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Identification of Key Sectors for Iran, South Korea and Turkey Economies: A Network Theory Approach

Esfandiar Jahangard*
Vida Keshtvarz**

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Abstract

Considering the scarcity of resources especially in developing countries, it is critical to identify the key sectors of these economies. Recognition of key sectors is one important subject for policy makers and economic planners. In determining key sectors both in theory and in practice several different methods are proposed in the literature. One of the most novel and recent approaches is based on network theory, under which different weights, known as influence indices, are assigned to both intermediate and final demand of sectors. In order to pinpoint those sectors with strong linkages in a contributing to the economy, network theory proposes a definition of centrality measures including total effects, meditative effects and immediate effects which considered as multilevel indicators. as. The purpose of this study is to determine the key sectors of Iran, South Korea and Turkey and compare the results using Iran's 1999 input-output table, South Korea's 2005 input-output table and Turkey's 2002 input-output table. The results show that considering the role of final demand for some economic activities are really important in identifying key sectors of Iran, Turkey and Korea although it is less important in some sectors of Turkey and South Korea.

Keywords: Network Theory, Input-Output Analysis, Key Sectors, Iran, Turkey, South Korea.

1- Introduction

Economic theories as well as the experiences of different countries show that there are several ways that an economy can grow. The amount of economic growth is related to and depends on the sectors, and investments of those sectors. Growth rate differs by the sectors. In a long run perspective, growth maximization is the outcome of allocating more and more resources

* Assistant Professor, University of Allameh Tabatabaei,Iran, (Corresponding Author).
** M.A. in Economics, University of Allameh Tabatabaei,Iran,

to the important key sectors of the economy. In other words, intersectoral relations are really important and necessary for understanding the economic structure and consequently tailoring economic policies. The Input-output (IO) model along with developments in science and emerging new software packages, provide a suitable basis for identifying the key sectors in countries. Furthermore, The IO model can be used with some of the other methods to improve the quality of the results. An extensive research on identification of key sectors using both IO models and different new techniques have been done all over the world. These studies can be classified in to two groups: a) pure IO models and b) combined models. For the first group, a comprehensive research was pioneered by Hirschman (1958) using backward and forward linkages to rank the sectors. Chenery and Watanabe's study (1958) also is another that evaluates backward and forward linkages quantitatively. In fact Chenery-Watanabe's method is to compute the quadruplet division of goods. One drawback of this method is that only the increasing direct backward and forward linkages is considered for the output of a specific industry; so it does not consider the indirect effects. Another drawback is that its measurements are on the basis of mean values and therefore it does not precise the range of the data. To solve these drawbacks, Rasmusen suggested the use of inverse Leontief matrix. However this method also has its own flaws. In another attempt, Hazary recommended weighting the economic sectors. Number of experts suach as Jones (1976) criticized Chenery-Watanabe and Rasmusen's method in identifying the key sectors or finding the best investment pattern using the indices. In his criticism, he highlighted the double evaluation of Chenery-Watanabe's linkages, as well as not considering the indirect effects. Mattas and Chandra (1991) use IO elasticity to identify importance of Greece economic sectors. They proposed that the use of their method results in a significant dissimilarity in analyzing and ranking the economic sectors, since in their method, the role of final demands have been taken into account in the form of elasticity to identify the key sectors. Recently Oosterhaven (2008) proposed to use the net indices to identify the key sectors. By this method he stressed the role of the final demand and the value added of the sectors in the backward and forward linkages.

