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An Assessment of the Causal Model of Effective Metrics on Urban Competitiveness Using a Fuzzy DEMATEL Approach

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Abstract: At the beginning of the 21st century, globalization and innovation in the field of information technology and, consequently, the formation of the flow of space, have made cities, in national spaces, like multinational corporations, increasingly compete gain economic benefits. In the past, competition was associated with companies and manufacturing institutions, but as globalization and networking of the global economy began to emerge, cities have always enjoyed a special status as a node in network economy, and it is believed that the competition is at the same level with national competition. Today, perhaps one of the most successful ways to transform a city into a city with a successful economy is to use the concept of a competitive city. Competitiveness of cities has a crucial role in urban development, and in this way, it will provide sustainable revenues for urban managers in these urban areas. Therefore, this research has been conducted with the aim of explaining the causal model of effective measures on the competitiveness of the city. The present research is applied in terms of purpose, and descriptive-causal based on method. The statistical sample of the study consisted of 30 experts related to urban economics. In order to achieve the aim of the study, fuzzy DEMATEL technique was used. The research findings indicated that based on D-R values, among the four criteria of urban competitiveness, the economic criterion with the value of 0.833 is the most influential and the environmental criteria with the value of 0.689 has been influenced the most of urban competitiveness. In addition, based on D+R-values, the economic criterion with the value of (2.671) was identified as the most important criterion for urban competitiveness.

Keywords: Assessment, Urban Competitiveness, City Economy, Fuzzy Dematel
JEL Classification: O18, C52, C29, P25

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1- Introduction

The process of later globalization, which, in its most primitive form, has been characterized by the globalization of the economy, is based on the thinking of neoliberalism. In fact, this is the globalization that influences the lives of the people of the world in the form of the universalization of the market model, outward expansion and prosperity. Economic globalization has caused dramatic changes in cities across the world. These changes are about not only the economy, but also social, cultural, political and structural aspects. The process has been accompanied by the synchronization process called localization, which has led to the emergence of a "global / local identity" (Saez, Perianez, 2015). Urban globalization and the urbanization of the world have led to a change in the role of cities in the global system, and this phenomenon has made the free movement of goods, human beings, information and capital smoother, faster, wider and more effective than before. This makes it important to understand concepts such as competitiveness and competition between Cities have been (Nejati Hosseini, 2011). Urban Economics is the basis for the development of social satisfaction and environmental protection, which determines the position and functioning of a city in competition with the domestic and international environment (Budd & Hirmis, 2004). Urban globalization and the urbanization of the world have led to a change in the role of cities in the global system, and this phenomenon has made the free movement of goods, human beings, information and capital smoother, faster, wider and more effective than before. This makes it important to understand concepts such as competitiveness and competition between cities (Nejati Hosseini, 2011). In the past, competition was associated with manufacturing companies and institutions but cities have always enjoyed a special status as nodes of network economics by forming globalization and networking of the global economy. In fact, cities are placed in the global economy context. Cities play a role in the international division of labor and production on a global scale (Cochrane, 2007). Cities are the national and international motor centers of economic and social growth and provide the ground for reaching national goals in the economic, social, political, and cultural fields (Pengfei and Kresl, 2011). This has led to the urban competition to be expanded. It is believed that the competition is as equal as national competition such that competitiveness has become one of the most widely used concepts in the urban and regional issue areas (Sasan Poor & Hatami, 2017). In many countries, urban policy is affected by the increased competition and competitive situation among cities at both national and international levels (Molotch et al, 2000). Today, perhaps one of the most successful ways to transform a city to a city having a successful economy is to use the concept of a competitive city. Competitiveness of cities has a crucial role in urban development. In this regard, it will provide sustainable income gaining for urban managers in these urban areas (Shen, 2004). In other words, cities can compete with their economies and their names among other cities. The opening up of national economies to world markets has led cities not only to play rivals with other cities in their countries, but also to play a transnational role. Identification of city competitiveness criteria, a guide to foster national urban

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policies and understanding of these criteria, and their importance help to identify more effectively the current situation of cities and the possibility of predicting, formulating and implementing more effective development policies in a targeted way. (Samani, 2014). On the other hand, one of the most important areas for creating a competitive city that is able to compete with other cities at international level is the recognition and attention to the most common criteria in the area of competitiveness of the city. This research seeks to answer the following questions:

What are the effective criteria on the competitiveness of cities?

How is the model of causal relationships of effective criteria on urban competitiveness?

How is the model of causal relationships sub-criteria of urban competitiveness?

2- Literature Review

A) Foreign Researches

Zaho et al., (2017) investigated the role of bridge construction in promoting the competitiveness of port cities. Research findings indicate that port cities do not have a significant advantage to attract foreign direct investment than other cities. In addition, the competitiveness of port cities depends on the geographic characteristics of these cities, and the construction of bridges will enhance the attractiveness of port cities.

Saez & Perianez (2015) have explored the competitiveness of the city in Europe in order to attract investment. The results confirm that there is a significant relationship between identified indicators for attracting investment with urban competitiveness indices.

Papa et al., (2014) have been studying Italian cities in terms of urban competitiveness measures from 1995 to 2013. The results of this study indicate that the cities of Italy, in addition to having criticized the economy of the country, have improved their competitiveness indices in the midst of their time.

Herchel (2013), in a study titled "Urban Competitiveness and Sustainable Development," states that cities are not only economically viable to meet the needs of their citizens, but also have a higher comparative advantage in their global competitors, so that they can be devastated by more opportunities, so that to be effective, with the ability to capture more opportunities, both in the construction of the national economy, and to have a higher level of quality of life and more stable and fair conditions for their citizens

Sinjalal et al., (2013) in this research entitled “An Applied Model for Assessing the Competitiveness of England Cities” while presenting the advantages of urban competitiveness for the citizens, using the hierarchical analysis model, the authors have investigated the role of urban regeneration as well as the extent to which enterprises are deployed in the competitiveness of cities. The results indicate that among the cities surveyed, Birmingham has the highest rating of the competitiveness indicators in this study.

