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AN ANALYSIS ON THE CONTRIBUTION OF DIFFERENT FACTORS IN PROMOTING LABOUR MIGRATION USING MULTI-STEP FUZZY COGNITIVE MAPPING APPROACH.

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Abstract

Labour mobility is one of the key features of economic development and its characterizations are closely tied with the nature of the development. Migration has expanded less rapidly than trade or capital movements during this recent phase of globalization. Many factors cumulatively determine the 'causes' of migration. To analyze the contribution and relationship between different types of factors for labour migration, a multi-step fuzzy cognitive mapping approach is proposed. This methodology is based on Fuzzy Cognitive Maps (FCM), which is a knowledge based technique, combines elements of fuzzy logic and neural networks to discuss all real life worldwide problems with unsupervised data. This study scopes various results on the relationship between push and pull factors, and draws more impactful factors for labour migration.

Keywords : Fuzzy cognitive maps, Labour migration, Multi-step FCM, Push and Pull factors.

Introduction

The International Organization for Migration's World Migration Report 2010 declares that the number of International Migrants was estimated as 214 million in 2010. If this number continues to grow at the same pace as during the last 20 years, it could reach 405 million by 2050. The pressures of human migrations, whether as outright conquest or by slow cultural infiltration and resettlement, have affected the grand epochs in history and in land (for example, the decline of the Roman Empire); under the form of colonization, migration has transformed the world such as the prehistoric and historic settlements of Australia and the America.

In December 2003, The Global Commission on International Migration (GCIM) was launched with the support of Secretary – General of the United Nations, Kofi Annan and several countries, with an independent 19-member commission, a threefold mandate and a finite life-span ending December 2005. Its report, based on regional consultation meetings with stakeholders and scientific reports from leading international migration experts, was published and presented to Kofi Annan on 5th October, 2005.

Likewise many international organizations, takes effort on analyzing the Migration, its causes and effects using international migration experts and trying to take remedial measures on it based on consultation with the committees allotted for it. The reason for concentrating migration, migrating labours, their problems, factors of labour migration, types of migration is that labour migration plays a key role in influencing the pattern of development, through its impact on a host of economic and non-economic variables, born in the origin and destination areas.

This paper attempts to analyze the various factors viz., push and pull factors for migration. It is none other than modeling social problem with unsupervised data. To do it the most efficient tool is Fuzzy Cognitive Maps (FCMs). FCM can be made of at most any system or problem. FCMs are capable of incorporating and adapting human knowledge in a given system of concepts and mutual dependence.

This paper considers eight sections. Section 1 explains about the theoretical background of labour migration, Section 2 shortly describes about FCM and its methodology, Section 3 deals with the Multi-Step FCM approach and Section 4 says about Adaptation of FCM to the problem and the next Section, about Coding adjacency matrices for Push and Pull factors. Section 6 explains the analysis on obtained FCMs, Section 7 describes about Results and the last Section reveals the discussion regarding the study.

Section 1. Theoritical Backgroung of Labour Migration

1.1 Definition of Migration :

Migration is a movement from one place to another, permanent or semi-permanent. When a person leaves his native place or villages comes to an urban / rural area, takes a job and starts living there he is known as a migrant and his move is referred as migration.

1.2. Types of Migration :

Internal Migration: Moving to a new home within a state, country, or continent.

External Migration: Moving to a new home in a different state, country, or continent.

Emigration: Leaving one country to move to another (e.g., the Pilgrims emigrated *from* England).

Immigration: Moving into a new country (e.g., the Pilgrims immigrated *to* America).

involuntary or **forced migration:** When a government forces a large group of people out of a region, usually based on ethnicity or religion.

Impelled Migration (also called "reluctant" or "imposed" migration): Individuals are not forced out of their country, but leave because of unfavorable situations such as warfare, political problems, or religious persecution.

Step Migration: A series of shorter, less extreme migrations from a person's place of origin to final destination—such as moving from a farm, to a village, to a town, and finally to a city.

Chain Migration: A series of migrations within a family or defined group of people. A chain migration often begins with one family member who sends money to bring other family members to the new location.

Return Migration: The voluntary movements of immigrants back to their place of origin. This is also known as **circular migration**.