FFor the second group, there have been significant advances by applying the software packages. Malcolm J. Beynon and Max Munday (2007) offer stochastic analysis method for identifying the key sectors due to the uncertainty in the outcome of the point estimation of IO coefficients. One of uncertainties happens due to the error in aggregation of IO tables. Ten Raa and Jose Manuel Rueda-Cantuche (2007) studied the multiple linear regression analysis, with linear, unbiased and consistent multipliers estimations by replacing matrix A and employing use and make matrices with commodity technology assumption. They showed that the inverse Leontief matrix underestimates the coefficients, according to the Young theorem. They also mention that if the number of sectors is more than the number of commodities (m>n), the technical coefficients are overestimated by use matrix, so an error term must be included and IO coefficients transform to the regression coefficients. In fact, Statistical Centers, mix make and use matrices for obtaining IO coefficients and economists inverse Leontief matrix for obtaining production and cost coefficients. This process is nonlinear with transformation of complex errors. In the mentioned study they present linear, unbiased and consistence estimations for backward linkages of production and employment for the economy. In this effort they use IO data in the micro level and then use DEA method for ranking econometric results. Another group of studies concentrates on mixture of IO method and Fuzzy Logic. Barbara Diaz, Laura Moniche & Antonio Morillas (2006) try to identify key sectors of Spanish economy using Fuzzy cluster techniques in combination with IO model. In their effort they proposed a multidimensional approach to classify the productive sectors of the Spanish. In contrast with pure IO models which are on the basis of zero-one logic with certainty in the results, in this method the uncertainties of the result have been taken into account and processed. It should be noted that the uncertainty in this method is different from the concept of statistical uncertainty which is due to the stochastic process.

Another approach in this field concentrates on the use of network theory and IO models. Moniz *et al*. (2008) suggest a new method for identification of key sectors based on the concentration of three complementary characteristics: Total effects, Meditative effects and immediate effects. These indicators have the enormous advantages of allowing different sized structures to be compared and the key sector concept to be approached from a national and global viewpoint. In fact, this approach draws not only on the study of the size of the linkages but also on the number of linkages and paths among sectors.

The purpose of this article is identifying key sectors of Iran, Turkey and South Korea using the new approach of network theory. Since in recent years South Korea have been added to the list of the developed countries, we intentionally chose this country to compare its results with the other two developing countries, Iran and Turkey. We collected the required data from 1999 IO table of Iran, 2005 IO table of South Korea and 2002 IO table of Turkey.

The organization of the paper is as follows: first, the theoretical framework will be presented followed by the methodology utilized. Then, the results for each country will be analyzed and finally we conclude.

Theoretical Framework

For understanding the importance of economic sectors and allocating resources, the growth and development theories are divided into three groups: Balanced growth theory, unbalanced growth theory, and pole growth theory, balanced growth theory, in fact, is the path or adjusted pattern of investing in a bundle of different sectors in a way that producers in these sectors become each other’s client and thus market capacity increases. This theory considers supply side impediments but not demand side’s. Although balanced growth theory was impressive in industrialized countries and resulted in industry growth but the usage of this theory in developing countries had serious objections. Some of these objections refer to the difficulty of planning precisely in developing countries and also the shortage of investing resources resulted from shortage of savings in these countries. As a response, unbalanced growth theory introduced by Hirschman. According to this theory, investing in specific sectors suggested in a way that the benefits of these investments transpire in other economic sectors to obtain the qualification of investing in them. According to Hircshman, when a key sector plays the leader role for development, unbalanced growth happens.Pole growth theories, as the third group, introduced by Perroux’s innovative definition derives from Schumpeter’s idea on “creative destruction”. According to Schumpeter, growth is the direct and indirect output of innovation. In Perroux’s theory, growth cannot be achieved in all sectors simultaneously, but it only happens around propulsive leading sectors or industries. These sectors spread the development in different channels and affect all the sectors in the economy. In different countries, the need of allocating a significant amount of resources in the capital goods sectors to foster the economic growth in a long term is obvious. It should be considered that due to the lack of resources, especially in developing countries, expansion of all economic sectors at the same time is not possible. Therefore, identifying the key sectors is a critical need.

One of the simplest methods for identifying key sectors is calculating backward and forward linkages. While the role of backward and forward linkages of economic sectors is remarkable, yet there is no agreement on the method of identifying key sectors in the economic literature. Nowadays methods for calculating linkages have become easier and more precise due to the developments in computers and software programs. In this paper, we follow Friedkin (1991) and Muniz and et.al (2008) studies. Under their methodology there are several complementary multilevel indicators which provide a complete view of the sector's position in the economic structure. Not only do they distinguish the sectoral economic impacts, but also the immediacy of their influences and the contribution of a sector as a conduit of other sectors will be addressed. These measures are defined from the same theoretical frame derived from a valued graph associated with the IO table, and therefore the total volume of available information can be used, unlike other conventional graph techniques in the IO field. The methodology of calculating the indexes are explained in next section.

