Inzinerine Ekonomika-Engineering Economics, **2012, 23(5), 462-470**

Prioritization of Export Promotion Programs by Fuzzy Linear Assignment Method

Seyed Hossein Razavi[1], Shide Sadat Hashemi[2], Edmundas Kazimieras Zavadskas[3*]

[1]*Institute for Trade Studies and Research*
Tehran, Iran
e-mail: s.hossein.r@gmail.com

[2]*Allame Tabatabaei University*
Tehran, Iran
e-mail: shide_hashemi@yahoo.com

[3*]*VilniusGediminasTechnicalUniversity*
Sauletekio al. 11, LT-10223, Vilnius, Lithuania
e-mail: edmundas.zavadskas@vgtu.lt

crossref http://dx.doi.org/10.5755/j01.ee.23.5.2674

Foreign business and export are the most important aspects of business and affect the country economics significantly. Therefore, governments try to stimulate the merchandises to export and extend their business abroad. This leads to better quality, extended markets, more customers and higher income. For this purpose, governments have considered some persuasive programs to promote exporting activities. However these programs do not influence export activities equally and their importance is different in exporters' viewpoint. In this paper we tried to use exporters' preferences and rank these promotion programs based on their opinions. Accordingly, we selected 15 exporters and asked them to rank 18 identified export promotion programs against to their effects on export procedures. The proposed Fuzzy Linear Assignment Method has assured responders that their uncertainty in ranking will be recognized in model. Finally the proposed method is applied for prioritizing the export promotion programs for Iranian food industry. Its results show that ambiguity of scoring among several options would be easy by considering each number as a triangular fuzzy number and it's more precise and reliable.

Keywords: *Fuzzy Linear Assignment Method, triangular fuzzy number, Export Promotion Program, Ranking, Food Industry, Iran.*

Introduction

Exporting is of vital economic importance to trading nations and their firms. Exports boost profitability, improve capacity utilization, provide employment, and improve trade balances (Ahmed *et al.,* 2006). Singer and Czinkota (1994) emphasize that export promotion programs may have a positive impact on export performance because they:

1) Increase firms' informational and experiential knowledge (Kotabe & Czinkota, 1992); 2) Stimulate managers' positive attitudes and perception towards exporting, and 3) Increase export commitment (see also Marandu, 1995). (Lederman *et al.,* 2008), using survey data on TPOs[1] from 88 developed and developing countries, found that export promotion agencies have a strong and statistically significant impact on the countries' total export volumes. In this context of opening borders and the increase in international trade, many enterprises, especially small- to medium-sized ones, do not make the most of all of the potential of foreign markets because of a lack of motivation, capabilities and/or human or financial resources. A whole set of services have been created, offered both through public and private initiatives, with the aim of helping companies to overcome these obstacles (Freixanet, 2011) - called export promotion programs.

Export promotion is defined as an incentive program designed to attract firms into exporting by offering help in product and market identification and development (Korsakiene & Tvaronaviciene, 2012; Travkina & Tvaronaviciene, 2011; Valuckaite & Snieska, 2007; Snieska 2008 a,b; Zhou *et al.,* 2010; Ortiz *et al.,* 2012) prescription and post-shipment, financing, training, payment guaranty schemes, trade fairs, trade visits, foreign representation, (Shamsuddoha *et al.,* 2009; Tang & Liu, 2011; Lages, *et al.,* 2008) used electronic information retrieval methods (Burinskas & Merkuryeva, 2010; Kaklauskas *et al.,* 2010a; Zavadskas, 2010; Kanapeckiene *et al.,* 2011; Azimi *et al.,* 2011; Zavadskas, *et al.,* 2003; Buyukozkan, 2004) and systems (Kaklauskas, *et al.,* 2002 a,b, 2003, 2010b; Zavadskas, *et al.,* 2002, 2005; Kanapeckiene, *et al.,* 2010).

At a micro level, the export of goods and services has become increasingly important for the survival of growth

[1] . Trade Promotion Organizations

oriented domestic firms. At a macro level, exporting is important for dealing with the trade deficit problems experienced by many countries (Julian and Ali 2009). Export promotion schemes can play an important part in the development strategies of countries, especially of developing countries that seek to make exports an engine for economic growth. The expansion of country's exports has positive effects on the growth of the economy as a whole, as well as on individual firms (Julian and O'Cass 2004). In general Export Promotion Programs involve all the measures and programs aimed at assisting current and potential exporters in foreign markets penetration and, for instance, export subsidies, reduced tax rates to exporting firms' earnings, favorable insurance rates, advantageous financial conditions, or variations in the exchange rates. These measures may be addressed to either national exporters or multinational enterprises producing locally (or both).

Government intervenes in the export domain with two aims: 1) to increase export flows. (Harrison & Rodriguez-Clare, 2009; Giles & Williams, 2000), 2) to select the sectors in which the country should specialize. (Dodaro, 1991; Pinerez & Ferrantino, 1997; An & Iyigun, 2004). Assessing the effectiveness of the EPPs is also important to increase awareness by local producers. Empirical evidence shows that not all exporting firms apply to export support programs, even when they are accessible. One reason is that firms may be not aware of the programs' existence and effectiveness. Since applying to programs incurs some costs, the uncertainly related with their success may discourage applications. Accordingly a line of research is aimed at gauging firms' awareness, usage and perceptions of the program; Vanderleest (1996) for the US, Crick (1997) for the UK, Haunschild *et al.,* (2007) for Germany, and Ali (2006) for Australia. Such evaluation of course cannot reveal the impact of the promotion measures on export performance, but can be enlightening when planning, assessment and decision-making (Francis & Collins-Dodd, 2004).

