brands of Iran’s food industry using this method and provides them some guidelines to make them efficient. The results of current study can be used by managers to determine the amount of inefficiencies in their advertising, and in designing their future advertising strategies. Also, by using reference models and proposed values to regulate the level of resources, they can prevent the loss of the resources, and improve the situation of their advertising efficiency.

2 Model specifications

Campaign duration is an effective indicator in advertising. Naik et al. (1998) explored the relationship between pulsing and continues strategies in advertising. They state that the quality of advertising is decreased due to the ware out in the continuous advertising strategy and is renewed by considering the effects of forgetting the period without advertising in the pulsing strategy. This variable has been introduced in the research (Luo and Donthu, 2001) as an input variable in the evaluation of advertising efficiency using the DEA model. Considering that the length of the advertising campaign should be the same as sales and profits for the period of one financial year [Tyagi and Kumar, (2004), p.282], this study considers campaign duration as one of the model variables for the financial year in 2017.

Brand familiarity is the brand-related experiences that the consumer has achieved (Alba and Hutchinson, 1987). Consumers have different knowledge about familiar and unfamiliar brands in their memory, which can be obtained by seeing ads, using them, friends, acquaintances, and studying them (Campbell and Keller, 2003). Brand familiarity is a constant structure that is directly related to the time used to process information, in spite of the type and content of the brand, and is the most basic form of consumer knowledge on the brand (Baker et al., 1986). Büschken (2007) states in his research that brand familiarity does not mean recall or awareness of a particular brand, but it refers to the perception of the brand’s general claim by the audience. Therefore, evaluating the efficiency of selected brands is considered as the output variable of his research model. This study also places this variable as one of the output variables of the model.

Several studies have identified sale as a factor influenced by advertising. In a study, Zhou et al. (2003) presented a sustainable marketing model that evaluates the long-term effects of TV advertising on sales. Turner (2000) investigated the relationship between advertising expenses, the volume of sales, and advertising prices between 1967 and 1997. And there is strong evidence that there is a link between actual advertising costs, sales volumes, product prices, and the cost of advertising messages. Luo and Donthu (2001) used sales revenue to evaluate efficiency of 100 top US advertisers between 1997 and 1998. In another study in 2005, sales as an output variable have been used to evaluate the efficiency of advertising using DEA and stochastic frontier. This study also places this factor as the output variable in the model.

Rosbergen et al. (1997) argue in their research that the amount of attention given to an advertisement is following the motivation, position and ability of consumers, which is itself influenced by the physical properties and the characteristics of consumers. The physical properties of the advertisement or the features that make the message visible to the advertiser, such as size and images, play an important role in attracting the attention of the audience. Characteristics of attraction of stimuli are divided into two categories.
Providing a framework for evaluating the advertising efficiency

First, the physical properties affect intensively the stimulus (such as lightness, colour, and size). Second, the collative properties that are related to the comparison or collation of stimulus elements, such as complexity, movement, unit formation, and novelty (Mackenzie, 1986). Luo and Donthu (2001), in another part of their research, evaluated the efficiency of the 23 advertising campaign with the input of the number of words on the billboard, the presented concepts on the billboard, the black and white or being colourful of the advertisement and the amount of graphics on the billboards using DEA. Therefore, in this study, the attractiveness of implementation variable is placed as an output variable of the model with four components including colour, graphics, content, and composition.

The advertising budget is the expense that a company allocates for an advertising activity in a period of time, usually a financial year. The amount of advertising budget is proper when it is based on the needs of consumers and the responses to their problems. Several studies have addressed the issue of advertising efficiency in terms of their costs. Luo and Donthu (2001), in their study use advertising expenses of broadcast and outdoor print media as an input variable to evaluate the efficiency of advertising. In another study, Pergelova et al. (2010) investigated the role of the internet in advertising efficiency. For this purpose, data on advertising costs for 18 car representations in Spain was evaluated as input for the research model using DEA. Büschken (2007) also explored media expenses (TV, radio, outdoor, magazine, and newspaper) as the input variable of the model. The present study also considers the amount of advertising budget in a financial year of brands as the input variable of the model.

2.1 Data envelopment analysis

For the first time, Charnes et al. (1981) introduced DEA as a kind of linear programming method for functional analysis of the efficiency of different organisation units and also to compare the efficiency of several competitive organisations within a competitive environment. In fact, this method has been added to economic literature by making the method of Farrell (1957) comprehensive in such a way that it includes the characteristics of the production process with multiple factors of production (input) and multi-products (output). In the DEA, using a set of observations, an experimental production function is constructed based on the observed data. The reason it is called ‘envelopment analysis’ is that this method provides a kind of boundary function that includes all the data. Since the DEA method is based on a set of optimisation problems in which there is no component to estimate, it is a non-parametric method (Charnes et al., 1978).

DEA is very useful for comparing decision-making units based on multiple inputs and outputs. Where the exact nature of the transformation relationship is unknown or not easily recognisable, an assessment based on this approach can be used to rank the decision-making units according to the specific function of each unit and the units with poor efficiency can be identified and ranked based on realised efficiency (Donnelly, 2000). This method has been used to evaluate the efficiency of public and non-profit organisations whose functional information is usually unavailable or unreliable (Charnes et al., 1985). The use of this approach provides comparable results from the efficiency of various organisations and provides a platform for improving efficiency.