2- Methodology

Total Effects: These effects are determined from a Markovian matrix $\tilde{A} = \{\tilde{a}_{i\,1}\}$ in which the relations between network nodes are gathered and each of its rows sum to unity:

$$\Sigma_{i=1}^{n} = \tilde{a}_{i1} = 1 \qquad\qquad \forall_i = 1....n$$

In fact, this matrix is the stochastic normalized matrix of technical coefficients, so there is a Markov chain of n states where the matrix $\tilde{A}$

gathers the transaction probabilities of one node to another. The main equation of general equilibrium model in the IO literature can be written as:

$$X_i = \alpha(\tilde{a}_{i1}X_1 + \ldots + \tilde{a}_{in}X_n) + (1-\alpha)d_i$$

Where X_i and d_i represent production and final demand of sector i respectively, α offers a weighting that allows the effect of exogenous changes in the demand to be calibrated. In fact, α is a sectoral relations weighting and as mentioned earlier $\tilde{a}_{i1}$ is a technical coefficient which is normalized by sum of columns of matrix A. It is obvious that $\tilde{a}_{i1}$ takes values between 0 and 1 and the sum of each row of $\tilde{A}$ matrix is equal to one.

α which attributes different weight to the final and intermediate demand, allows the study of the influence by exogenous changes. Determination of total effects in this model is essentially related to the length and number of the paths between sectors through the network. According to Friedkin(1991) study, matrix V in the probability IO model is:

$$V = (I-\alpha\tilde{A})^{-1}(1-\alpha) = (I + \alpha\tilde{A} + \alpha^2\tilde{A}^2 + \alpha^3\tilde{A}^3 + \ldots)(1-\alpha) \qquad 0<\alpha<1$$

It can be seen that matrix V is determined by the inverse Leontief matrix which is weighted by the coefficient α. In short, the total effect of one actor on the other is a weighted sum of the number of different channels that join them in the network, where each channel is weighted according to its length and the strength of constituent links (Friedkin, 1991).

We can affirm that under the hypothesis $\lim_{k\to\infty}\tilde{A}^k = \tilde{A}^\infty$ in the case that α approaches to one:

$$V = \lim_{a\to 1} - \left(I - a\tilde{A}\right)^{-1}(1-a) = \tilde{A}^\infty = W$$

So if α approaches to one, V may converge to W, under certain conditions of matrix $\tilde{A}$. In fact, matrix V approaches to the limit of $\tilde{A}$, in which the total effect is constant for each ith sector. Therefore matrix W takes the form of a stationary state:

$$W=\begin{bmatrix} W_1 & \cdots & W_n \\ \vdots & \ddots & \vdots \\ W_1 & \dots & W_n \end{bmatrix}$$

So total effect of each sector in the absence of additional information about weighting value α (TEC_j) is:

$$TEC_{(j)}=\frac{\Sigma_{i=1}^{n} V_{ij}}{n}=\frac{\Sigma_{i=1}^{n} w_{ij}}{n}=w_j \qquad \forall j=1\dots n$$

Or in matricial term:

$$t=V'\Phi$$

Where t is a (nx1) vector, $\Phi=\{\frac{1}{n}\}$ is also a (nx1) vector and $\hat{V}$ is the transposed matrix of V. Essentially, total effect of sector j equals to the mean of the elements of column j of matrix V. In the Leontief model, Rasmussen (1956) classified coefficients using the sum of the normalized columns of the inverse Leontief matrix to measure backward linkages of the sectors in the economy but total effect index uses the sum of the columns of the revised inverse Leontief matrix $V=(I-\alpha\tilde{A})^{-1}(1-\alpha)$. The Rasmussen coefficients can be therefore considered as a particular case where the influence coefficient matrix α has not been specified. In addition, for the Ghosh model, Augostinovics (1970) determines the forward linkages from the sum of the rows of the inverse distribution matrix. Considering the distribution coefficients, it is possible to derive the total effects indicator in the same way as forward linkages. Likewise, consideration of the normalized distribution coefficients would allow it to be adapted for the supply model. Throughout this paper, we present the measures under the demand model although their translation to the Ghosh model results immediate.