Yohang & Lijiang (2012) have conducted a research entitled Urban “Competitiveness Structuralization from the Information City’s perspective”. In this research, urban competitiveness is divided into traditional and information-based city viewpoints. The traditional view is based on space, if the view of urban competitiveness is based on the flow of space. The main sources of competition are in the traditional view of internal resources if, in the view of the

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city, information is the main source of internal and external competition.

Comparative Comparison of the Urban Capacity of Metropolises in the World is the title of research that was carried out by Pengfei in 2011. The results of this study indicate that urban competitiveness in the European and American countries is stronger than other areas and the growth of urban competitiveness in Asia is faster than other areas.

Mustard & Murray (2010) in a study titled "Which factors make cities competitive?" did a survey of selected international experiences. In this research, the emphasis is on the capabilities of the national and local government as well as the human resources along with the appropriate urban infrastructure for investment and the convenience of starting a business as factors that make cities competitive.

b) Iranian Researches

Samani-Karehari (2014) did a research for doctoral dissertation entitled "designing the urban competitiveness model, based on good urban governance indicators in the context of the process of globalization." In this study, good urban governance and urban competitiveness were examined in 251 cities from more than 100 countries. The results in the theoretical part confirm that good urban governance has a positive effect on urban competitiveness. In the quantitative studies, there is a difference between good urban governance and competitiveness in different groups of cities from different countries, as well as positive effects.

Nazmfar et al., (2018) conducted a research aimed at explaining the competitiveness of Iranian cities based on economic indicators. The results indicate inequalities of the central cities of the provinces of the country in terms of economic competitiveness indicators. The cities of Tehran with the TOPSIS rate of 99% ranked first. The cities of Ahwaz and Isfahan are respectively in the second and third ranks. Zahedan, Gorgan, Khorramabad, Ilam, Zanjan, Semnan, Qom, Sanandaj, Ardebil, Shahrekord, Birjand, Bojnord and Karaj, are in the last rank

3-Theoretical Framework

Given the need to differentiate between the definitions of competitiveness at different levels, this section, after defining competitiveness, addresses the definition of urban-level competitiveness. Competitiveness is a key criterion for assessing the degree of success of countries in the field of political, economic and commercial competition. This means that any country, region, city or firm with a high competitive ability in competitive markets has more competitiveness (Dadashpour & Ahmadi, 2010). Competitiveness is defined as a set of assets and processes in which assets are manageable or can be created and processes transform these assets into economic results (Man et al, 2002). Competitiveness refers to the dynamic process of acquiring assets and resources, turning them into competitive advantages, and managing them with a strategy to achieve a superior competitive position (Vares et al., 2012). Ireland's National Competitiveness Council defines competitiveness as the ability to acquire and maintain domestic and foreign markets (Pajviyan & Faghihnasiri, 2009). The proper definition of competitiveness is different, depending on its level of analysis (firms, industries, regions, cities, transnational areas, and the world) because the objectives of each of these

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cases are different. For example, companies generally aimed to increase profits and market share, while local authorities and urban managers in the field of competitiveness, struggle to improve the standards of living and welfare of their citizens. Indeed, the main objective is to create conditions and a framework in which both firms and society can compete at one time and thus contribute to the prosperity of society (Boddy & Parkinson, 2004). Considering that the analysis unit of this research is the urban level, the definition of urban competitiveness is expressed. In recent years, the concept of urban competitiveness has been taken into account in many academic studies in such a way that interest in the urban and regional political discourse of many international organizations, such as European Commission (2011), OECD[1], and Institute for Management and Development has expanded. Urban competitiveness means exploiting the potential of the city and creating comparative advantage and sustainable economic growth compared to other cities (Jiang & Shen, 2010). Turok (2004) uses the term "Institutionalized Competition "to define urban competitiveness. This idea is based on the argument that governments and public institutions are responsible for improving competitiveness in their regions and cities. Consequently, in Europe, competitiveness has been chosen as the main goal of regional policy and is considered as the most important tool for achieving and promoting balanced development and territorial cohesion (Turok, 2004). The concept of urban competitiveness is defined by Louvre and Torque (1999). As cities can provide goods and services to meet the vast needs of regional, national and international markets, while simultaneously increasing real incomes, improve the quality of life for citizens. The concept of urban competitiveness by the Lever and Turok (1999) is defined as the extent to which cities can provide goods and services to meet the needs of large regional markets, national and international producers, while simultaneously real income increases, the quality of life for citizens improve and promote development in a sustainable way. "In this definition, authors not only consider the financial profit that cities need for competitiveness, but also take into account social profitability. In addition, this means that cities, as in the regions where they are located, can simultaneously help companies compete or become a major barrier to their competitiveness (Zhao et al., 2017). Malecki (2002) uses the term " Sticky Place " to define urban competitiveness, and he considers the city's ability to create conditions for increasing the standard of living of citizens, he believes that competition between cities is more than marketing or trying to sell goods, including strengthening or improving Characteristics that make it possible to attract and retain capital, investors and human resources make the city a sticky place (Malecki, 2002). Basically, city-level competitiveness is related to the interests of companies, citizens and government. For firms, urban competitiveness means how to extract urban resources to create high productivity (Porter, 2004). For citizens, urban competitiveness means improving living standards. For the government, urban competitiveness means development through the benefits of local marketing and the acquisition of

1- Organisation for Economic Co-operation and Development

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new competitive advantages (Borozan, 2009). Figure 1 shows the nature of urban competitiveness based on the interests of companies, citizens and the government.