Since DEA identifies the inefficiency of decision-making units by comparing them with similar decision-making units that are efficient, this analysis can be used as a
valuable modelling tool (Avkiran, 2006). Unlike other modelling tools that rely heavily on managers’ observations, DEA can identify the best practices that cannot be accurately identified due to their extreme complexity (Sherman and Ladino, 1995). The most important advantage of DEA over other traditional econometric methods is that it requires no prior hypotheses about the analytic form of the production function. On the other hand, the main problem with DEA is that it is a non-parametric method which makes it sensitive to measurement problems (Kim et al., 2008).

In general, the DEA capabilities include: identifying template organisations with the maximum amount of efficiency, identifying efficiency improvement strategies, possibility of evaluating specific goals, determining returns to scale, identifying solutions for development of organisations, identifying technical improvements or regression in organisation at a certain time period, and optimal allocation of resources. Overall, the organisation’s decision-making unit is assessed using DEA, based on the type of return to scale, into two general categories of return to constant models and return to variable scale models. In each of these models, there are two perspectives: the input-oriented view is reducing inputs without reducing outputs to reach the efficiency level. This approach is called efficiency measure with the input-oriented nature. And the output-oriented view is increasing outputs to reach the efficiency level, without attracting more inputs. This method is called as the measurement of efficiency with an output oriented nature. Choosing the input oriented view is based on the amount of network management control on each input and output. If the network management has no control over the outputs and the amount is already constant and specified, the decrease in the inputs will be considered as management perspective. In other words, the input-oriented model is solved. If the management has no control over the amount of inputs and their value is already specified and constant, the management focus is on increasing outputs and the model is resolved as output-oriented. Therefore, all of the DEA models can be solved with two views of input or output. In DEA method with an input-oriented approach, there is need to improve technical efficiency as a proportion by which the network inputs are reduced so that its output remains unchanged to reach the efficiency level. In the output-oriented view, we are looking for a relationship that needs to increase network outputs without changing the network inputs so that the network reaches the efficiency level (Charnes et al., 1981).

Although the number of DEA models is increasing gradually and becoming more specialised, but their fundamental basis is a number of major models that the founders of this approach have designed. The first model of DEA in Edward Rodes’s PhD thesis with Cooper as advisor was presented in Carnegie University in 1976 and was introduced by Charnes et al. (1978) by publishing an article titled ‘Measuring the efficiency of decision making units’ (DMUs). This model was named by using the first letters of the names of the authors, called CCR, which assumed a constant return to the CRS scale. Banker et al. (1984) developed another model, which generally entered a return to scale in CCR model and established a BCC model with assumption of variable returns to the VRS scale. Stable returns relative to the scale, that is, the change in the amount of data, lead to a change in the amount of output to the same ratio. This model is appropriate for all units to operate on an optimal scale. Variable returns to scale, that is, change in data to a lesser or greater proportion in the amount of output.

The DEA divides the units into two groups of ‘efficient’ and ‘inefficient units’. Efficient units are units whose efficiency scores are equal to one and inefficient units take a number from zero to one.
Super efficiency models are used to evaluate efficient units. In this study, firstly, using the input-oriented BCC model, brands were divided into two efficient and non-efficient groups. They are ranked using the Anderson Peterson and Norm-L1 super-efficiency models which are method for determining the most efficient units. In these methods, the score of efficient units can be more than one so that efficient units can be ranked as inefficient units.

2.2 DEA models

2.2.1 BCC-IO stage one

When each of the advertisers is active on different economic scales, efficiency models are used in relation to the variable DEA scale (Banker et al., 1984). On the one hand, in this study, considering the fact that only budget variables and campaign time are changeable as input variables by managers, the input oriented approach of DEA models has been used.

In the BCC input-oriented model (1) presented by Banker et al. (1984), $\theta$ is the inefficiency of the advertisement, $\lambda$ is the weight of the reference units, $i = 1, \ldots, m$ are constraints, $r = 1, \ldots, s$ are outputs, $n = 15$ is the number of DMUs, $o$ is the index of the under evaluation unit, $j$ is the index of units, $x_{ij}$ is the amount of input number $i$ for the number $j$ unit, and $y_{rj}$ is the amount of the output number $r$ for the $j$ unit.

\[
\begin{align*}
\text{Min} \theta \\
\text{s.t} \\
\sum_{j=1}^{n} \lambda_{j} x_{ij} & \leq \theta x_{io} \\
\sum_{j=1}^{n} \lambda_{j} y_{rj} & \geq \theta y_{ro} \\
\sum_{j=1}^{n} \lambda_{j} & \leq 1 \\
\lambda_{j} & \geq 0
\end{align*}
\]  

In model (1), the goal is to minimise inputs to produce the same amount of outputs. In other words, the budget or the duration of the brand campaign number $o$ can be minimised by $\theta^*$ until the output stays constant. The $\theta^*$ value is presented as part of an optimal solution to the linear programming formula, which presents realistic numerical values for the radial motion efficiency of the DMU under the investigation of number $o$. The $\theta^* x_{io}$ value shows the proportional reduction in the DMU input under the investigation of number $o$ if optimal efficiency is obtained without changing the output level.