Immediate effects: Analyzing immediate effects is an important feature for evaluating economic policies. The sectors which their effects are transmitted over a lengthy sequence of economic relations have less economic impact than those with a high number of direct linkages. This characteristic is determined by the index named immediate effects that are quantified from the Markov chain of $\tilde{A}$ matrix. In this sense, the Markov chain can be interpreted as a random walk for the weighted graph of the stochastic matrix of the normalized IO coefficients $\tilde{A}=\{\tilde{a}_{ij}\}$ and as mentioned earlier the weight $\tilde{a}_{ij}$ is attributed to the arc between the ith and jth sectors of the valued graph. Thus there is a Markov chain of n states where the matrix $\tilde{A}$ gathers the transaction probabilities of one sector to another, so that the element (i,j) of the transaction matrix of the Kth step ($\tilde{A}^k$) will show the probability of passing from the ith sector to jth sector in k steps exactly.

Immediate effects of jth sector in the network can be determined by the length of weights of the economic transaction sequence for the relation's strength:

$$M=(I-Z+E\hat{Z}_{dE})\hat{q}$$

Where $\hat{q}$ is a diagonal matrix with elements $q_{ii}=\frac{1}{w_i}$, E is a (nxn) unity matrix and Z, the main matrix in the equation is:

$$Z=(I-\tilde{A}+\tilde{A}^{\infty})^{-1}$$

Where $\tilde{A}^{\infty}$ is matrix W that collects the process stationary state ($w_1 \ldots w_n$) and $\hat{z}_{dg}$ is a diagonal matrix built from matrix z. Thus m_{ij} gathers the average length of the sequences of relations from sector j to sector i where each sequence weighted according to the strength of its constituent links. In fact immediate effect of sector j is determined by inversing the mean of column j of matrix M:

$$IEC_{(j)}=\left(\frac{\Sigma_{i=1}^{n} m_{ij}}{n}\right)^{-1}$$

Where m_{ij} are the elements of matrix M. In matricial terms:

$$r=n\,\wp$$

Where $\gamma=\{\gamma_i\}=\left\{\frac{1}{\Sigma_{i=1}^{n} m_{ij}}\right\}$ is a (nx1) vector.

Immediate effect takes into account the length and strengths of the sequences of productive relations. The larger the index, the more widely the total effects of a sector tend to extend and so the branch is less depend on intervening sectors.

Meditative effects: Meditative effects refer to the importance of specific sectors as instruments of the transmission of total effects. The essential assumption of meditative effect is that, sectors involved in many of the paths linking other sectors can affect the relations that occur along these paths. These sectors facilitate the operations and economic interconnections, so that they support the interrelation between productive activities. Such economic sectors work like crossroads in the system and constitute key points for the entire development of the economy. For estimating the mean length of the sequences of productive relations, the previous matrix M can be decomposed in the number of steps from sector j to sector i via other intermediate sectors:

$$m_{ij} = \Sigma_{k=1}^{n} t_{(j)ik} \qquad i \neq j \neq k$$

Where $t_{(j)ik}$ is the ikth entry in the matrix T in:

$$T_{(j)} = \left(I - \tilde{A}_{(j)}\right)^{-1}$$

And $\hat{A}_{(j)}$ is a matrix which built from deleting the jth row and column of A matrix. Meditative effect of sector j shows the importance of sector j as a transmission link or a crossroad in the economic network relations. Meditative effect is calculated by this formula:

$$MEC_{(j)} \frac{\Sigma_{k=1}^{n} \bar{t}_{(k)j}}{n}$$

Where

$$\bar{t}_{(k)j} = \frac{\Sigma_{i=1}^{n} t_{(k)j}}{n} \qquad i \neq j$$

Which gathers the contribution of sector j in the transmission of the effects of sector k. Meditative effects also can be calculated in matricial terms, where:

$$\mathrm{T} = \{t_{(k)j}\} \rightarrow C = \mathrm{T}\Phi$$

Where Φ is a (nx1) vector by elements $\frac{1}{n}$.