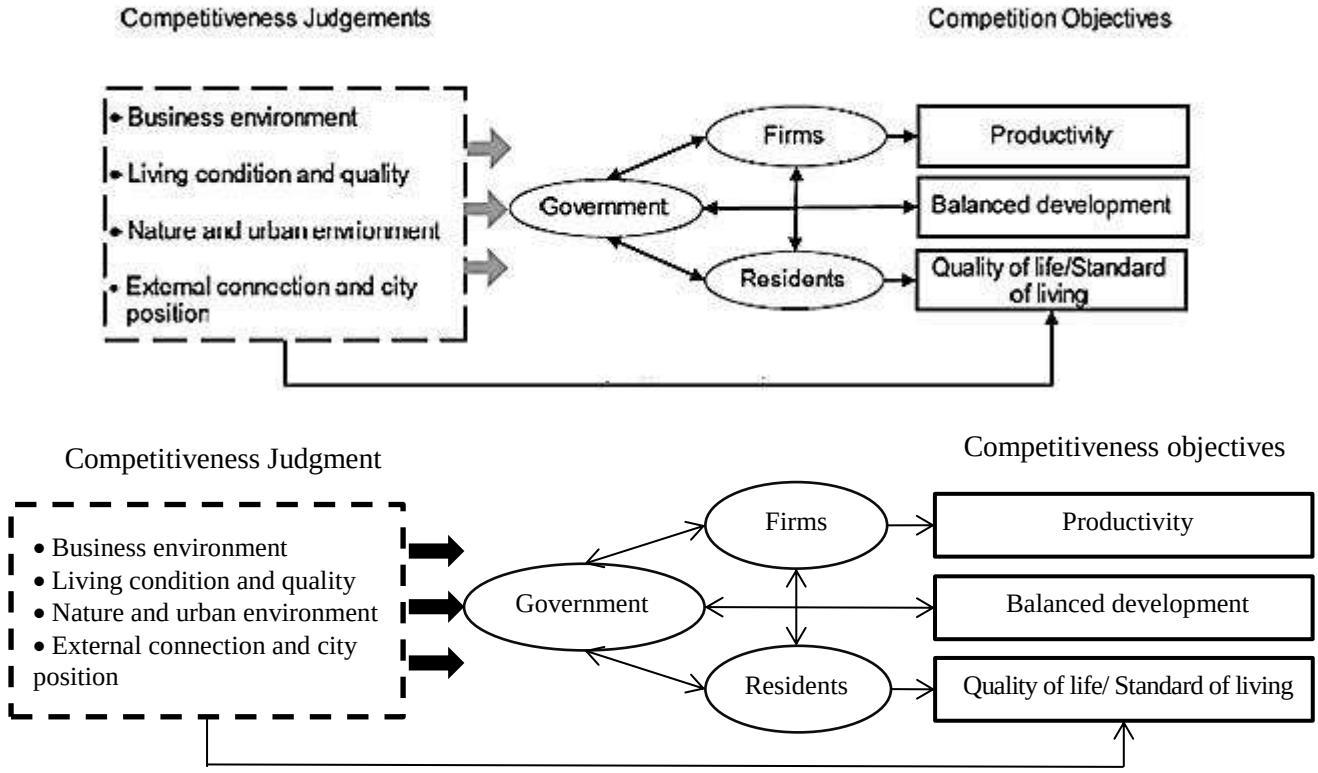

Fig1. The nature of urban competitiveness

Some scholars have linked the concept of national competitiveness to its urban level. Urban competitiveness is "the ability of a local economy to attract and retain companies that gain a steady or rising market share in one activity, at the same time the local economy and people's living standards are stable or increases "(Martin, Simmie, 2008). This definition was broadly welcomed by OECD countries. A similar interpretation of urban competitiveness has been used by researchers or institutions active on a regional or urban scale (Camagni, 2002). Other researchers such as Begg (2002), Sobrino (2002), Moori-Koening & Yoguel (1998) argue that urban competitiveness is the process of production and distribution of competencies that not only affects microeconomic factors (businesses), but also depends on the ability of regions to provide features that facilitate economic activity. In other words, the main idea is that the creation of physical-technological, social, environmental and institutional environments will attract and develop economic activities that are capable of generating wealth and occupation. Cities can promote or create such conditions, and then make competitiveness a decisive factor for economic development. In the global environment, the most successful economic cities are those that have a degree of autonomy from their national economy and can compete in an international environment. Therefore, the economic performance of a country depends on the performance of its cities on the international level, but in general, such cities are less dependent on the performance of their domestic market (Camagni, 2002).

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Urban Competitiveness Criteria

Using the library studies and the use of research carried out by other researchers and experts' opinions, the criteria and sub-criteria affecting the competitiveness of the city were identified. Table 1 lists the criteria and sub-criteria of research.

Table1. Criteria and sub criteria of research

Economic	City Economic Potential	Backup resources
Economic	City Economic Potential	Budd & Hirmis2004, sinkiene 2009, Jiang, & Shen 2010
	The economic structure of the city	
	City Economic Productivity	
	Economic production	
social	Government efficiency	saez,perianez,2015, Lin 2002, Wang & Shen,2002, So & Shen, 2004, Pengfei 2011.
	Social Cultural Infrastructure	
	Education	
Environment	City landscape	Kamal-Chaoui and Robert,2009, Xu et al 2005, Wang & Shen,2002, So & Shen, 2004
	Confronting urban air pollution	
	public Hygiene status	
External Connection	Transportation	saez,perianez,2015, Porter 2004 Borozan 2009,papa et al2014, Parkinson:2004
	Foreign trade and investment	
	International Tourism and Cultural Interactions	

Source: (authors' studies)

4- Research Method

In terms of purpose, this research is applied, and it is causal-descriptive in terms of method. The statistical population is the experts and professors familiar with urban economic issues, urban and regional competitiveness. Experts were selected by snowball method among university professors and researchers active in urban economics and urban and regional competitiveness.