Seasonal Migration: The process of moving for a period of time in response to labor or climate conditions (e.g., farm workers following crop harvests or working in cities off-season;"snowbirds" moving to the southern and southwestern United States during winter).

1.3. Economic Implications of Labour Migration:

Labour Migration has often been associated with economic development in the country of origin(Michai A. Bolezatu, 2006). Several simulation exercises indicate that the total global income gains from even small increments to labour mobility could be quite enormous(Robert E.B. Lucas, 2008). Walmsley and winters(2003), estimates that a three percent expansion of global migration could generate a larger increase in world incomes than a complete librations of all trade flows.

1.4. Recent Statistics on labour migration :

International Labour Organization (ILO, 2006) declared same key statistics on Labour Migration such as :

- In 2005, there were 191 million migrants which includes those migrating for employment, their dependents and refugees and asylum seekers.
- ILO estimated that 86 million of the 175 international migrants on 2000 were economically active – migrant workers.
- Women now constitute 49% of migrants, world-wide and more than 50% in Asia, Europe, etc.

1.5 Motives Behind Migration

The search for material well-being has always been the main motive behind the largest and most stable migration. Also income differential, individual's native cultural environment, demographic demand economic reason, transportation and communication are actives as motivation factors for Migration(Sergaey Ivanov, 2006).

1.6. Case Study :

Punjab Human Development Report declared the article named 'Migrant Labour –Invisible' detaily sxplains the problems of migrant labours and how the migration affects Punjab's economy. In a study of the impact of migration, the article discussed two case studies on migration to the Industrial sector, the sugar industry and migrant labour and migration to the Brick Kilns (Nasir Ateeq, "Status of Migrant labour in Brick industry of Punjab), (Krishnat Chand et al, 1998). Manjit Singh, 1995 discussed how the seasonal labourers migrated due to Bondage problem. Also this article explored the working conditions of migrant workers.

Section 2. Fuzzy Cognitive Maps (FCMs)

A Fuzzy Cognitive Map (FCM) is a graphical representation consisting of nodes indicating the most relevant factors of a decisional environment and links between these nodes representing the relationships between those factors(Rodriguez-Repiso, 2005a). FCM is a modeling methodology for complex decision system, which has originated from the combination of fuzzy logic and neural networks.

The concept of Cognitive Maps (CMs) was first proposed by Axel Rod (1976). A CM is a signed digraph designed to capture the casual assertions of a person with respect to a certain domain and then use them to analyze the effects of alternatives in respect to achieving certain goals (Asher, 1983).

Bart Kosko(1986), introduces the concept of Fuzzy Cognitive Maps (FCMs), which are weighted cognitive maps with fuzzy weights. A FCM describes the behaviour of a system in terms of concepts; each concept representing an entity, a state, a variable, or a characteristic of the system. FCMs are digraphs that capture the cause/effect relationships in a system. Nodes of the graph stand for the concepts representing key factors and attributes of the modeled system, such as inputs, outputs, variables, states, events, actions, goals and trends of any system. Signed weighted arcs describe the causal relationships, which exist among concepts and interconnect them, with a degree of causality. The constructed graph clearly shows how concepts influence each other and how much the degree of influence is (Craiger, Goodman, Weiss, & Butler, 1996).

2.1. FCM Methodology :

There are various models in FCM to model ecological, environmental, social, variety of industry / engineering problems. Among them we identified to discuss social models based on people's knowledge, a multi-step fuzzy cognitive map as the most adaptable one. Ozesmi (1999a) developed a multi-step fuzzy cognitive mapping approach for analyzing how people perceive an eco-social systems and for comparing and contrasting the perceptions of different people or groups of stakeholders (Uygar Ozesmi, Sticy L. Ozesmi, 2004).

The multi-step approach is a synthesis of relevant useful techniques from many disparate disciplines on cognitive mapping.

In this research paper, we adapted multi-step fuzzy cognitive map to analyze the push and pull factors for labour migration.

Section 3. Multi- Step FCM Approach :

Multi-step FCM analysis approach includes the following steps.

1. Drawing of Cognitive maps.
2. Determining of the sample size in adequate.
3. Coding the cognitive maps into adjacency matrices.
4. Augmenting individual cognitive maps and then adding them together to form stakeholder social cognitive maps.
5. Analyzing the structure of individual and social cognitive maps using graph.
6. Analyzing the differences and simulation in variables among stakeholder groups.
7. Condensing complex cognitive maps into simpler maps for comparison purposes.