Different studies have been carried out to evaluate EPPs[2]. Balassa,(1978); Kumar Roy, (1993); Ramaseshan & Soutar, (1996); Billings *et al*., (2003); Francis & Collins-Dodd, (2004); Shamsuddoha & Ali, (2006); Zia, (2008); Julian & Ali, (2009); Larbi & Chymes, (2009); Lederman *et al.,* (2010); Freixanet, (2011) and Argent, (2011) have examined the effects of promotion programs on export performance and competency, and realized that they are positively effective. Also Armah and Epperson, (1997); Knowles & Mathur, (1997); Onunkwo and Epperson, (2000) have tried to measure the global impact of specific promotion interventions, and they are mostly centered in the food industry too.

Some studies have indirectly evaluated program effects, considering them among other factors to explain export performance (Crick & Chaudhry, 1997; Katsikeas *et al.,* 1996; Walters 1983). Finally *et al.,* (2001), and Calderon & Fayos, (2004) have measured EPPs' effects using different performance outcomes. Freixanet (2011) segmented companies based on level of export commitment and internationalization. For example for starting/passive exporters, use of direct promotion programs, information, assistance in starting exporting and financial aid programs is positively related with the following export performance measurements. This group requires support to develop their exports, training and information to improve export competencies, and assistance in identifying contacts and opportunities. This segmentation is shown in table1.

Table 1

Export stage and related programs

Stage	Programs	Impact measures
Starting exporter	Direct promotion Information (about market, programs, use of foreign trade offices) Assistance to start exporting Financial aid	Economic performance export planning Market diversification Intermediate results
Regular exporter with little structure	Direct promotion Information Consultancy Export groups Financial aid	Economic performance Export planning Market diversification Intermediate results
Regular exporter with complete structure	Direct promotion	Export profitability Export planning Market diversification Intermediate results
Consolidated exporter with permanent sales est. abroad	Information Consultancy Direct promotion Investment support	Export profitability Export planning Market diversification
Industrial multinational	Consultancy Investment support	Export profitability Export planning

Freixanet (2011) studied a comprehensive set of multidimensional indicators and used Statistical hypothesis testing to probe which companies in different export stages, need various types of promotion programs.

According to above, export promotion programs are effective and on the other hand, they are various and numerous. Therefore companies and enterprises which present these promotion programs should consider a type of priority for their export programs in viewpoint of their customers.

In 1992 TPCC[3] (an interagency organization created to strengthen federal export promotion efforts) was responsible for establishing a government wide strategy for promoting U.S exports. TPCC continued to identify government wide export promotion priorities in terms of export markets, programs and policies, though member agencies have exercised flexibility in focusing their efforts. TPCC's export strategy identifies a series of government wide priorities in terms of foreign markets, export programs, and, most recently, export policies. They ranked their work areas as:

- Assistance to small business.
- Countering tied aid. (United states general accounting office, 1992, online: www.gao.gov/assets/90/85423.pdf)

[2] . Export Promotion Programs

[3] . Trade Promotion Coordinating Committee

As UNECA (2011) shows, export promotion policies include: incentives for export activities; export processing zones; export promotion (manufacturing); standardization, quality improvement for export; measures to attract FDI for export activities; facilitated credit for non-traditional manufacturing; selective tariff protection (peak/high tariffs); utilization of other trade instruments; export duties to favor local manufacturing.

Bruneckiene and Paltanaviciene (2012) have distinguished the factors enhancing export development, possibilities on application of the basic competitiveness models and methods, and then analyzed their application for measurement of the export competitiveness in Baltic States.

In section 2 and 3 we describe the Fuzzy set theory and linear assignment method as two applied techniques of this paper. Then the aggregated method called fuzzy linear assignment is explained and a numerical example shows the application of proposed method in prioritization problems. Finally this paper is concluded in section 6.

Fuzzy set theory

Zadeh (1965) introduced fuzzy set theory as a generalization of classic set theory. Zadeh (1973) believed that "as the complexity of a system increases, our ability to make precise and yet significant statements about its behavior diminishes". Fuzzy set theory provides a mean to overcome this inability. A classical set is defined as a collection of elements or objects $x \in X$. Each single element can either belong to or no belong to a set A, $A \subseteq X$ (Zimmermann, 2001). Fuzzy sets are characterized by their membership functions. Here, an element can belong to a fuzzy set $\widetilde{A}$ with a specific degree $\mu_{\widetilde{A}}(x)$ which is called membership function or degree. The notion of fuzzy numbers can be defined as follows (Dubois and Prade 1980).

Definition1. A fuzzy number $\widetilde{A}$ is a convex normalized fuzzy set on the real line R such that:

1) There exists at least one $x_0 \in R$ with $\mu_{\widetilde{A}}(x_0) = 1$.
2) $\mu_{\widetilde{A}}(x_0)$ is piecewise continuous.

Definition2. A triangular fuzzy number $\widetilde{A}$ can be specified by the ordered triple $\widetilde{A} = (a, b, c)$, with $a \le b \le c$ and its membership function is (Kaufman and Gupta 1985):

$$\mu_{\widetilde{A}} = \begin{cases} \dfrac{x-a}{m-a} & \text{for } a \le x \le m \\ \dfrac{x-c}{b-c} & \text{for } b \le x \le c \\ 0 & \text{otherwise} \end{cases} \qquad (1)$$

Definition3. A triangular fuzzy number $\widetilde{A} = (a, b, c)$ is said to be non-negative fuzzy number if $a \ge 0$.