According to Tersin and Riggs (1976) and Brady (2009), if the participant group is homogeneous, the sample size of 10 to 15 is sufficient to produce effective results. In some sources, the desirable number of experts is recommended from 10 to 20 people (Ziaee et al., 2017). Therefore, in order to achieve valid results, the sample size was determined to complete the questionnaire of 30 university professors and experts in the field of research. In this research, first, a comprehensive review of the literature of the research was determined urban competitiveness criteria. Then, fuzzy DEMATEL questionnaire has been assigned to the experts in order to explain and assess cause and effect relationships between the criteria. The questionnaire consisted of 17 questions about the extent to which the criteria and sub-criteria influenced each other. Since the questionnaire was used based on the criteria identified in the research background and the views of experts and experts, the validity of the questionnaire was confirmed simultaneously. To assess the reliability of the questionnaire, Cronbach's alpha test was used and its rate was 0.81, which indicates the reliability of the questionnaire. After collecting questionnaires, causal relationships between the factors were determined using the fuzzy DEMATEL in Excel software environment. Fuzzy DEMATEL is one of the multi-criteria decision-making tools based on graph theory, which allows for a better understanding of causal relationships, a map of network relationships between multiple criteria in a causal / impacted

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group (Aghaei et al., 2015). The advantages of this method are the acceptance of the feedback of relations, in comparison with other decision-making methods based on the paired comparison. In other words, in the resulting hierarchical structure, each element can affect all elements of the level, the higher level, or the lower level of its own, and interact with each other (Sharifabadadi et al., 2016). In managerial and social issues, it is possible to classify and organize many factors affecting a particular problem using the mutual interaction (Pamucar et al., 2017). The process of implementing the fuzzy DEMATEL with the findings of the research is presented below.

5- Results

Step 1: Designing Decision Matrix

In order to measure the relationship between the criteria and the impact of these criteria, the matrix, which includes the aim and criteria for the relationship between them, and the paired comparison questionnaire, was designed. To measure the impact of the criteria, a five-level scale was used, with the corresponding fuzzy triangular levels and numbers in Table 2, which was based on Lee's proposal in 1999.

Table2. Fuzzy numbers associated with each linguistic variable

Variables	Definite numbers	Fuzzy value (L,M,U)
Insignificant	٠	(1,1,1)
Very little significant	1	(2,3,4)
Little significant	2	(4,5,6)
Much significant	3	(6,7,8)
Very much significant	4	(8,9,9)

Source: (BaykasoğLu et al., 2013)

In table 3, the matrix of comments is provided by 2 experts from the research sample. In these matrices, $\tilde{x}_{ij} = (l_{ij}, m_{ij}, u_{ij})$ are fuzzy numbers triangular and $\tilde{x}_{ij} = (i = 1,2,...,n)$

Are considered as fuzzy numbers (0,0,0).

Table3. Sample comparison of research criteria

Expert1	Economic	Social	Environment	External Connection
Economic	0,0,0	6,7,8	6,7,8	8,9,9
social	6,7,8	0,0,0	1,1,1	2,3,4
Environment	4,5,6	1,1,1	0,0,0	2,3,4
Foreign exchange	2,3,4	1,1,1	1,1,1	0,0,0
Expert2	**Economic**	**Social**	**Environment**	**External Connection**
Economic	0,0,0	8,9,9	6,7,8	8,9,9
Social	8,9,9	0,0,0	6,7,8	6,7,8
Environment	1,1,1	1,1,1	0,0,0	1,1,1
Foreign exchange	2,3,4	1,1,1	1,1,1	0,0,0

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Step 2: Calculating the Fuzzy Matrix of Direct Communication

After collecting expert opinions on the impact of the criteria on each other, direct communication matrix is formed (z), (matrix n*n). Then, the mean matrices were calculated for the aggregation of expert opinions using equation (1).

$$\tilde{z} = \frac{\tilde{x}^1 + \tilde{x}^2 + \tilde{x}^3 + ... + x^p}{p}$$

In this equation, p is the number of experts and $\tilde{x}^1$ ،$\tilde{x}^2$، $\tilde{x}^p$ accordingly; the comparison matrix is the expert pair 1, expert 2 and expert p. And z is the triangular fuzzy number $\tilde{z}_{ij} = (l'_{ij}, m'_{ij}, u'_{ij})$ Table 4 shows the average pairings of experts.

Table4. Average opinions of experts

Average expert opinions	Economic	Social	Environment	External Connection
Economic	0,0,0	8.133, 8.533, 7.133	8.666 ،8.533، 7.533	7.333, 8.333, 8.5
Social	4.766, 5.333, 6.233	0,0,0	5.6, 5,133, 7.433	4.133, 5.133, 5.433
Environment	1.933, 2.621, 3.266	1.6, 1.866,2.133	0,0,0	1.066, 1.2, 1.133
Foreign exchange	1.3, 2.2, 3.766	1.233, 1.333, 1.433	1.333, 1.4, 1,433	0,0,0

Step 3: Normalization of the Direct Communication Matrix

At this stage, the normalized matrix of fuzzy direct communication was obtained from the relations of 2 and 3 of the fuzzy direct-relation matrix.

$$\widetilde{H}_{ij} = \frac{\tilde{z}_{ij}}{r} = (\frac{l'_{ij}}{r}, \frac{m'_{ij}}{r}, \frac{u'_{ij}}{r}) = (l''_{ij}, m''_{ij}, u''_{ij}) \quad (2)$$

Where r is obtained from the following equation:

$$r = max_{1 \le i \le n}(\sum_{j=1}^{n} u_{ij}) \quad (3)$$

Table 5 shows the normalized matrix.

Table5. Normalized Matrix

Normalized matrix	Economic	Social	Environment	External Connection
Economic	0,0,0	0.277, 0.316, 0.332	0.293, 0.332, 0.337	0.285, 0.324, 0.330
Social	0.185, 0.215, 0.242	0,0,0	0.217, 0.254, 0.289	0.172, 0.199, 0.211
Environment	0.075, 0.101, 0.127	0.062, 0.072, 0.083	0,0,0	0.041, 0.044, 0.046
Foreign exchange	0.081, 0.114, 0.146	0.047, 0.051, 0.055	0.051, 0.054, 0.055	0,0,0

Step 4: Calculating the Fuzzy General Communication Matrix

The general communication matrix is represented by T and its layers are fuzzy. The matrix of all fuzzy relations is obtained according to relations 4 to 7.

$$\lim_{k \to +\infty}(\widetilde{H}^1 + \widetilde{H}^2 + \cdots + \widetilde{H}^k) \quad (4)$$

Each of which is a fuzzy number in the form $\tilde{t}_{ij} = (l^t_{ij}, m^t_{ij}, u^t_{ij})$ And calculated as follows

$$[l^t_{ij}] = H_l \times (I - H_l)^{-1} \quad (5)$$

$$[m^t_{ij}] = H_m \times (I - H_m)^{-1} \quad (6)$$

$$[u^t_{ij}] = H_u \times (I - H_u)^{-1} \quad (7)$$

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In these formulas, I is a single matrix, and H_i, H_m, and Hu are each matrix n × n, in which the forms contain the lower number, the middle number, and the upper number of the triangular fuzzy numbers of the matrix H. In Table 6, the results of calculating the Fuzzy General Matrix of the research criteria are shown.