The optimal value of $\theta^* = 1$ means that the under evaluation brand is efficient and if $\theta^* < 1$ means the inefficiency of brand advertising. Therefore, the inefficiency of each brand is expressed as a percentage of 100. ($\theta^*$) in the DEA input oriented model (1).

2.2.2 Anderson-Peterson

This method, by eliminating the constraints of the efficiency units of BCC in equation (1), calculates efficiency values greater than one for the efficient units. Classic
DEA models do not allow comparisons of efficient units with each other, because they do not create a perfect ranking between the units. The AP model was presented in 1993 to solve this problem. In the BCC model, the units placed on the efficiency level have the maximum efficiency value equal to one. In this case, the unit was evaluated as the criterion for assessing itself. But the proposed model, by Anderson Peterson, rejects the reference of the DMU for the unit itself. In fact, it implements the same standard DEA models (VRS or CRS) with the assumption that the DMU is excluded from the reference set (Andersen and Petersen, 1993). If \( k \) is the unit of under evaluation DMU, then the AP method of linear programming is in form of equation (2).

\[
\begin{align*}
\text{Min} & \quad \theta_j \quad j = 1, 2, 3, \ldots, n \\
\text{s.t} & \quad i = 1, \ldots, m \\
\sum_{j=1}^{n} \lambda_{j}y_{ij} = y_{ik} & \quad r = 1, \ldots, s \\
\lambda_{j} & \geq 0
\end{align*}
\]

(2)

2.2.3 Norm-L1

Among the problems of model (2) is its high sensitivity to small changes in data when some DMUs have relatively small values for some of their inputs. In order to eliminate this problem in the output of the study, the Norm-L1 model by Jahanshahloo et al. (2004) was used based on a collective model with constant and variable scales for ranking brands.

If there exist \( n \) decision-making units for evaluation and it is assumed that each DMU will generate \( s \) different output from \( m \) different input, the input and output observations of the DMU \( j \) are respectively \( x_j = (x_{j1}, \ldots, x_{jm}) \) and \( y_j = (y_{j1}, \ldots, y_{jn}) \), all elements entries of \( x_i \) and \( y_j \) are non-negative and each DMU has at least an absolute positive value of input and output. It is assumed that all DMUs are super-efficient. To rate the super-efficient DMUs, model (3) is considered.

\[
\begin{align*}
\text{Min} & \quad \Gamma^*(X, Y) = \sum_{i=1}^{m} |x_i - x_0| + \sum_{r=1}^{s} |y_r - y_0| \\
\text{s.t} & \quad \sum_{j=1}^{n} \lambda_{j}x_{ij} \leq x_i, \quad i = 1, \ldots, m, \\
\sum_{j=1}^{n} \lambda_{j}y_{ij} & \geq y_r, \quad r = 1, \ldots, s, \\
x_i & \geq 0, \quad y_r \geq 0, \quad i = 1, \ldots, m, r = 1, \ldots, s, \\
\lambda_{j} & \geq 0, \quad j = 1, \ldots, n, j \neq 0,
\end{align*}
\]

(3)

where \( X = (x_{11}, \ldots, x_{mn}) \) and \( Y = (\lambda_{11}, \ldots, \lambda_{1n}, \lambda_{21}, \ldots, \lambda_{2n}) \) are the variables of the model and \( \Gamma^*(X, Y) \) is the difference between \((X_0, Y_0)\) and \((X, Y)\) using the Norm-L1 model. Jahanshahloo et al. (2004) state that the linearised model (4) of the aforementioned model for implementation in the software is:
Providing a framework for evaluating the advertising efficiency

\[
\begin{align*}
\text{Min} & \, \Gamma^*(X, Y) = \sum_{i=1}^{m} x_i - \sum_{r=1}^{s} y_r + x_i \\
\text{s.t} & \, \sum_{j=1, j \neq 0}^{n} \lambda_j x_{ij} \leq x_i, \quad i = 1, \ldots, m, \\
& \sum_{j=1, j \neq 0}^{n} \lambda_j y_{ij} \leq y_i, \quad i = 1, \ldots, m, \\
& \sum_{j=1, j \neq 0}^{n} \lambda_j y_{ij} \leq y_i, \quad r = 1, \ldots, s \quad (4) \\
& x_i \geq x_{0i}, \quad i = 1, \ldots, m \\
& 0 \leq y_r \leq y_{0r}, \quad r = 1, \ldots, s \\
& \lambda_j \geq 0, \quad j = 1', \ldots, n, \ j \neq 0, \\
& \alpha = \sum_{r=1}^{s} y_{0r} - \sum_{i=1}^{m} x_{0i} \quad \text{which is constant}
\end{align*}
\]

2.2.4 BCC-stage two

In the first phase of the efficiency calculation using the BCC-I/O model, the efficiency level is not entirely robust because the amount of reduction in inputs occur with an equal \( \theta^* \) ratio and may be among the inputs that their amount of efficiency can increase with its reduction. So, for the strength of the calculated efficiency, firstly, the value of \( \theta^* \) must be equal to one, and secondly, the excess amount of number \( i \) input and the loss of the number \( r \) input in the second step of the BCC model have been calculated and presented as \( s_i^+ (\forall i) \) and \( s^r_j (\forall r) \), respectively reach to zero (Banker et al., 2004).