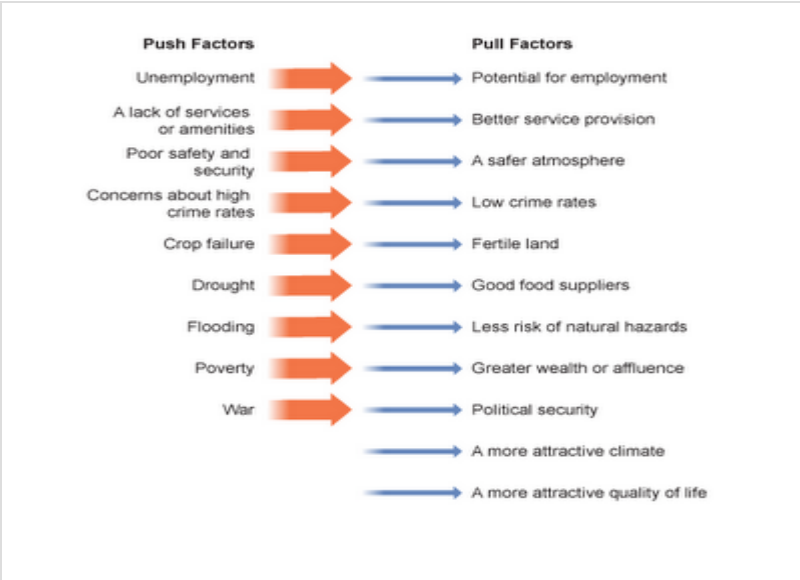
8. Analyzing the outcomes of CMs among neural network computation.
9. Simulating different policy option through neural network computation.

Section 4. Adaptation of multi-step FCM approach to the undertaken problem :

There are many factors motivates migration, like economic factors, demographic factors, socio-cultural factors, political factors and miscellaneous factors. The factors are mainly classified into 2 basic economic factors namely push and pull factors.

Push Factors: Reasons for emigrating (leaving a place) because of a difficulty (such as a food shortage, war, flood, etc.).

Pull Factors: Reasons for immigrating (moving into a place) because of something desirable (such as a nicer climate, better food supply, freedom, etc.).



According to Lee Lee's laws (1966) Push and Pull factors are those that compel a person, due to different reasons, to leave that place and go to some other place whereas pull factors are those which attract the migrants to an areas, such as, opportunities for better employment, higher wages etc.
For this study the following factors are taken as per Lee Lee's laws (1966) :

Push Factors :

1. Not enough jobs
2. Few opportunities
3. Primitive condition
4. Desertification
5. Famine
6. Political fear or persecution
7. Poor medical care
8. Loss of wealth
9. Natural disasters
10. Death threats
11. Lack of political or religious freedom
12. Pollution
13. Poor housing
14. Landlord / tenant issues
15. Bullying
16. Discriminations
17. Poor chances of marrying

18. Condemned Housing
19. War / Civil War

Pull Factors :

1. Job opportunities
2. Better living condition
3. Political and / or religious freedom
4. Enjoyment
5. Education
6. Better medical care
7. Attractive climates
8. Security
9. Family links
10. Industry
11. Better chances of marrying

Obtaining cognitive maps and coding into adjacency matrices

The above mentioned push and pull factors are examined well by the Director of NGO and the FCMs are drawn separately. Then FCMs are coded into the corresponding adjacency matrices as follows :

The adjacency matrix for the push factors M_1 is given by

$$
\begin{array}{c}
\\ 1\\2\\3\\4\\5\\6\\7\\8\\9\\10\\11\\12\\13\\14\\15\\16\\17\\18\\19
\end{array}
\begin{array}{c}
\begin{array}{ccccccccccccccccccc}
1&2&3&4&5&6&7&8&9&10&11&12&13&14&15&16&17&18&19
\end{array}\\
\begin{bmatrix}
0&0&0&1&1&0&1&1&0&0&0&0&1&1&0&1&1&1&0\\
1&0&1&1&1&0&1&0&0&0&0&0&1&1&0&0&1&1&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0\\
1&0&0&0&1&0&0&1&0&1&0&0&1&0&0&0&1&1&0\\
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0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0\\
0&0&0&0&0&0&0&1&0&1&0&0&1&0&0&0&0&1&0
\end{bmatrix}
\end{array}
$$