Influence index: The total, immediate and meditative effects refer to the three important and complementary structural features where the sectorial influence weighting plays a fair role. In the case where there is no additional information, the applied assumption is a sectorial weight (α) which is equal for all sectors and its value is near unit ($\alpha \rightarrow 1^-$). This hypothesis is excessively restrictive in the IO case, because exogenous changes in the network influence each sector differently. The assumption of existing different coefficients for each sector seems a reasonable assumption in an economic universe, where the agents have very different degrees of influence and the final and intermediate demand weight can have an unequal dominance in sectorial production necessities induced by variations in the final demand. This way of analyzing allows the differentiation of coefficients between sectors (α_i) by the purpose of distinguishing the sector propensity to sectorial influences. Determination of α which is known also as the influence index is useful because it allows one to know the influence capacity generated by the sectors in the IO table. Under this assumption the new model is:

$$X_i=\alpha_i(\tilde{a}_{i1}X_1+\ldots+\tilde{a}_{in}X_n)+(1-\alpha_i)d_i$$

Or in matricial terms:

$$X=\hat{S}\tilde{A}X++(I-\hat{S})d$$

Where $\hat{S}$ is a diagonal (nxn) matrix that shows the influence coefficients of each sector.

$$\hat{S}=\begin{bmatrix}\alpha_1 & \cdots & 0\\ \vdots & \ddots & \vdots\\ 0 & \ldots & \alpha_n\end{bmatrix}$$

$\tilde{A}=\{\tilde{a}_{ij}\}$is a (nxn) matrix which gathers the normalized technical coefficients. $X=\{X_i\}$ and $d=\{d_i\}$ are also (nx1) vectors which show production and final demand of sector i respectively. Leontief standard model is:

$$X=AX+d$$

The determination of the output level from the equivalence between these two models is:

$$\hat{S}\tilde{A}X+(I-\hat{S})d=AX+d$$

Or in matricial terms:

$$\hat{S}(\tilde{A}X\text{-}d)=AX$$

It is more suitable not to consider the auto-consumption of sectors as an integrant part of the degree of sectoral influence. By eliminating auto-consumption, the system of equations is:

$$\begin{pmatrix} \alpha_1\left[a_{12}x_2+\ldots+a_{1n}x_n\right](\tilde{a}_{12}x_2+\ldots.+\tilde{a}_{1n}x_n) \\ \alpha_n\left[(a_{n1}x_1+\ldots.+a_{n(n-1)}x_{(n-1)})+(\tilde{a}_{n1}x_1+\ldots+\tilde{a}_{n(n-1)}x_{(n-1)}\right] \end{pmatrix}=\begin{pmatrix} a_{12}x_2+\ldots+a_{1n}x_n \\ a_{n1}x_1+\ldots a_{n(n-1)}\,x_{(n-1)} \end{pmatrix}$$

As mentioned before, the normalized technical coefficients are $\tilde{a}_{IJ}=\frac{a_{ij}}{\Sigma_{j=1}^{n}a_{ij}}$ so sectorial influence weighting can be defined as:

$$\alpha_i=\frac{1}{\left[1+\left(\frac{1}{\Sigma_{j=1}^{n}a_{ij}}\right)\right]}$$

This is a measure related to the direct effects of sector i $\left(\Sigma_{j=1}^{n}a_{ij}\right)$ on the rest of the productive sectors and allows the total effect generated for the sector to be recalibrated. In this new scenario total effects must be revised. Considering expression $X=\hat{s}\tilde{A}x+(I-\hat{s})d$ we can have the next equation as:

$$X=(I-\hat{s}\tilde{A})^{-1}(i-\hat{s})D$$

Where V is:

$$V=(I-\hat{s}\tilde{A})^{-1}(I-\hat{s})$$

So revised total effects of jth sector is:

$$TEC_{(j)}{}^{*}=\forall i,j$$

This index will offer a more exact valuation of the impacts of the sectors in the network. Multilevel indicators and the sectoral influence index allow the identification of sectors that work as crossroads in the economic structure performance. So determination of key sectors in the diffusion of economic influence is depend on the total effects, immediacy of these effects on other members in the network, the importance of transmitting sectors in the exchange network and also the influence index. The next part we calculate and analyze the indexes for Iran, Turkey and South Korea's economy.