Table6. Total Fuzzy Matrix

Total matrix (T)	Economic	Social	Environment	External Connection
Economic	0.132, 0.209, 0.289	0.360, 0.448, 0.507	0.431, 0.534, 0.610	0.403, 0.505, 0.560
Social	0.251, 0.332, 0.418	0.103, 0.154, 0.204	0.328, 0.423, 0.512	0.275, 0.356, 0.417
Environment	0.105, 0.153, 0.208	0.099,0.134,0.234	0.057,0.091,0.128	0.091, 0.134, 0.091
Foreign exchange	0.110, 0.163, 0.222	0.087, 0.118, 0.151	0.105, 0.143, 0.181	0.050, 0.083, 0.114

Step 5: De-Fuzzy Generic Communication Matrix

Using the relation 8, the general communication matrix was de-fuzzy.

$$B = \frac{(a_1+a_3+2\times a_2)}{4} \quad (8)$$

B fuzzy number $\widetilde{A} = (a_1, a_2, a_3)$ Table 7 presents the de fuzzy values of the criteria.

Table7. De-fuzzy matrix of criteria

Matrix of criteria	Economic	Social	Environment	External Connection
Economic	0.269	0.441	0.514	0.532
Social	0.333	0.154	0.351	0.421
Environment	0.155	0.141	0.110	0.092
Foreign exchange	0.165	0.118	0.082	0.143

Step 6: Drawing a Causal Diagram

In this step, the sum of the rows and columns of the matrix of the decimation matrix is calculated. The sum of rows and columns is called matrices D and R, respectively**.** Of these, the matrix (D + R) is derived from the matrix of excellence and of the difference (D-R), which is called the associative matrix. In other words, in the causal relationship diagram, the horizontal vector axis (D + R), called the vector of significance, and the horizontal axis in the diagram of the causal relations (DR), which is called the vector of the relationship, and the factors in the network are divided into two groups of cause and effect Divides. If the result (D-R) is positive, then the agent belongs to the group, and if it is negative, the agent belongs to the disabled group (Song, Cao, 2017). In Table 8, values for D and R urban competitiveness metrics along with the importance of the D + R criteria and the impact and effectiveness of the criteria (D-R) are presented.

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Table8. Matrix of the Importance and Influence of Research Criteria

City Competitiveness Criteria	R	D	D+R	D-R
	)L,M,U(	)L,M,U(		
Economic	0.599, 0.858, 1.326	1.327, 1.706, 1.961	2.681	0.833
Social	0.651, 0.855, 1.035	0.960, 1.266, 1.553	2.711	0.405
Environment	0.923, 1.201, 1.433	0.353, 0.504, 0.666	1.689	0.689-
External Connection	0.821, 1.07, 1.249	0.354, 0.508, 0.669	1.569	0.549-

Based on D + R and D-R obtained in Table 8, the causal diagram of urban competitiveness metrics was depicted in Fig. 2. The horizontal axis shows the significance of the criteria and the vertical axis of the impact and impact of the criteria

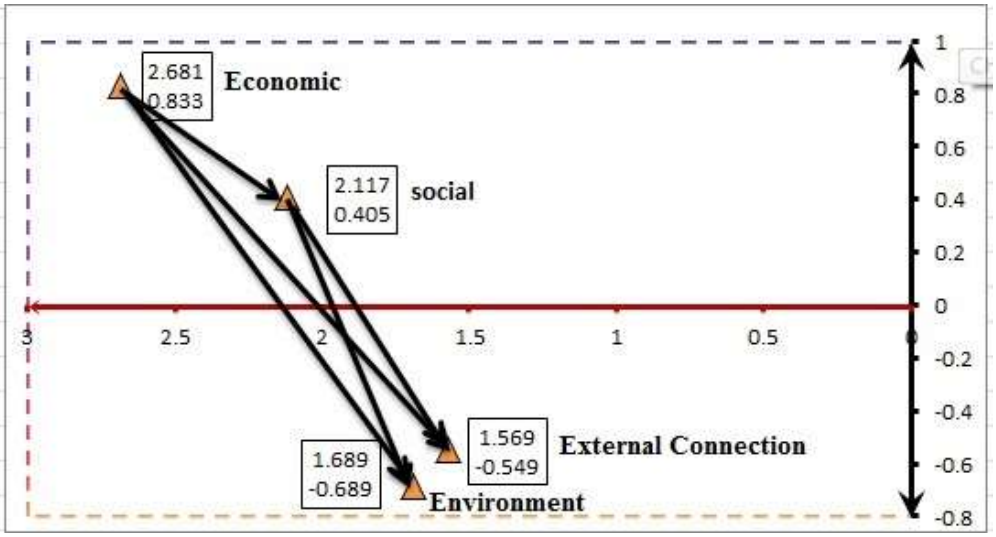

Fig2. Causal diagram of effective metrics on city competitiveness

Figure 2 shows the position of each criterion based on two indicators of importance and relevance. As can be deduced from Fig. 2, economic and social criteria are in the category of cause criteria so that the economic criterion with the highest D-R value is at the top of the graph and shows that this criterion is the most effective criterion. This means that if this city's competitiveness criterion is to be promoted, other city competitiveness measures will be promoted and, as a result, the competitiveness of cities will increase. Also, based on the D + R value, this criterion is the most important criterion. It can also be deduced from Fig. 2 that the environmental criterion is known as the most effective criterion given that the lowest value of D-R is allocated to it. Social criteria and external exchanges also have a certain intermediate role in terms of impact on the competitiveness of cities.