The adjacency matrix for the pull factors M_2 is given by

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \\ 9 \\ 10 \\ 11 \end{array} \begin{array}{c} \begin{array}{ccccccccccc} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11 \end{array} \\ \begin{bmatrix} 0 & 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 1 \\ 1 & 0 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \end{bmatrix} \end{array}$$

For this analysis, we preferred a single expert's opinion, as the no. of variables is large. So as per the methodology of multi-step FCM approach, accumulation curves are not presented here.

Analysis on obtained FCMs :

FCMs are nothing but the weighted directed graphs only. So to analyse the complex cognitive maps, the tools of graph theory indices have been used.
Multi-step FCM approach is useful to study the structure of the maps and make comparisons among stakeholder groups. In this study our aim is to study the structure of the maps and to compare the push and pull factors.
To analyze a cognitive map, the following formulae are needed :

1. The density (clustering coefficient) of a FCM is as index of connectivity, which shows how connected (or) sparse the maps are $D = \dfrac{C}{N(N+1)}$ (or) alternatively $D = \dfrac{C}{N^2}$ where C is the no. of connections between the variables and N is the number of variables. The density of a directed graph lies in the range 0 to 1 (Jie Chen and Yousef Sand, 2009).

2. The type of variables in a map is important because it shows how the variables act in relation to the other variable. The three types of variables are : transmitter variables (given, forcing functions, tails), receiver variable (ends, utility variables, heads), and ordinary variable (means) (Bougon et al., 1997 ; Eden et al, 1992 ; Harary et al, 1965). These variables are defined by their Outdegree [$Od(V_c)$] and undegree [$id(v_i)$] as $Od(\theta_i) = \sum_{R=1}^{N} \bar{a}_i R$, $id(V_i) = \sum_{R=1}^{N} \bar{a} R_i$ where outdegree is the row sum of the absolute values of a variable and Indegree in the column sum of absolute values of a variable in the adjacency matrix.

3. The Centrality (immediate domain, total degree [$td(\theta_i)$] ; Harary et al., 1965) of a variable in the summation of indegree and outdegree (Bougon et al, 1977 ; Eden et al, 1992 ; Harary et al., 1965) :
$C_i = td(V_i) = 0d(V_i) + id(V_i)$

   The centrality shows how connected the variable is to other variables and what the cumulative strength of these connections are.

4. Index of complexity is the total number of receiver variables. As the index of complexity value increases, the FCM considers many outcomes and implication that are a result of the system (Eden et al., 1992) However, a large number of transmitter variables indicates thinking top down influences, a "formal hierarchial system" (Simon, 1996, P.185) and also show "flatness" of a CM where casual argument are not well elaborated.

   Hence CMs are compared in terms of the ratios R/T.

5. Another structural measure of a CM is the hierarchy index (h) (Mac Donald, 1983)

$$h = \frac{12}{(N-1)N(N+1)} \sum_i \left[\frac{Od(V_i) - [\sum Od(V_i)]}{N} \right]^2$$

where N is the total number of variables.

Case (i) : When h = 1, the map is fully hierarchial.

Case (ii) : When h = 0, the system is fully democratic. Sandell (1996) calls these domination (hierarchial) and adaptation eco-strategies (democratic and delivered that democratic maps and delivered that democratic maps are much more adaptable to local environmental changes because of their high level of integration and dependence.

The above calculations are implemented for the values in the adjacency matrices M_1 and M_2 for Push and Pull factors of labour migration respectively. The results are shown in the following tables 1 and 2.