3- Data

Required data for studying Iran economy is gathered from Input-Output table of 1999 with 54 sectors with sector technology assumption at producer price which is compiled by central bank of Iran. The data for Turkey is collected from Input-Output table of 2002 with 43 sectors which is based on sector technology assumption and finally the data for South Korea is collected from Input-Output table of 2005 with sector technology assumption. In this study, due to coordinated and integrated to create tables and admission for analysis, the three country tables - the aggregate output and we have aggregate tables to 20 sectors.

4- Results

Total Effects

Figures1-3 present total effects of each sector for Iran, Turkey and South Korea's economy, under the hypothesis of unit influence index for all sectors. As mentioned before, total effects index determine the relative total effects of each sector on the rest of the economy. Figure one presents sectors with high total effects of Iran's economy as follows: communication(17) ,paper, paper products, printing and publishing(7), Water,Gas and Electricity(13), Food products,beverages and tobacco(4),Construction(14),other Manufacring (12)and Basic metal Manufacring(10).

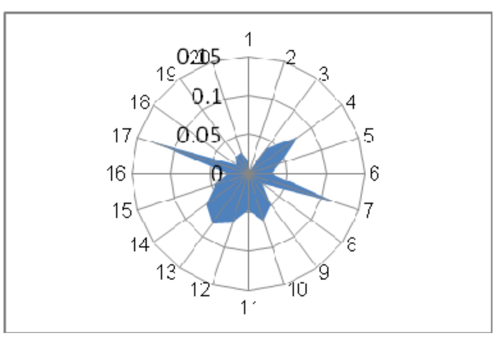

Figure 1: Total Effects of Iran

For Turkey the sectors with high total effects are: Health & social work, other Manufacring, Wood and products of wood and cork, Textiles, textile products, leather and footwear, paper, paper products, printing and publishing, Food products,beverages and tobacco and Construction.

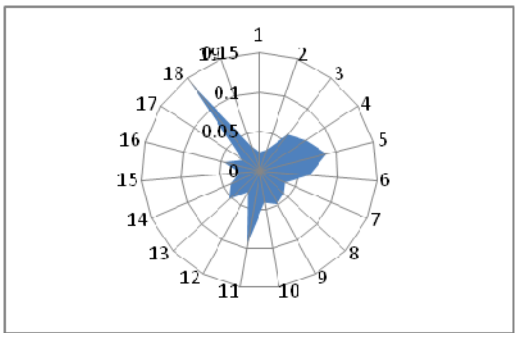

Figure 2: Total Effects of Turkey

Figure (3) represents the results for South Korea's economy as: other Manufacring, Textiles, textile products, leather and footwear, Wood and products of wood and cork, pulp, paper products, printing and publishing,Food products,beverages and tobacco,Non-metallic mineral products and communication are sectors with high total effects.

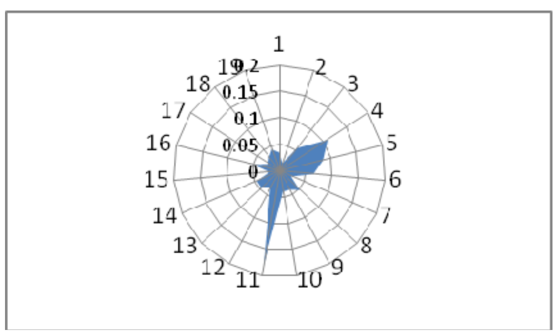

Figure 3: Total Effects of South Korea

Immediate Effects:

Three next figures present the immediate effects for Iran, Turkey and South Korea. Figure (4) shows that sectors with immediate effects above the mean in Iran's economy are: Construction, Water ,Gas and Electricity, Other Manufacturing, Communication, Non-metallic mineral products, Wholesale & retail trade; repairs and Hotels & restaurants, Pulp, paper, paper products, printing and publishing, Basic Metal Products, Mining and quarrying .