Definition4. Let $\widetilde{A} = (a, b, c)$ and $\widetilde{B} = (e, f, g)$ be two triangular fuzzy numbers. Then (Kaufman and Gupta, 1985):

(i) $\widetilde{A} + \widetilde{B} = (a+e, b+f, c+g)$

(ii) $-\widetilde{A} = (-c, -b, -a)$

(iii) $\widetilde{A} - \widetilde{B} = (a-g, b-f, c-e)$

(iv) Let $\widetilde{A} = (a, b, c)$ be a non negative triangular fuzzy number and λ being a real scalar. Then $\lambda\widetilde{A} = (\lambda a, \lambda b, \lambda c)$ if $\lambda \ge 0$ and $\lambda\widetilde{A} = (\lambda c, \lambda b, \lambda a)$ if $\lambda \le 0$

Definition5. A ranking function is a function $\Re : F(R) \to R$, where $F(R)$ is a set of fuzzy numbers defined on set of real numbers, which maps each fuzzy number into the real line, where a natural order exists. Let $\widetilde{A} = (a, b, c)$ be a triangular fuzzy number the $\Re(\widetilde{A}) = (a + 2b + c)/4$ (Liou & Wang, 1992).

Linear assignment method

Bernardo and Blin (1977) developed linear assignment method (LAM) as a compensatory model of consumer choice among multi-attribute brands. This method further is extended and applied in some multi-criteria decision making problems (Amiri *et al.,* 2009; Bashiri *et al.,* 2011). This model is based on a product-attribute matrix π as a square $m \times m$ nonnegative matrix whose elements π_{ij} represents the frequency that A_i is ranked the k^{th} attribute-wise ranking. If attributes have different weights, then π_{ij} will be the sum of the weights of those attributes that in which A_i take the rank *j*. It is understood that π_{ij} measures the contribution of A_i to the overall ranking, if A_i is assigned to the k^{th} overall rank. Hence the problem is to find π_{ij} for each *j*, $j = 1,2,\ldots,m$, maximizes $\sum_{j=1}^{m} \pi_{ij}$. This is an *m!* comparison problem which can be solved with an linear programming model.

Suppose that *P* is defined as a permutation matrix $m \times m$ whose elements $p_{ij} = 1$ if A_i is assigned to overall rank *k*, and $p_{ij} = 0$ otherwise. The linear assignment method can be written as the following linear programming model (Lai and Hwang, 1992):

$$\max \sum_{i=1}^{m}\sum_{j=1}^{m} \pi_{ij} p_{ij}$$

subject to

$$\sum_{i=1}^{m} p_{ij} = 1, \quad i = 1,2,\ldots,m \quad (2-1) \qquad (2)$$

$$\sum_{j=1}^{m} p_{ij} = 1, \quad j = 1,2,\ldots,m \quad (2-2)$$

$$p_{ij} = 0 \text{ or } 1, i, j = 1,2,\ldots,m$$

Since $p_{ij} = 1$ means that alternative A_i is assigned to overall rank *k* and clearly alternative *i* can be assigned to only one rank, therefore Eq. (2-1) is held. Likewise, a given rank *k* can only have one alternative assigned to it and so the Eq. (2-2) is held.

Fuzzy linear assignment

The ranking of a set of alternatives regard to a given objective or criterion is often a difficult task which contains ambiguity and uncertainty. A decision maker might be doubtful about which of alternatives A_k and A_l can be laid in rank *j*. Therefore the decision maker assigns both A_k and A_l to rank *j* that this trepan to tie. To avoid this shortcoming of ordinal LAM, in this paper a fuzzy LAM (FLAM) is proposed.

Suppose that a problem is on hand to rank a set of *m* alternatives. When a decision maker is asked to rank the alternatives regard to his or her preferences, he or she can assign each alternatives a rank among a set of fuzzy ranks like $\tilde{J} = \{\tilde{1}, \tilde{2}, \ldots, \tilde{m}\}$, where each $\tilde{j} \in \tilde{J}$ is a symmetric triangular fuzzy number $\tilde{j} = (j-1, j, j+2)$. Therefore, the set of ranks can be shown as:

$$\tilde{J} = \{(1,1,2),(1,2,3),\ldots,(m-1,m,m)\} \quad (3)$$

When a decision maker is envisaged with a set of ranks like $\tilde{J}$, it will satisfy his or her sights more better than a crisp set of ranks and the likelihood of creation of tie will be decreased. Now, suppose that a set of *n* experts express their opinions regard to ranking of alternatives and product-attribute matrix is formed as follows.

Alternatives \ Rank	$\tilde{1}$	$\tilde{2}$	$\cdots$	$\tilde{m}$
A_1	$\pi_{1\tilde{1}}$	$\pi_{1\tilde{2}}$	$\cdots$	$\pi_{1\tilde{m}}$
A_2	$\pi_{2\tilde{1}}$	$\pi_{2\tilde{2}}$	$\cdots$	$\pi_{2\tilde{m}}$
$\vdots$	$\vdots$	$\vdots$	$\cdots$	$\vdots$
A_m	$\pi_{m\tilde{1}}$	$\pi_{m\tilde{2}}$	$\cdots$	$\pi_{m\tilde{m}}$