\[
\begin{align*}
\text{Max} & \, \sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+ \\
\text{s.t} & \, \sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{0i} + s_i^- \\
& \sum_{j=1}^{n} \lambda_j y_{ij} \geq y_{0r} - s_r^+ \\
& \sum_{j=1}^{n} \lambda_j \leq 1 \\
& \lambda_j, s_i^+, s_r^+ \geq 0 \quad (5)
\end{align*}
\]

To calculate the optimal input and output values by embedding \( \theta^* \) derived from the implementation of model (1) in model (5), we have new variables of \( \lambda_j, s_i^- \) and \( s_r^+ \). The positive value of \( \lambda_j^+ \) obtained from the solution of model (5) shows that the unit is a reference. A robust efficient DMU image is defined as follows:

\[
P := (\hat{x}_i, \hat{y}_r) = \sum_{j=1}^{n} \lambda_j^+ (x_j, y_j) = \left( \theta^+ X_o - S^-, y_o + S^+ \right)
\]

The obtained image may be viewed as a component of DMUs; in this case, it can be modelled and used to improve the status of inefficient units, or it may not exist, which is then considered a virtual unit. If multiple virtual reference units are provided for a DMU, \( \lambda_j^+ \) is the weight of each virtual unit.
3 Data, analysis and results

3.1 Data

Data on sale variables and advertising budget for year 2017 have been extracted from 15 Iranian active food brands from financial statements of corporations at http://www.codal.ir which is an integrated system for collecting, monitoring and disseminating electronic information and the ‘Organization of stock exchange and worthy documents in Iran’ has been created to protect the rights of investors of companies registered there. The data of this website is publicly available for free.

Also, 15 questionnaires were designed for each brand to measure the values of attractiveness variables and brand familiarity. The questionnaires were evaluated by three advertising experts, a university professor, and two journalists as teller of advertising, in order to make sure that the content and scale of the measure were clear, valid and appropriate. The reliability test was also used for questionnaire variables. It was done in a way that, 30 samples were distributed among the audience before the distribution of all the questionnaires. The total results of Cronbach’s alpha test for each of the variables in this questionnaire were higher than the proposed value of 0.7, which indicates the reliability of the designed questionnaire. In the following, the number of the questionnaires of well-known brands that distributed randomly among consumers through Social media networks on the basis of convenience in the major cities including Tehran, Tabriz, Isfahan, and the number of the questionnaires that was returned and also, Cronbach’s alpha value of each of the variables in the questionnaire in the stage before the extensive distribution are mentioned.

For each brand, 300 questionnaires were distributed. The number of returned questionnaires is as follows: ASAN: 286, Aftab: 249, Behnoosh: 248, Minoo: 276, Pak: 261, Pakdis: 249, YEK-O-YEK: 253, Pegah: 278, Chin Chin: 221, Goldis (Shahd Iran): 298, Kalber: 256, Gorji: 237, Ladan: 276, Mahram: 247, and Nosh Mazandaran: 268. The brand familiarity variable with two statements through the Five Likert scale is measured from the very low to the very high, which is the first statement of the previous experiences of the brand, including personal use, hearing from the acquaintances or the media, and seeing the advertisements. The second statement is about having the amount of information that you can select the brand for the next purchase by awareness. For each brand, a separate questionnaire was developed. The Cronbach’s alpha value of the questionnaire is 0.72, 0.73, 0.79, 0.7, 0.84, 0.86, 0.75, 0.7, 0.74, 0.74, 0.89, 0.93, 0.72, 0.78, and 0.88 for brands of Pakdis, Behnoosh, Mahram, Chin Chin, Nosh, Minoo, Gorji, Pegah, Pak, Kalber, Ladan, Aftab, Goldis, Asan, and Yek-O-Yek, respectively. The attractiveness of implementation variable is measured from the very good to the very bad using Likert scale which was defined by the four statements that the consumers of each brand ask about their products, including colour, graphics, content, and composition. The Cronbach’s alpha in each questionnaire for each brand is Asan: 0.75, Aftab: 0.88, Behnoosh: 0.87, Minoo: 0.83, Pak: 0.89, Pakdis: 0.91, Yek-O-Yek, 0.94, Pegah: 0.78, Chin Chin: 0.83, Goldis (ShahdIran): 0.74, Kalber: 0.71, Gorji: 0.79, Laden: 0.75, Mahram: 0.96, Nosh Mazandaran: 0.79.

Variable data of the duration of each brand’s advertising campaign during a fiscal year has been taken from advertising agencies in Iran that were in charge of advertising
affairs of these brands. The data used in this study is shown in Table 1. The descriptive statistics of the data are shown in Table 2. Due to the fact that there should be a correlation between the input and output variable data for DEA application (Luo and Donthu, 2001, 2005), Pearson correlation test was performed on the data. The results of Table 2 show the correlation between the variables.