Table 1 : Graph Theory indices for the adjacency Matrix M_1 (Push factors)

Variables /Indices	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Column Total, Indegree	2	1	1	2	4	2	3	5	0	6	2	1	8	4	1	4	7	9	5
Row Total, Outdegree	9	9	1	8	4	6	1	6	2	2	2	1	3	0	6	2	0	2	4
Centrality	11	10	2	10	8	8	4	11	3	8	4	2	11	4	7	8	7	11	9
No. of Transmitter variables	1																		
No. of Receiver variables	2																		
No. of Ordinary variables	17																		
Total no. of variables	19																		
No. of connections	67																		
Complexity Receiver / Transmitter	2																		
Density, D	0.18559																		
Hierarchy Index, h	0.4949																		

Table 2 : Graph Theory indices for the adjacency Matrix M_2 (Pull factors)

Variables / Indices	1	2	3	4	5	6	7	8	9	10	11
Column Total, Indegree	**3**	**7**	**2**	**7**	**2**	**2**	**0**	**4**	**3**	**0**	**4**
Row Total, Outdegree	**5**	**7**	**3**	**0**	**3**	**2**	**2**	**3**	**3**	**3**	**3**
Centrality	**8**	**14**	**5**	**7**	**5**	**4**	**2**	**7**	**6**	**3**	**7**
No. of Transmitter variables	**2**										
No. of Receiver variables	**1**										
No. of Ordinary variables	**8**										
Total no. of variables	**11**										
No. of connections	**34**										
Complexity Receiver / Transmitter	**0.5**										
Density, D	**0.309**										
Hierarchy Index, h	**0.7918**										

Section 5

Discussion :

From the above Graph Theory indices for the Push and Pull factors, we obtain the following results.

If the density of a map is high then the interviewee sees a large number of causal relationships among the variables. Stakeholders can be compared to see which groups have more relationships among variables(U.Ozermi, S.L.Ozesmi, 2004).

From the density values in the table, it is concluded that in both the factors, the variables have less number of connections. Comparatively, the variables of pull factors have more connections. ie, the relationships among pull factors are more.

In Push factors, the outdegrees of variables are comparatively larger than the indegrees (except death threats, poor housing, landlord issues, poor chances of marrying, condemned housing). It shows that the cumulative strength of connections in the existing the variable is more than the entering the variable(U.Ozesmi, S.L.Ozesmi, 2004). That is, while saying in FCM language, the variables have larger implications ie, causal objects (Kosko, 1985). So variables in push factors causes more variables.

In Pull factors, both outdegree and indegree are comparatively equal. So the variables have equal causes and effects.

In fuzzy cognitive maps, a variable can be more central although it has fewer connections if the connections carry large weights (Kosko, 1986). The centrality values are larger in both push and pull factors. So it is delivered that, the variables are connected strongly and the cumulative strengths of the connections are more.

Complex maps will have larger complexity ratios (R/T) because they define more utility outcomes and less controlling forcing functions (U.Ozesmi, S.L.Ozesmi, 2004). Push factors have more complexity ratio than pull factors. This result considers with the first that the push factors have larger complications and outcomes than the pull factors.

Finally, while discussing the hierachial index (h) (Mac Donald, 1983), the h value for push factors is 0.4949. ie., it is neither fully hierarchical nor fully democratic but is both. Whereas the h value for pull factors n 0.7919 which indicates that the Map is democratic. Sandell (1996), pointing out that democratic maps are much more adaptable to local environmental changes because of their high level of integration and dependence. Hence the stakeholders with pull factors are more likely to perceive that the system can be changed and thus these stakeholders can be a starting point for achieving management objectives (U.Ozesmi, S.L.Ozesmi, 2004).

Conclusion

Labour migration is becoming increasingly intertwined with the multifaceted globalization process. The prevailing concept of globalization proclaims the essential significance of greater freedom for the international movement of capitals, goods, services, information and ideas. It would be logical to provide as much freedom for the movement of people as well. However as it has a great impact on the economy of the country, concerned organizations are taking a lot of efforts on analyzing various aspects of migration. They welcome research papers also, to help for their analysis.

This paper analyzes Lee Lee's laws of standardized push and pull factors for labour migration using multistep FCM approach. Using graph theory indices, many results are declared in it. Especially, the most impactful variable (factor) can also be found using this analysis. Among push factors, the factors like not enough jobs, few opportunities are more impactful factors as they have more out degree (implications). Among pull factors, job opportunities and better living conditions are more impactful factors. Surely these results and informations would be very much useful for the Labour Migration Organizations.

This explorative study gives a valuable first insight in the importance of the push and pull factors for migrations. Especially the relationship among the factors and the more impactful push and pull factors are notable key results.

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