Where, $\pi_{i\tilde{j}}$ is the frequency of assigning the fuzzy rank $\tilde{j}$ to alternative A_i by decision makers. The problem is to find the best assignment of alternatives to ranks such that $\sum_{\tilde{j}=\tilde{1}}^{\tilde{m}} \pi_{i\tilde{j}}$ be maximized. A fuzzy state variable $\tilde{f}_{ij} = (f_{ij-1}, f_{ij}, f_{ij+1})$ is defined such that if A_i is assigned to rank *j*, then $f_{ij} = 1$ and other elements of $\tilde{f}_{ij}$ will be zero. Hence, the FLAM model cab stated as follows:

$$\begin{aligned} &\max \sum_{i=1}^{m}\sum_{j=1}^{m} \pi_{ij}\tilde{f}_{ij} \\ &\text{subject to} \\ &\sum_{i=1}^{m} \tilde{f}_{ij} = \tilde{1}, \quad j = 1,2,\ldots,m \quad (4-1) \\ &\sum_{j=1}^{m} \tilde{f}_{ij} = \tilde{1}, \quad i = 1,2,\ldots,m \quad (4-2) \\ &f_{ij} = 0 \, or \, 1, i, j = 1,2,\ldots,m \end{aligned} \quad (4)$$

Where $\tilde{1} = (1,1,1)$ in the right hand side of (4-1) and (4-2). Model (4) is a fuzzy pure 0-1 model which can be considered as an assignment model. This model can be modified according to the approach proposed by Kumar et al. (2011).

According to Kumar et al. (2011) approach, the maximization of model (4)'s objective function is equivalent to $\max \Re\left(\sum_{i=1}^{m}\sum_{j=1}^{m} \pi_{ij}\tilde{f}_{ij}\right)$ that the function $\Re$ is defined as definition 5.

On the other hand, the constraints (4-1) can be rewritten as follows:

$$\left(\sum_{i=1}^{n} f_{ij-1}, \sum_{i=1}^{n} f_{ij}, \sum_{i=1}^{n} f_{ij}\right) = (1,1,1) \quad (5)$$

Eq. (5) is equivalent to say that:

$$\begin{cases} \sum_{i=1}^{n} f_{ij-1} = 1 \\ \sum_{i=1}^{n} f_{ij} = 1 \\ \sum_{i=1}^{n} f_{ij+1} = 1 \end{cases} \quad (6)$$

Likewise, constraints (4-2) are transformed to the following form:

$$\begin{cases} \sum_{j=1}^{n} f_{ij-1} = 1 \\ \sum_{j=1}^{n} f_{ij} = 1 \\ \sum_{j=1}^{n} f_{ij+1} = 1 \end{cases} \quad (7)$$

Therefore, the final form of FLAM will be as follows:

$$\begin{aligned} &\max \Re\left(\sum_{i=1}^{m}\sum_{j=1}^{m} \pi_{ij}\tilde{f}_{ij}\right) \\ &\text{subject to} \\ &(6)-(7) \\ &f_{ij} = 0 \, or \, 1, i, j = 1,2,\ldots,m \end{aligned} \quad (8)$$

The model (8) transforms the FLAM to an ordinal linear assignment model that can be solved by current methods.

Application of FLAM in Prioritization of export promotion programs in Iranian food industries

This study addresses export promotion programs (EPPs) in food industry of Iran and prioritizes these

programs from the viewpoints of exporters. For this purpose, research team identified a set of 18 export promotion programs and selected 5 successful, 5 ordinary and 5 weaker merchandises in food industry. Then, they have been asked to prioritize these programs (Table 2). In this study the responders were able to rank EPPs based on fuzzy ranks from $(1,1,2)$ in first place to $(17,18,18)$ in 18th place. This ranking scheme will decrease the ambiguity of experts to assign a crisp and certain rank to a given EPP in comparison with other programs.

Table 2

Product – attribute matrix

EPPs \ Rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Export rewards	3	2	1	0	1	0	0	1	0	2	0	1	0	0	1	0	0	3
Tax shield	3	1	2	0	1	0	1	1	0	3	0	0	0	0	1	0	0	2
International exhibitions	2	1	0	2	4	0	1	0	0	0	1	0	1	0	0	1	1	1
Sending and receiving trade missions	2	2	1	1	1	1	0	0	1	1	0	1	0	2	0	1	0	1
Promotion and marketing	1	2	0	1	1	0	1	1	1	0	1	0	0	0	1	1	2	2
Support insurance	1	1	1	1	2	0	1	2	1	0	1	1	0	1	0	0	0	2
Currency support	3	1	1	2	0	0	3	0	1	1	1	0	0	0	0	0	0	2
Financial support	1	1	2	0	0	2	0	0	0	1	1	0	0	0	1	1	1	4
Customs protection	3	0	1	2	2	1	0	0	1	0	0	0	3	0	0	0	1	1
Establishing overseas Trade center	1	0	1	0	1	1	0	0	0	0	1	2	1	1	2	2	1	1
Protection of packaging for export	1	0	2	1	1	1	1	1	1	2	0	0	0	1	1	0	0	2
Consultancy, train and announcement	1	1	0	0	0	1	0	2	0	1	1	2	1	1	0	2	0	2
Protection of transfer for export	3	3	2	1	0	1	1	0	0	1	0	1	0	0	0	0	0	2
Enrichment and empowerment for export infrastructures	3	3	1	0	0	1	1	1	0	0	1	0	0	2	0	0	0	2
SMEs promotions	0	0	1	0	1	0	0	0	1	1	1	0	1	0	3	1	1	4
Commercial cluster development	0	0	0	0	1	0	0	1	1	1	1	1	0	1	1	0	2	5
Establishing export consortium and enterprise	1	0	0	0	3	0	1	0	0	2	0	1	1	0	0	1	1	4
Protection of R&D with export purpose	2	1	1	0	1	1	0	0	1	2	0	1	1	0	0	2	0	2

After they ranked these programs according to their preference (Table 2), we translated these undetermined numbers into determined ones. For example, decision maker may express that *i*th alternative is preferred 6 times to *j*th alternative. We can transform this crisp number to a fuzzy number as $[(5,6,7)]$. The FLAM model in this case can be written as follows:

$$\max \sum_{i=1}^{18}\sum_{j=1}^{18} \pi_{ij} \frac{f_{ij-1} + 2f_{ij} + f_{ij+1}}{4}$$

$$\text{subject to}$$

$$\sum_{i=1}^{18} f_{ij} = 1,\ j = 1,2,\ldots,18 \qquad (9)$$

$$\sum_{j=1}^{18} f_{ij} = 1,\ i = 1,2,\ldots,18$$

$$f_{ij} = 0\ or\ 1, i, j = 1,2,\ldots,18$$

After model (9) is solved, the alternatives (EPPs) are prioritized and its results are presented in Table. 3.