Table 1 Inputs and outputs data

<table>
<thead>
<tr>
<th>Brand</th>
<th>Budget (million rial)</th>
<th>Campaign duration</th>
<th>Sale (million rial)</th>
<th>Attractiveness of implementation</th>
<th>Brand familiarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>YEK-O-YEK</td>
<td>9,180</td>
<td>60</td>
<td>1,362,563</td>
<td>3.07</td>
<td>2.97</td>
</tr>
<tr>
<td>ASAN</td>
<td>1,392</td>
<td>60</td>
<td>114,179</td>
<td>2.03</td>
<td>2.29</td>
</tr>
<tr>
<td>GOLDIS</td>
<td>38</td>
<td>30</td>
<td>38,000</td>
<td>1.78</td>
<td>1.57</td>
</tr>
<tr>
<td>AFTAB</td>
<td>6,887</td>
<td>60</td>
<td>6,460,664</td>
<td>2.48</td>
<td>2.25</td>
</tr>
<tr>
<td>LADAN</td>
<td>139,395</td>
<td>365</td>
<td>21,235,096</td>
<td>4.43</td>
<td>4.22</td>
</tr>
<tr>
<td>KALBER</td>
<td>359</td>
<td>90</td>
<td>593,203</td>
<td>1.85</td>
<td>1.79</td>
</tr>
<tr>
<td>PAK</td>
<td>18,528</td>
<td>180</td>
<td>6,120,465</td>
<td>2.39</td>
<td>2.30</td>
</tr>
<tr>
<td>PEGAH</td>
<td>8,197</td>
<td>120</td>
<td>1,720,422</td>
<td>2.07</td>
<td>2.23</td>
</tr>
<tr>
<td>GORJI</td>
<td>40,000</td>
<td>60</td>
<td>680,127</td>
<td>3.77</td>
<td>3.63</td>
</tr>
<tr>
<td>MINOO</td>
<td>60,000</td>
<td>90</td>
<td>3,521,998</td>
<td>3.48</td>
<td>3.41</td>
</tr>
<tr>
<td>NOSH MAZANDARAN</td>
<td>29</td>
<td>60</td>
<td>82,140</td>
<td>1.33</td>
<td>1.62</td>
</tr>
<tr>
<td>CHINCHIN</td>
<td>45,000</td>
<td>90</td>
<td>274,642</td>
<td>3.19</td>
<td>3.25</td>
</tr>
<tr>
<td>MAHRAM</td>
<td>76,945</td>
<td>60</td>
<td>1,541,706</td>
<td>3.05</td>
<td>3.34</td>
</tr>
<tr>
<td>BEHNOUSH</td>
<td>22,110</td>
<td>60</td>
<td>3,799,390</td>
<td>2.87</td>
<td>2.80</td>
</tr>
<tr>
<td>PAKDIS</td>
<td>57,000</td>
<td>90</td>
<td>1,813,515</td>
<td>2.38</td>
<td>2.29</td>
</tr>
</tbody>
</table>

Note: *All data belong to year 2017.

Since the value of the largest variance inflation factor (VIF) was 2.006, which is less than ten (Jaccard and Turrisi, 2003; Neter et al., 1990), and in no case the value tolerance was less than 0.1, it shows that there is no concern for multicollinearity in the data.

3.2 Efficiency results

By implementing the BCC input-oriented model, efficiency of 15 food brands was calculated in the first step, among which Pak, Pegah, Minoo, Chin Chin, Mahram, Behnoosh, and Pakdise brands obtained output value was less than one, showing the existence of inefficiency in their resources. These brands need to reduce their current level of inputs by 38%, 44%, 95%, 63%, 98%, 98%, and 50%, respectively to become efficient. Eight other brands have gotten the output value of one, showing that they are efficient. In order to rank the brands in terms of efficiency, AP model was used in the next step. Due to the infeasible presence of the Ladan brand as a result of the weakness of the AP model, the Norm-L1 model was used. According to the output of the models shown in Table 3, Laden has the highest rank among the brands and Pak has the lowest.
Table 2  Descriptive statistics and correlation

<table>
<thead>
<tr>
<th>Mean</th>
<th>SD</th>
<th>Budget</th>
<th>Campaign duration</th>
<th>Sale</th>
<th>Brand familiarity</th>
<th>Attractiveness of implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>32,337.3333</td>
<td>38,889.08572</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>98.3333</td>
<td>81.71524</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3,290,540.666667</td>
<td>5,384,818.486034</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2.6642</td>
<td>0.78622</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2.6780</td>
<td>0.83684</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes: **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.01 level (2-tailed).
Providing a framework for evaluating the advertising efficiency