Reviewing Economic Sub-Criteria of Urban Competitiveness

In order to investigate the causal relationships of sub-criteria of each of the main criteria of the research, due to the large volume of calculations and tables, only the definitive final tables of the impact level and the impact of sub-criteria are presented and the resulting causal graphs are, drawn and displayed. Table 9 presents the results of the sub-criteria by reviewing economic competitiveness of the city

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Table9. Matrix of the Importance and Influence of Economic Sub-criteria

sub-criteria economic	R (L,M,U)	D (L,M,U)	D+R	D-R
The economic structure of the city	0.428, 0.769, 1.313	0.967, 1.523, 2.393	2.284	0.781
City Economic Potential	1.048, 1.626, 2.538	0.991, 1.472, 2.122	3.179	0.149-
City Economic Productivity	0.838, 1.375, 2.221	0.667, 1.157, 1.932	2.579	0.326-
Economic production	1.109, 1.704, 2.522	0.799, 1.322, 2.148	3.443	0.306-

Based on D+R and D-R obtained in Table 9, the causal diagram of urban economic competitiveness sub-criteria was drawn as Fig. 3. Horizontal axis shows the significance of the criteria and the vertical axis shows the influence of the criteria.

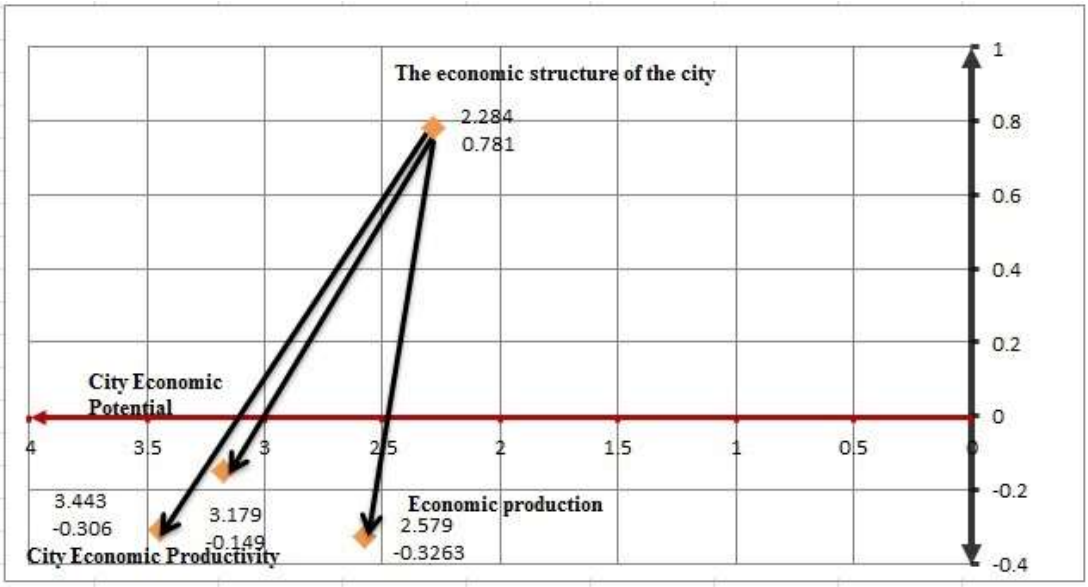

Fig3. Causal graphs of economic sub-criteria of urban competitiveness

According to Fig3, considering the fact that the value of D-R is positive under the criterion of the economic structure of the city, this sub-criterion is placed in the cause of the group, and under the criteria of economic potential of the city, economic productivity and economic production of the city, due to the negative amount of the values of D-R In the disabled group. Considering the D-R value of the city's economic structure, the most impressive economic sub-criterion of urban competitiveness and productivity were identified as the most influential urban economic competitiveness sub-criterion. Based on the values of D+R, the sub-criterion of economic efficiency of the city is considered with having the highest amount of the most important economic sub-criterion of city competitiveness.

Reviewing Social Sub-Criteria

In relation to the social criteria of urban competitiveness, sub criteria were identified: educational, socio-cultural infrastructure and government efficiency. The results of the implementation of fuzzy DEMATEL for social sub criteria of urban competitiveness are described in Table 10.

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Table 10: Matrix of the Importance and Influence of Social Sub-criteria

Social sub criteria	R (L,M,U)	D (L,M,U)	D+R	D-R
Government efficiency	0.508, 0.735, 0.844	1.355, 1.792, 2.021	2.446	1.034
Social Cultural Infrastructure	1.092, 1.476, 1.672	0.591, 0.851, 0.972	2.246	-0.612
Education	0.979, 1.327, 1.551	0.634, 0.895, 1.073	2.171	0.421-

Based on D + R and D-R obtained in Table 10, the causal diagram of social sub-criteria of urban competitiveness was depicted in Fig. 4. The horizontal axis shows the significance of the criteria and the vertical axis shows the impact of the criteria.