Table 3

Prioritization of Export Promotion Programs

EPPs	Rank
Export rewards	1
Enrichment and empowerment for export infrastructures	2
Protection of transfer for export	3
Customs protection	4
International exhibitions	5
Financial support	6
Currency support	7
Support insurance	8
Protection of packaging for export	9
Tax shield	10
Protection of R&D with export purpose	11
Consultancy, train and announcement	12
Establishing export consortium and enterprise	13
Sending and receiving trade missions	14
SMEs promotions	15
Establishing overseas Trade center	16
Promotion and marketing	17
Commercial cluster development	18

Conclusions

According to importance of export in economics for countries, governments try to establish some organizations and set up procedures as "export promotion programs" to extend the commercial relations and develop exportation. For these purposes, in this paper we selected 18 export promotion programs to prioritize based on merchandise preferences. According to obtained results, the first group of programs including: "export rewards", "Enrichment and empowerment for export infrastructures", "Protection of transfer for export", "Customs protection", "International exhibitions" and "Financial support" are the most important promotion programs; therefore rewards play the major role in export development. This group shows that exporters need a combination of essential requirements such as infrastructural and financial supports. Also this category emphasizes on significant role of transportation, custom and finance and they could be called *"basic requirements"*. The second group consist of "Currency support", "Support insurance", "Protection of packaging for export", "Tax shield", "Protection of R&D with export purpose" and "Consultancy, train and announcement", that shows merchandises require "*supportive actions"* in second stage. Finally the third group including: "Establishing export consortium and enterprise", "Sending and receiving trade missions", "SMEs promotions", "Establishing overseas Trade center", "Promotion and marketing" and "Commercial cluster development", implies the low role of different actions so called *"subsidiary actions"*.

Regard to importance of categorizing promotion programs, the proposed method has considered ranks as fuzzy numbers to assure responders that their crisp numbers include an interval number and this ranking scheme will decrease the ambiguity of experts to assign a crisp and certain rank to a given EPP in comparison with other programs.

References

Ahmed, Z. U., Julian, C. C., Baalbaki, I., & Hadidian, T. V. (2006). Firm Internationalization and Export incentives From a Middle Eastern Perspective. *Journal of Small Business and Enterprise Development* 13(4), 660-669. http://dx.doi.org/10.1108/14626000610705804

Ali, M. Y. (2006). *Barriers to Export and Export Promotion Programs: Insights from SME Managers.* Mimeo, Queensland University of Technology.

Amiri, M., Zandieh, M., Soltani, R., & Vahdani, B. (2009). A Hybrid Multi-Criteria Decision-Making Model for Firms Competence Evaluation. *Expert Systems with Applications* 36(10), 12314-12322. http://dx.doi.org/10.1016/j.eswa.2009.04.045

An, G., & Iyigun, M. F. (2004). The Export Skill Content, Learning by Exporting and Economic Growth. *Economic Letters* 84(1), 29-34. http://dx.doi.org/10.1016/j.econlet.2003.12.008

Argent, J. (2011). Price Incentives to Rwanda's Exporters: Trade Policy Priorities. *International Growth Centre, Rwanda Policy Note Series* (2), 1-4.

Armah, B., & Epperson, J. (1997). Export Demand for U.S. Orange Juice Impact Sof U.S. Export Promotion Programs. *Agribusiness* 13, 1-10. http://dx.doi.org/10.1002/(SICI)1520-6297(199701/02)13:1<1::AID-AGR1>3.0.CO;2-8

Azimi, R., Yazdani-Chamzini, A., Fouladgar, M. M., Zavadskas, E. K., & Basiri, M. H. (2011). Ranking the Strategies of Mining sector Through ANP and TOPSIS in a SWOT Framework. *Journal of Business Economics and Management* 12(4): 670-689. http://dx.doi.org/10.3846/16111699.2011.626552

Balassa, B. (1978). Export Incentives and Export Performance in Developing Countries: a Comparative Analysis. *Review of World Economics* 114(1), 24-61.

Bashiri, M., Badri, H., & Hejazi, T. H. (2011). Selecting Optimum Maintenance Strategy by Fuzzy Interactive Linear Assignment Method. *Applied Mathematical Modelling* 35 (1), 152-164. http://dx.doi.org/10.1016/j.apm.2010.05.014

Bernardo, J. J., & Blin, J. M. (1977). A Programming Model of Consumer Choice Among Multi-Attributed Brands. *Journal of Consumer Research* 4(2), 111-118. http://dx.doi.org/10.1086/208686

Billings, B. A., McGill, G. A., & Mougoue, M. (2003). The Effect of Export tax Incentives on Export Volume: the DISC/FSC Evidence. *Advances in Taxation* 15, 1-28. http://dx.doi.org/10.1016/S1058-7497(03)15001-6

Bruneckiene, J., & Paltanaviciene, D. (2012). Measurement of Export Competitiveness of the Baltic States by Composite Index. *Inzinerine Ekonomika-Engineering Economics,* 23(1), 50-62.