<table>
<thead>
<tr>
<th>DMU</th>
<th>BCC</th>
<th>AP</th>
<th>NORM-L1</th>
<th>RANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>YEK-O-YEK</td>
<td>1</td>
<td>2.519</td>
<td>0.100</td>
<td>4</td>
</tr>
<tr>
<td>ASAN</td>
<td>1</td>
<td>2.958</td>
<td>0.022</td>
<td>6</td>
</tr>
<tr>
<td>GOLDIS</td>
<td>1</td>
<td>8.288</td>
<td>0.088</td>
<td>5</td>
</tr>
<tr>
<td>AFTAB</td>
<td>1</td>
<td>3.221</td>
<td>0.230</td>
<td>3</td>
</tr>
<tr>
<td>LADAN</td>
<td>1</td>
<td>Inf.</td>
<td>1.240</td>
<td>1</td>
</tr>
<tr>
<td>KALBER</td>
<td>1</td>
<td>2.514</td>
<td>0.004</td>
<td>7</td>
</tr>
<tr>
<td>PAK</td>
<td>0.380</td>
<td></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>PEGAH</td>
<td>0.440</td>
<td></td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>GORJI</td>
<td>1</td>
<td>2.881</td>
<td>0.244</td>
<td>2</td>
</tr>
<tr>
<td>MINOO</td>
<td>0.949</td>
<td></td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>NOSH MAZANDARAN</td>
<td>1</td>
<td>3.789</td>
<td>0.001</td>
<td>8</td>
</tr>
<tr>
<td>CHINCHIN</td>
<td>0.631</td>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>MAHRAM</td>
<td>0.981</td>
<td></td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>BEHNOUSH</td>
<td>0.980</td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>PAKDIS</td>
<td>0.506</td>
<td></td>
<td></td>
<td>13</td>
</tr>
</tbody>
</table>

By removing the input and output variables, the model was re-implemented and the ranking was performed; the results are shown in Table 4. The removal of the budget variable worsened the rating of Yek-O-Yek, Asan, Kalber, and Nosh Mazandaran and makes the rankings of Goldis, Minoo, Chin Chin, Mahram, Behnoosh, and Pakdis brands better. Removing the campaign duration variable has led to a better brand ranking for Asan, Kalber, Pak, Minoo, and Chin Chin and a worse brand ranking for Goldis, Mahram, and Pakdis. The removal of the sale variable has led to a better brand ranking of Yek-O-Yek, Asan, Goldis, Kalber, Nosh, Mahram, and Behnoosh and has led to a worse brand ranking for Aftab. Removing the attractiveness of implementation variable would result in better ranking for Aftab, Pak, and Minoo and worse ranking for Pegah and Gorji, and finally the removal of the brand familiarity variable has worsened the brand ranking of the Gorji brand and improved the brand ranking of the Aftab brand. In general, the variables which removal of them have worsened rankings relative to the initial ranking have a positive impact on efficiency, and those that have improved ranking have a negative impact on efficiency. Budget and sale had the most impact and brand familiarity had the least impact on the efficiency of Iran’s food industry advertisements.

The proposed solution to improve the efficiency of the BCC-IO model (1) reduces all inputs to the same ratio. But there are some inputs that can be improved by reducing their efficiency, so the so-called efficiency is said to be poorly calculated. For this purpose, step two of the BCC models was implemented and the results are shown in Table 5. To consider calculated efficiency as strong, the slack rate should be zero and the efficiency output should be equal to one, thus, only the calculated efficiency for Pegah brand was strong in model (1). The calculated slack for the Pak brand campaign duration variable is 8.409, which suggests that the brand needs to reduce its campaign days with this amount to boost its efficiency. The calculated slack for the Minoo brand budget variable is 15,130.370, which shows that this brand, in addition to the amount calculated in the first
step of implementing the BCC model, should also reduce its budget by this amount to become strong efficient. For the Chin Chin brand, calculated slack of sale is 497,288.875, which should be reduced from the amount calculated in the first step of implementing the BCC model. Calculated slack of budget for Mahram is 42,073.223, which should be reduced from the calculated amount in the first step of implementing the BCC model to make it strong efficient. Behnoosh and Pakdis brands like Mahram should reduce their budget by 1,282.220 and 16,401.762, respectively, to become strong efficient. However, in some cases, such as brand familiarity variable, brands have a low slack value that can be ignored because they are not considerable.

Table 4  Ranking results after excluding each variable (see online version for colours)

<table>
<thead>
<tr>
<th>DMU</th>
<th>Budget</th>
<th>Campaign duration</th>
<th>Sale</th>
<th>Attractiveness of implementation</th>
<th>Brand familiarity</th>
<th>Primary output</th>
</tr>
</thead>
<tbody>
<tr>
<td>YEK-O-YEK</td>
<td>8</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>ASAN</td>
<td>9</td>
<td>3</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>GOLDIS</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>AFTAB</td>
<td>3</td>
<td>3</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>LADAN</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>KALBER</td>
<td>13</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>PAK</td>
<td>15</td>
<td>12</td>
<td>15</td>
<td>14</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>PEGAH</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>15</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>GORJI</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>MINOO</td>
<td>7</td>
<td>9</td>
<td>11</td>
<td>10</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>NOSH</td>
<td>11</td>
<td>8</td>
<td>7</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>MAZANDARAN</td>
<td>11</td>
<td>8</td>
<td>7</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>CHINCHIN</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>MAHRAM</td>
<td>5</td>
<td>13</td>
<td>8</td>
<td>11</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>BEHNOUSH</td>
<td>6</td>
<td>10</td>
<td>9</td>
<td>9</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>PAKDIS</td>
<td>12</td>
<td>15</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
</tr>
</tbody>
</table>