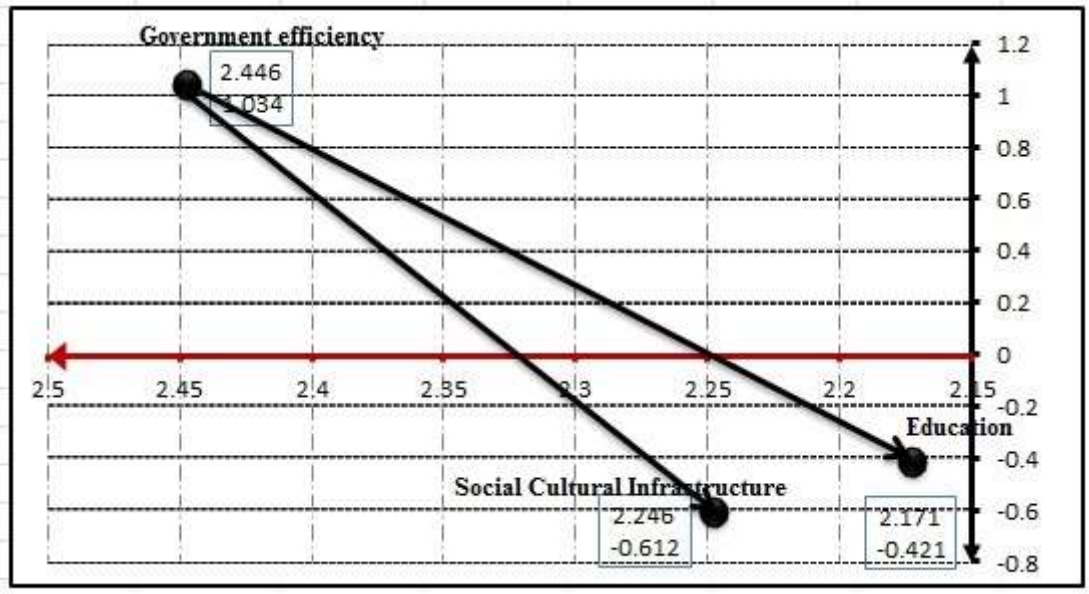

Fig4. Causal graph of social sub-criteria of urban competitiveness

According to Figure 3, considering the fact that the value of **D-R** is positive under the criterion of the government efficiency, this sub-criterion is placed in the cause of the group, and education and social-cultural infrastructures, due to the negative amount of the values of D-R In the disabled group. Also, according to the D-R value of Government efficiency, the most influential social competitiveness sub-criterion and socio-cultural infrastructure are recognized as the most influential social competitiveness sub-criterion. In addition, the efficiency of the government with regard to having the highest amount of D + R is considered as the most important sub-criterion for social urban competitiveness.

Reviewing the Environmental Sub-Criteria

For the environmental criterion of city competitiveness, city landscape, confronting urban air pollution and public hygiene status were identified. The results of the implementation of the fuzzy DEMETLE for the sub-criteria of urban competitiveness are described in Table 11.

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Table11. Matrix of the Importance and Influence of Environmental Sub-criteria

Environmental sub criteria	R (L,M,U)	D (L,M,U)	D+R	D-R
City landscape	1.089, 1.599, 2.016	1.679, 2.239, 2.915	3.883	0.619
Confronting urban air pollution	1.140, 1.682, 2.145	1.372, 2.018, 2.536	3.493	0.541
Public hygiene status	1.435, 2.095, 2.621	0.613, 0.968, 1.332	2.573	1.161-

Based on D+R and D-R obtained in Table 11, the causal diagram of environmental sub-criteria of urban competitiveness was depicted as Fig. 5 The horizontal axis shows the importance of the criteria and the vertical axis of the impact of the criteria.

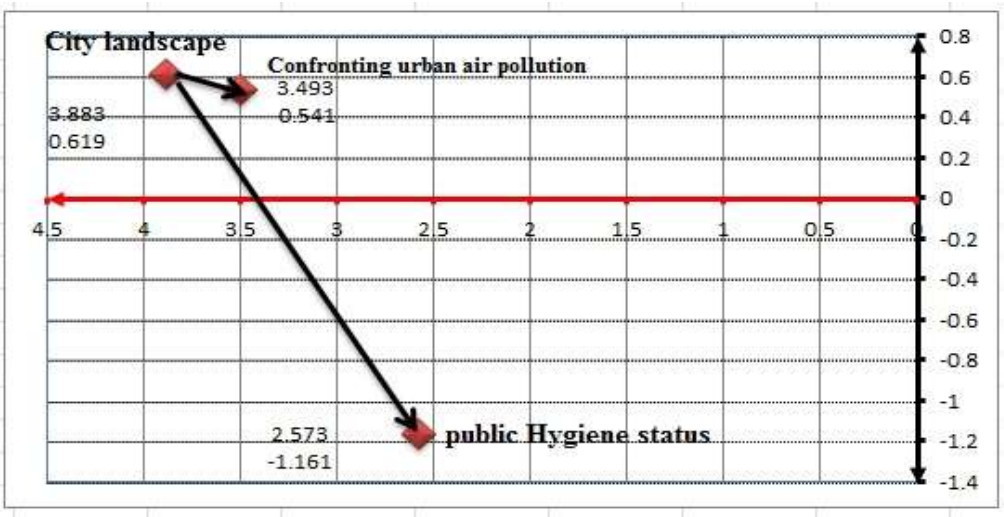

Fig5. Causal graph of environmental sub-criteria of city competitiveness

According to Figure 5, the sub-criteria of city landscape and fighting against urban air pollution are due to the presence of D-R values in the cause group. So, sub-criteria of city landscape, with the highest amount of D-R, the most influential sub-criteria of the environment and the state of the city's public hygiene are considered as the most influential sub-group and in the group.

Reviewing Foreign Exchange Sub-Criteria

For foreign exchange criterion of city competitiveness, the sub-criteria of transportation, foreign trade and investment, international tourism and cultural interactions were identified. The results of implementing fuzzy DEMETLE for sub-criteria of foreign exchange of city competitiveness are presented in Table 12.

Table12. Matrix of the importance, and influence of the sub-criteria of foreign exchange

External Connection Sub criteria	R (L,M,U)	D (L,M,U)	D+R	D-R
Transportation	0.368, 0.536, 0.720	1.316, 1.753, 2.129	2.278	1.197
Foreign trade and investment	0.911, 1.265, 1.629	0.700, 0.969, 1.237	2.237	0.298-
International Tourism and Cultural Interactions	1.269, 1.695, 2.054	0.531, 0.774, 1.037	2.458	0.899-