Burinskas, A., Burinskiene, A., & Merkurjeva, G. (2010). Evaluation and Comparison of Selling Terms in International e-commerce. *European Integration Studies* (4), 30-39.

Buyukozkan, G. (2004). Multi-Criteria Decision Making for e-Marketplace Selection. *Internet Research,* 14(2), 139-154. http://dx.doi.org/10.1108/10662240410530853

Calderon, H., & Fayos, T. (2004). Analisis de la Relacion Entre el Compromiso Exportador y las Ayudas a la Internacionalizacio´n de las Empesas, *Investigaciones Europeas de Direccio´n y Economı´a de la Empresa* 10(2), 201–220.

Crick, D. (1997). 'UK SMEs' Awareness, Use, and Perceptions of Selected Governmental Export Assistance Programs: An Investigation into the Effect of the Internationalization Process. *The International Trade Journal* 11(1), 135-167. http://dx.doi.org/10.1080/08853909708523876

Crick, D., & Chaudhry, S. (1997). Small Businesses' Motives for Exporting. The Effect of Internationalization. *Journal of Marketing Practice: Applied Marketing Science* 3(3), 156–170. http://dx.doi.org/10.1108/EUM0000000004340

Dodaro, S. (1991). Comparative Advantage, Trade And Growth: Export-Led Growth Revisited. *World Development,* 19(9), 1153-1165. http://dx.doi.org/10.1016/0305-750X(91)90064-O

Dubois, D., & Prade, H. (1980). *Fuzzy Sets and Systems: Theory and Applications*. New York, Academic Press.

Francis, J., & Collins-Dodd, C. (2004). Impact of Export Promotion Programs on Firm Competencies, Strategies and Performance: The case of Canadian high-technology SMEs. *International Marketing Review* 21 (4-5), 474-495. http://dx.doi.org/10.1108/02651330410547153

Freixanet, J. (2011). Export Promotion Programs: Their Impact on Companies' Internationalization Performance and Competitiveness. *International Business Review,* doi:10.1016/j.ibus-rev.2011.12.003 (in press).

Gencturk, E. F., & Kotabe, M. (2001). The Effect of Export assistance Program Usage on Export Performance. *Journal of International Marketing,* 9(2), 51-72. http://dx.doi.org/10.1509/jimk.9.2.51.19886

Giles, J. A., & Williams, C. L. (2000). Export-Led Growth: a Survey of the Empirical Literature and Some Noncausality Results Part I, *Econometrics Working Papers 0001*. Department of Economics, University of Victoria.

Gutierrez de Pineres, S. A., & Ferrantino, M. (1997). Export Diversification and Structural Dynamics in the Growth Process: The case of Chile. *Journal of Development Economics* 52(2), 375-391. http://dx.doi.org/10.1016/S0304-3878(96)00446-4

Harrison, A., & Rodriguez-Clare, A. (2009). Trade, Foreign Investment, and Industrial Policy for Developing Countries, NBER Working Papers, 15261.

Haunschild, L., Hauser, C., Gunterberg, B., Muller, K., & Solter, A. (2007). *Die Bedeutung der außenwirtschaftlichen Aktivitäten für den deutschen Mittelstand*, Gutachten im Auftrag des Bundesministeriums fur Wirtschaft und Technologie, *IfM-Materialie*, 171.

Julian, C. C., & Ali, M. Y. (2009). Incentives to Export for Australian Export Market Ventures. *Journal of Small Business and Enterprise Development* 16(3), 418-431.

Julian, C. C., & O'Cass, A. (2004). The Antecedents of Export Marketing Performance: An Australian Perspective. *Journal of Asia Pacific Marketing* 3(2/3), 99-113. http://dx.doi.org/10.1108/14626000910977143

Kaklauskas, A., Zavadskas, E. K., Kaminskas, A. Z., Trinkunas, V., & Kaklauskiene, J. (2002a). Efficiency Increase of Export on-line Systems by Applying Multiple Criteria Decision Support Systems, ICEB 2002: *Proceedings of the Second International Conference on Electronic Business: Global E-Business in Knowledge-Based Economy: Management, Practice, and Opportunities*. December 10-13, 2002 Grand Hotel, Taipei, Taiwan. Taiwan, 45-47.

Kaklauskas, A., Zavadskas, E. K., Banaitis, A., & Trinkunas, V. (2002b). Efficiency Increase of Export e-Commerce systems by applying multiple criteria, 9th International Multi-Conference Advanced Computer Systems "ACS'2002"-"SCM'2002": *Product System Design, Supply Chain Management and Logistics.* Part II: proceedings: Międzyzdroje, Poland October 23-25, 2002. Szczecin, 2002. ISBN 8387362468. 589-597.

Kaklauskas, A., Zavadskas, E. K., Gikys, M., & Gulbinas, A. (2003). Multiple criteria Property E-Business system, Construction Innovation and Global Competitiveness. The Organization and Management of Construction. Vol. 1, 2: *10th International Symposium on Construction Innovation and Global Competitiveness*. Cincinnati, Ohio, September 9th-13th, 2002. Cincinnati : Crc Press Inc, Boca Ration, 739-752.

Kaklauskas, A., Zavadskas, E. K., Seniut, M., Vainiuas, P., Krutinis, M., & Tupenaite, L. (2010a). Electronic Information Retrieval Method and System. European Patent Application EP 2 187 319 A1, Bulletin 21010/20.