By calculating the reference units, it is recommended that decision makers should improve their efficiency status by combining the inputs and outputs of these references. In Table 6, the reference units of the brands of Pak, Pegah, Minoo, Chin Chin, Mahram, Behnoosh, and Pakdis are calculated. Pak brand should take 6% of the Yek-O-Yek brand and 93% of the Aftab brand to leverage it to the efficient level. The Pegah brand should be sampled with 16% from Yek-O-Yek, 36% from Asan, 23% from Goldis, and 22% from Aftab, and Minoo brand should be sampled with 19% from Aftab, 8% from Ladan, and 72% from Gorji. Chin Chin brand should also be sampled with 23% from Yek-O-Yek, 10% from Goldis and 65% from Gorji to leverage itself to an efficient level. The brands of Mahram, Behnoosh, and Pakdis should be sampled 3%, 4%, and 48% from Goldis, 15%, 54%, and 25% from Aftab, and 81%, 41%, and 26% from Gorji, respectively to leverage them to efficiency level.
Table 5  BCC stage two output results

<table>
<thead>
<tr>
<th>DMU</th>
<th>Budget</th>
<th>Campaign duration</th>
<th>Sale</th>
<th>Attractiveness of implementation</th>
<th>Brand familiarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAK</td>
<td>Current 18,528.000</td>
<td>180.000</td>
<td>6,120,465.000</td>
<td>2.300</td>
<td>2.388</td>
</tr>
<tr>
<td></td>
<td>Eff * current 7,041.954</td>
<td>68.413</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slacks 0.000</td>
<td>8.409</td>
<td>0.000</td>
<td>0.000</td>
<td>0.129</td>
</tr>
<tr>
<td></td>
<td>Optimal 7,041.954</td>
<td>60.004</td>
<td>6,120,465.000</td>
<td>2.300</td>
<td>2.517</td>
</tr>
<tr>
<td>PEGAH</td>
<td>Current 8,197.000</td>
<td>120.000</td>
<td>1,720,422.000</td>
<td>2.226</td>
<td>2.075</td>
</tr>
<tr>
<td></td>
<td>Eff * current 3,608.491</td>
<td>52.827</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slacks 0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.170</td>
</tr>
<tr>
<td></td>
<td>Optimal 3,608.491</td>
<td>52.827</td>
<td>1,720,422.000</td>
<td>2.226</td>
<td>2.245</td>
</tr>
<tr>
<td>MINOO</td>
<td>Current 60,000.000</td>
<td>90.000</td>
<td>3,521,998.000</td>
<td>3.409</td>
<td>3.485</td>
</tr>
<tr>
<td></td>
<td>Eff * current 56,918.377</td>
<td>85.378</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slacks 15,130.370</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.086</td>
</tr>
<tr>
<td></td>
<td>Optimal 41,788.006</td>
<td>85.378</td>
<td>3,521,998.000</td>
<td>3.409</td>
<td>3.571</td>
</tr>
<tr>
<td>CHINCHIN</td>
<td>Current 45,000.000</td>
<td>90.000</td>
<td>274,642.000</td>
<td>3.250</td>
<td>3.188</td>
</tr>
<tr>
<td></td>
<td>Eff * current 28,372.737</td>
<td>56.745</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slacks 0.000</td>
<td>0.000</td>
<td>497,288.875</td>
<td>0.000</td>
<td>0.201</td>
</tr>
<tr>
<td></td>
<td>Optimal 28,372.737</td>
<td>56.745</td>
<td>771,930.875</td>
<td>3.250</td>
<td>3.388</td>
</tr>
<tr>
<td>MAHRAM</td>
<td>Current 76,945.000</td>
<td>60.000</td>
<td>1,541,706.000</td>
<td>3.341</td>
<td>3.047</td>
</tr>
<tr>
<td></td>
<td>Eff * current 75,509.770</td>
<td>58.881</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slacks 42,073.223</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.450</td>
</tr>
<tr>
<td></td>
<td>Optimal 33,436.547</td>
<td>58.881</td>
<td>1,541,706.000</td>
<td>3.341</td>
<td>3.497</td>
</tr>
<tr>
<td>BEHNOUSH</td>
<td>Current 22,110.000</td>
<td>60.000</td>
<td>3,799,390.000</td>
<td>2.798</td>
<td>2.873</td>
</tr>
<tr>
<td></td>
<td>Eff * current 21,667.616</td>
<td>58.799</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slacks 1,282.220</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.113</td>
</tr>
<tr>
<td></td>
<td>Optimal 20,385.396</td>
<td>58.799</td>
<td>3,799,390.000</td>
<td>2.798</td>
<td>2.986</td>
</tr>
<tr>
<td>PAKDIS</td>
<td>Current 57,000.000</td>
<td>90.000</td>
<td>1,813,515.000</td>
<td>2.290</td>
<td>2.380</td>
</tr>
<tr>
<td></td>
<td>Eff * current 28,816.812</td>
<td>45.500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slacks 16,401.762</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.104</td>
</tr>
<tr>
<td></td>
<td>Optimal 12,415.050</td>
<td>45.500</td>
<td>1,813,515.000</td>
<td>2.290</td>
<td>2.484</td>
</tr>
</tbody>
</table>
Table 6  Reference sets of brands