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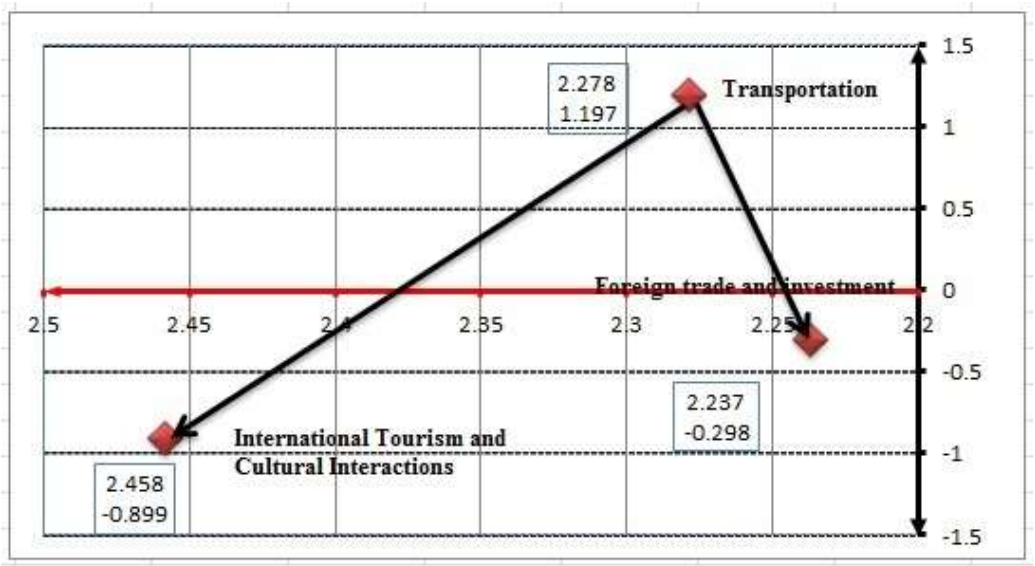
Based on the D + R and D-R data obtained in Table 12, the causal diagram of sub-criteria of foreign exchange was drawn as Fig. 6. The horizontal axis shows the importance of the criteria and the vertical axis shows the impact of the criteria.



Fi.g6 Causal graph of foreign exchange sub-criteria of urban competitiveness

According to Figure 6, the transport sub- criterion, due to the positive value of D-R, is in the cause group. So that this sub-criterion with the highest amount of D-R is the most influential sub-criterion for foreign exchange and tourism, and foreign cultural interactions as the most influential sub-group in the disabled group. In addition, the sub-criterion of tourism and foreign cultural interactions considering the highest amount of D + R is the most important sub-criterion of foreign exchanges of city competitiveness.

Table 13 shows the final rank of each of the criteria and sub-criteria for each of the major research criteria based on the D-R values.

Table13. Ranks of criteria and sub-criteria based on the magnitude of the impact of the criteria

Criteria	Rating based on D-R values	Sub-criteria	Rating based on D-R values
Economic	1	The economic structure of the city	1
		City Economic Potential	2
		City Economic Productivity	3
		Economic production	4
Social	2	Government efficiency	1
		Social Cultural Infrastructure	3
		Education	2
Environment	4	City landscape	1
		Confronting urban air pollution	2
		Public hygiene status	3
Foreign Exchange	3	Transportation	1
		Foreign trade and investment	2
		International Tourism and Cultural Interactions	3

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6- Conclusion and Discussion

This research was aimed at evaluating the causal model of effective criteria on urban competitiveness. In order to achieve the aim of the research, a fuzzy DEMATEL technique was used. The findings of the implementation of the fuzzy DEMATEL technique indicate that among economic, social, environmental, foreign exchange criterion of city competitiveness, the economic criterion is the most effective criterion, and the environmental criterion is the most affected one. Furthermore, the findings showed that social criterion of city competitiveness has an impact on the environmental criteria and foreign exchange, and it is in the cause group as the economic criterion.

Of other results obtained in this research was to evaluate causal model the sub-criteria of each of the main criteria of city competitiveness using fuzzy DEMATEL. The results of the sub criteria of economic criterion of city competitiveness indicate that among sub-criteria, the city's economic structure was identified as the most influential and the sub-criterion of economic efficiency is identified as the most affected one.

The results of the implementation of the fuzzy DEMATEL model for the social sub-criteria indicated that the government efficiency was the most influential social sub-criterion and the social and cultural infrastructures as the most affected ones. Thus, the ground for improving education and developing cultural and social infrastructure can be prepared by increasing and improving the efficiency of the state, which in turn would promote the social criterion of city competitiveness. The findings of the explanation of the causal model of social sub-criteria of urban competitiveness can be interpreted as such. First, the government has a significant influence on the local education system, infrastructure, manufacturing industries; and so on second, the government affects the mechanisms of local institutions. The results of the review on the sub-criteria of the environmental criteria indicated that city landscape was the most influential and city's public hygiene status as the most affected sub-criterion for the environmental criterion. In explaining the findings, it can be stated that in many researches and studies from the urban perspective, one of the important factors in improving the quality of the city of the mentioned city is that it creates a relative advantage for cities. This makes it possible to attract skilled labor force, investors and tourists. (Kamal-Chaoui &Robert, 2009). The findings of the sub-criteria review of foreign exchange measures indicate that the transport criterion was identified as the most influential sub-criteria and tourism and cultural interactions as the most affected ones. In the interpretation of the findings, it can be noted that transportation in the world today is one of the most important sectors for foreign exchange and economic growth and development and the basis for the development of foreign trade. It is also one of the most important infrastructures necessary for tourism development, as it has been mentioned in many studies, including research by Sassan[2] (2002), Jiang & Shen (2010).

For city competitiveness, the following suggestions are presented:

-Cities can shape practical urban systems (Collaborate Cities Network) and seek to create and collaborate to enhance the competitive advantage in the global economy and compete in the Cosmopolitan.

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-Participation in global urban competitiveness assessment projects implemented by accredited institutions. This will make the strengths and weaknesses better identified and appropriate strategies to be selected and implemented.

- Preparation of Urban Development Strategy (CDS) can provide an important step for shaping a strategic vision for promoting city competitiveness and providing a framework for cities to identify the power and potential available.

- Planning to create proprietary policies for the foreign economy -cities themselves policies for themselves, business, foreign direct investment, tourism and attracting foreign talent.

* This article is taken from Ph.D. thesis by Dr. Mohammad Yapang Gharavi, which is under the guidance of Dr. Firouz Jamali and consulted by Dr. Shahrivar Roostaei at University of Tabriz.

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