Kaklauskas, A., Zavadskas, E. K., Pruskus, V., Vlasenko, A., Seniut, M., Kaklauskas, G., Matuliauskaite, A., & Gribniak, V. (2010b). Biometric and Intelligent Self-Assessment of Student Progress System, *Computers & Education* 55(2): 821-833. http://dx.doi.org/10.1016/j.compedu.2010.03.014

Kanapeckiene, L., Kaklauskas, A., Zavadskas, E. K., & Seniut, M. (2010). Integrated Knowledge Management Model and System for Construction Projects. *Engineering Applications of Artificial Intelligence* 23(7): 1200-1215.

Kanapeckiene, L., Kaklauskas, A., Zavadskas, E. K., & Raslanas, S. (2011). Method and System for Multi-Attribute Market Value Assessment in Analysis of Construction and Retrofit Projects. *Expert Systems with Applications* 38(11): 14196-14207. http://dx.doi.org/10.1016/j.engappai.2010.01.030

Katsikeas, C., Piercy, N., & Ioannidis, C. (1996). Determinants of Export Performance in a European Context. *European Journal of Marketing* 30(6), 6–35. http://dx.doi.org/10.1108/03090569610121656

Kaufmann, A., & Gupta, M. M. (1985). *Introduction to Fuzzy Arithmetic Theory and Applications*, New York, Van Nostrand Reinhold.

Knowles, L., & Mathur, I. (1997). The Effectiveness of the Foreign Trade Zone as an Export Promotion Program. Policy Issues and Alternatives. *Journal of Macro marketing* 17(2), 20–31. http://dx.doi.org/10.1177/027614679701700203

Korsakiene, R., & Tvaronaviciene, M. (2012). The Internationalization of SMEs: an Integrative Approach, *Journal of Business Economics and Management* 13(2), 294-307. http://dx.doi.org/10.3846/16111699.2011.620138

Kotabe, M., & Czinkota, M. R. (1992). State Government Promotion of Manufacturing Exports: A Gap Analysis. *Journal of International Business Studies* 23(4), 637-658. http://dx.doi.org/10.1057/palgrave.jibs.8490281

Kumar Roy, D. (1993). Impact of Incentives on Export Performance of Bangladesh: A Preliminary Assessment. *The Bangladesh development studies* 21(2), 25-44.

Kumar, A., Kaur, J., & Singh, P. (2011). A New Method for Solving Fully Fuzzy Linear Programming Problems. *Applied Mathematical Modeling* 35(2), 817-823. http://dx.doi.org/10.1016/j.apm.2010.07.037

Lai, Y. J., & Hwang, C. L. (1992). A New Approach to Some Possibility Linear Programming Problem. *Fuzzy Sets and Systems* 49(2), 121-133. http://dx.doi.org/10.1016/0165-0114(92)90318-X

Lages, L. F., Jap, D. S., & Griffith, A. D. (2008). The role of past Performance in Export Ventures: a Short-Term Reactive Approach. *Journal of International Business Studies* 39(2): 304-325. http://dx.doi.org/10.1057/palgrave.jibs.8400339

Larbi, W., & Chymes, A. (2009). *The impact of the Government Policies and Incentives to Promote the Export of Agricultural Products in Tunisia: Case of Olive oil*, 113th EAAE Seminar "A resilient European food industry and food chain in a challenging world", Chania, Crete, Greece, date as in: September 3 - 6, 2009.

Lederman, D., Olarreaga, M., & Payton, L. (2008). *Export Promotion Agencies: What Works and What Doesn't*. *CEPR* Discussion Paper, DP5810.

Lederman, D., Olarreaga, M., & Payton, L. (2010). Export Promotion Agencies: Do they work? *Journal of Development Economics* 91, 257-265. http://dx.doi.org/10.1016/j.jdeveco.2009.09.003

Liou, T. S., & Wang, M. J. (1992). Ranking Fuzzy Numbers with Integral Value. *Fuzzy Sets and System* 50(3), 247–255. http://dx.doi.org/10.1016/0165-0114(92)90223-Q

Marandu, E. E. (1995). Impact of Export Promotion on Export Performance: A Tanzanian Study. *Journal of Global Marketing* 9(1-2), 9-39. http://dx.doi.org/10.1300/J042v09n01_02

Onunkwo, I. M., & Epperson, J. E. (2000). Export Demand for U.S. Pecans: Impact of US Export Promotion Programs, *Agribusiness* 16(2), 253-265. http://dx.doi.org/10.1002/(SICI)1520-6297(200021)16:2<253::AID-AGR8>3.0.CO;2-O

Ortiz, R. F., Ortiz, J. A., & Ramirez, A. M. (2012). How Does Management Perceive Exporting? An Empirical Study of SMEs. *Inzinerine Ekonomika-Engineering Economics,* 23(2), 200-208.

Ramaseshan, B., & Soutar, G. N. (1996). Combined Effects of Incentives and Barriers on firm's Export Decisions. *International Business Review* 5(1), 53-65. http://dx.doi.org/10.1016/0969-5931(95)00032-1

Shamsuddoha, A. K., & Ali, M. Y. (2006). Mediated effects of Export Promotion Programs on firm Export Performance. *Asia pacific Journal of Marketing and Logistic* 18(2), 93-110. http://dx.doi.org/10.1108/13555850610658255

Shamsuddoha, A. K., Ali, Y. M., & Ndubisi, N. O. (2009). Impact of Government Export Assistance on Internationalization of SMEs from Developing Nations. *Journal of Enterprise Information Management* 22(4), 408-422. http://dx.doi.org/10.1108/17410390910975022

Singer, T. O., & Czinkota, M. R. (1994). Factors Associated with Effective Use of Export Assistance. *Journal of International Marketing* 2(1), 53-71.