<table>
<thead>
<tr>
<th>DMU</th>
<th>REF. DMU: WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAK</td>
<td>YEK-O-YEK = 0.067 AFTAB = 0.933</td>
</tr>
<tr>
<td>PEGAH</td>
<td>YEK-O-YEK = 0.169 ASAN = 0.369 GOLDIS = 0.239 AFTAB = 0.223</td>
</tr>
<tr>
<td>MINOO</td>
<td>AFTAB = 0.196 LADAN = 0.083 GORJI = 0.721</td>
</tr>
<tr>
<td>CHINCHIN</td>
<td>YEK-O-YEK = 0.237 GOLDIS = 0.108 GORJI = 0.655</td>
</tr>
<tr>
<td>MAHRAM</td>
<td>GOLDIS = 0.037 AFTAB = 0.153 GORJI = 0.810</td>
</tr>
<tr>
<td>BEHNOUSH</td>
<td>GOLDIS = 0.040 AFTAB = 0.544 GORJI = 0.416</td>
</tr>
<tr>
<td>PAKDIS</td>
<td>GOLDIS = 0.483 AFTAB = 0.250 GORJI = 0.267</td>
</tr>
</tbody>
</table>

4 Discussions and conclusions

Since, advertising as one of the marketing tools leads to customers’ familiarisation with products and services is used to increase the company’s sales or profits. So that, huge sums of money are spent on advertising every year, while the ratio of the achievements of these advertising to their costs and expenses or, in other words, the efficiency of advertising is questioned. Regarding the fact that, previous researches and studies indicated the inefficiencies in the field of advertising (e.g., Aaker and Carman, 1982; Bass, 1979; Simon and Arndt, 1980), the present study investigated the inefficiency of advertising for selected brands in Iran through using a DEA technique. The results show that advertisement campaigns of 46% of brands in Iran, or seven brands out of 15 selected brands, are inefficient, and some must reduce about 50% of their budget and the number of days spent on their advertisement campaigns, so that their situation improve. In the following of the study, it was demonstrated that just performing the first step of the BCC model does not fully determine the inefficiency, and it is better to perform the second step of the BCC model, to determine, more precisely, the inefficiency. Also, through sensitivity analysis, it was shown that budget and sales had the most effect and brand familiarity had the least effect on the efficiency of advertising in the Iranian food industry.

The DEA technique can calculate inefficiencies for decision-making units that simultaneously have multiple inputs and outputs. It can also determine the efficiency level exclusively for each input and output. The premier advantage of this non-parametric technique is that there is no need to establish a functional relationship between a fixed-weight alternative input and output. The output of commonly used DEA models, such as BCCs, divides brands into two categories; efficient category with value of one and inefficient category with value between zero and less than one. Commonly used super-efficient models such as Anderson and Patterson model are used in order to
determine the status of efficient brands toward each other, but current study indicated that
due to the high sensitivity of this model to small variations of data, outputs are infeasible
in some cases. This issue has been solved by Norm-L1 model, which operates on the
basis of normalising data, so that even efficient brands can be ranked. Brand ranking,
through performing sensitivity analysis, would help identifying and determining the most
important variables that affect the efficiency of the industry.

4.1 Managerial implications
The results of the DEA model allow managers to rank their advertising levels in terms of
efficiency and determine their inefficiencies and reuse them in designing and
implementing their future strategies. Implementing the DEA also provides managers with
good information to know exactly how much they should reduce their inputs or increase
their outputs to reach the efficiency. The present study make it clear for the managers
who are decision makers in the food industry that, if they want to improve their brand
situation in terms of advertising efficiency, in some cases they must reduce up to 50% of
the budget and the number of days of their advertising campaign to reach the efficiency
boundaries. Also, the results of this study confirm the existence of inefficiency in the
field of advertising. The other advantage of using DEA model for managers is showing
them how they can reach high efficiency level by implementing slack analysis and
 deducting it from the multiplication of the amount of inefficiency to the amount of
primary resources. The DEA allows administrators and managers to evaluate the
efficiencies without a need to know the functional relationship between input and output
variables.

4.2 Limitations and future research
This study also included important constraints. Brands may not be able to change their
advertising budget due to uncontrollable factors such as long-term marketing strategies of
the company. On the other hand, companies tend to leverage their advertising budget to a
level that does not lose their market penetration. Also, factors such as antiquity, brand
strength, and organisational size can be considered as interventional variables that are not
considered in this study. Therefore, other inputs and outputs may also be available that
have an important effect on the efficiency level that are not considered. The data used in
the present study is limited to only the registered companies in the Iran stock exchange
and small food companies and their representations are not considered for lack of
presenting transparent information. The strategy of continuous advertising and its
implementation in different time intervals has different impacts on advertising. In this
research, this issue is not considered in the investigation of campaigns in time dimension,
which is suggested in future research. Since companies operating in different industries
may have different characteristics and objectives, the results of this study do not allow
active companies in other industries to follow it precisely. Therefore, the research should
be conducted in other industries in future researches. Other variables can also be used
with other types of DEA or other efficiency assessment methods such as stochastic
frontier analysis.
References


Providing a framework for evaluating the advertising efficiency