Snieska, V. (2008a). Research into International Competitiveness in 2000–2008. *Inzinerine Ekonomika -Engineering Economics*(4), 29-41.

Snieska, V. (2008b). A New Textbook on International Trade. *Inzinerine Ekonomika-Engineering Economics* (1), 120-121.

Tang, J., & Liu, B. (2011). A Network Based Theory of Foreign Market Entry Mode and Post-Entry Performance. *International Journal of Business and Social Science* 2(23), 51-59.

Travkina, I., & Tvaronaviciene, M. (2011). Export Competitiveness and domestic productivity facets: case of Lithuania. *Journal of Business Economics and Management,* 12(1), 49-68. http://dx.doi.org/10.3846/16111699.2011.555360

UNECA. (2011). *Industrial Policies for the Structural Transformation of African Economies: Options and Best Practices* (Addis Ababa: United Nations Commission for Africa).

Valuckaite, A., & Snieska, V. (2007). Export Pricing in Business-to-Business Market. *Inzinerine Ekonomika-Engineering Economics*(4), 103-109.

Vanderleest, H. W. (1996). What New Exporters Think About US Government-Sponsored Export Promotion Services and Publications. *Multinational Business Review* 4(2), 21-30.

Walters, P. (1983). Export Information Sources – A Study of their Usage and Utility. *International Marketing Review* 1, 33-43. http://dx.doi.org/10.1108/eb008250

Zadeh, L. A. (1965). Fuzzy sets. *Information and Control* 8, 338–353. http://dx.doi.org/10.1016/S0019-9958(65)90241-X

Zadeh, L. A. (1973). *The Concept of a Linguistic Variable and its Application to Approximate Reasoning.* Memorandum ERL-M 411 Berkley, October 1973.

Zavadskas, E. K., Kaklauskas, A., & Trinkunas, V. (2002). Increase of Efficiency of Construction Materials e-commerce systems applying intelligent agents, *The Organization and Management of Constr 10th International Symposium : Construction Innovation and Global Competitiveness*. September 9th-13th, 2002, Cincinnati, Ohio, USA. Ohio, 2002. p. 1-13.

Zavadskas, E. K., Kaklauskas, A., Trinkunas, V., & Trinkuniene, E. (2003). Model of Construction e-Business System, *Modelling and Simulation of Business Systems: International Conference,* May 13-14, 2003, Vilnius, Lithuania. Kaunas: Technologija, p. 359-363.

Zavadskas, E. K., Kaklauskas, A., & Trinkunas, V. (2005). eGovernment and Intelligent Systems for International Trade. Electronic Government: Workshop and Poster Proceedings of the International EGOV Conference 22-26 August 2005. Denmark. Schriftenreihe Informatik, Band 15. Linz: Trauner Verlag, 366-373.

Zavadskas, E. K. (2010). Automation and Robotics in Construction: International Research and Achievements. *Automation in Construction* 19(3), 286-290. http://dx.doi.org/10.1016/j.autcon.2009.12.011

Zhou, T., Lin, G., & Li, Y. (2010). Determinants of Interest in the Acquisition of Export Skills for Chinese Exporters. *Journal of Technology Management in China* 5(3), 196-212. http://dx.doi.org/10.1108/17468771011086229

Zia, B. H. (2008). Export Incentives, Financial Constraints, and the (mis) Allocation of Credit: Micro-level Evidence from Subsidized Export Loans. *Journal of Financial Economics* 87, 498-527. http://dx.doi.org/10.1016/j.jfineco .2006.12.006

Zimmermann, H. J. (2001). *Fuzzy Set Theory - and Its Applications*. Kluwer Academic Publishers Group, Dordrecht. The Netherlands.

Seyed Hossein Razavi, Shide Sadat Hashemi, Edmundas Kazimieras Zavadskas

Eksporto skatinimo programų parinkimas taikant tiesinių lygčių su neraiškiaisiais skaičiais metodą

Santrauka

Šalies ekonomikos ir verslo plėtrai labai svarbus užsienio eksporto ir verslo augimas. Vyriausybės nuolat skatina plėtoti prekybą užsienyje, plėsti eksportą, skatinti verslą, nes tai sąlygoja geresnę kokybę, besiplečiančią rinką, daugiau pirkėjų ir didesnes pajamas. Dėl šių priežasčių vyriausybės diegia eksportą skatinančias programas. Tačiau šios programos neturi tiesioginės įtakos eksporto veiklai. Be to, jų svarba eksportuotojų požiūriu skiriasi. Šiame straipsnyje, autoriai, atsižvelgdami į eksportuotojų nuomonę, pačias eksporto skatinimo programas vertino pačių eksportuotojų požiūriu. Todėl buvo apklausta 15 eksportuotojų ir paprašyta jų pažymėti pagal svarbą 18 eksporto skatinimo programos būdų. Autorių siūlomas Fuzzy Linear Assignment metodas padeda atsiradusius reitigavimo neapibrėžtumus atpažinti modelyje. Galiausiai siūlomas metodas buvo taikomas suteikiant prioritetą Irano maisto pramonės eksporto skatinimo programoms vertinti. Išvados rodo, kad atsiradęs neaiškumas tarp kelių alternatyvų, lengviau ir patikimiau išsprendžiamas taikant neraiškiųjų skaičių teoriją.

Raktažodžiai: *Fuzzy Linear Assignment metodas, neraiškieji skaičiai, eksporto skatinimo programa, reitingavimas, maisto pramonė, Iranas.*

The article has been reviewed.

Received in October, 2012; accepted in December, 2012.