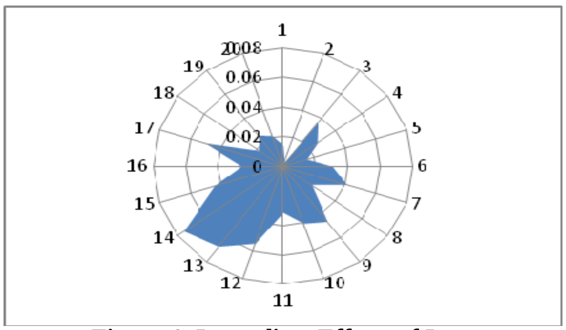

Figure 4: Immediate Effects of Iran

In general we can claim that most of the sectors with high total effects also enjoy a relatively quick access capacity to the rest of the economic agents. This feature allows them to transmit their influence efficiently to the rest of the economy. Considering complementary feature of multilevel indicators, inconsistancy in the indices of a typical sector shorten the importance of that sector in the economy. As figure (5) shows, in Turkey's economy sectors with immediate effects above the mean are:Other Manufacturing, Health & social work, Construction, Wholesale & retail trade; repairs and Hotels & restaurants, Wood and products of wood and cork.

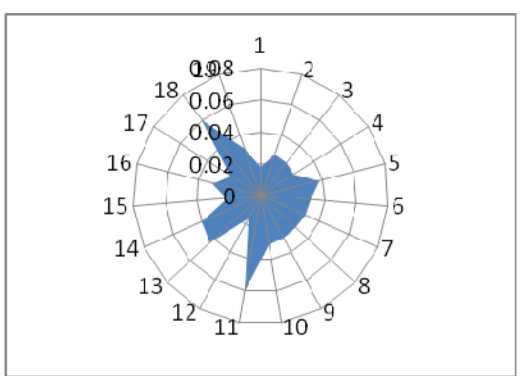

Figure 5: Immediate Effects of Turkey

For South Korea, as figure (6) represents economy sectors with immediate effects above the mean are: Other Manufacturing,Construction,Wholesale & retail trade; repairs and Hotels & restaurants, Other Services, Textiles, textile products, leather and footwear,Wood and products of wood and cork.all other sectors with high total effects enjoy relatively high immediate effects in Southkorea’s economy.

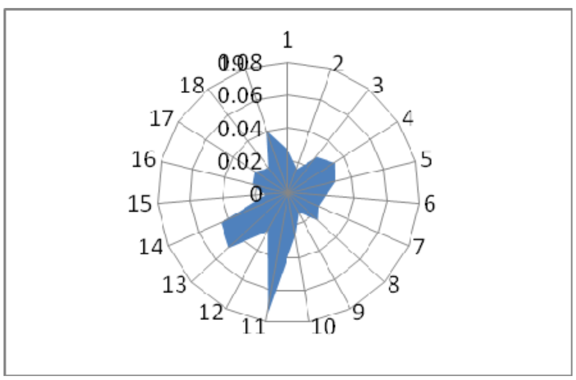

Figure 6: Immediate Effects of South Korea

Mediative Effects

As mentioned before, in fact mediative effects outstand the importance of certain sectors as instruments of the transmission of total effects. As figure (7) presents mediative effects for Iran.According to the results from calculating mediative effect index for Iran economy, sectors with mediative effects above the mean are: Construction ,Distrbution Water,Gas and Electricity,Other Manufacturing,Non-metallic mineral products,Wholesale & retail trade; repairs and Hotels & restaurants,communication,Basic metal products ,Pulp,paper products, printing and publishing,Wood and products of wood and cork and Mining and quarrying.

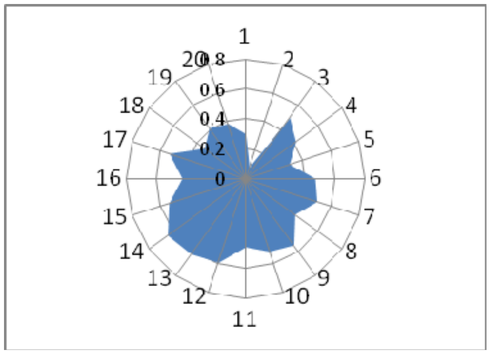

Figure 7: Mediative Effects of Iran

Considering results from immediate and mediative effects calculation in Iran economy, we can claim that all of the sectors with relatively high immediate effects enjoy relatively high mediative effects. As figure (8) presents for Turkey's economy, sectors with high mediative effects are: Other Manufacturing,Health and social work,Construction, Hotels and restaurants,Other services, machinary and equipment , refined petroleumproducts and nuclear fuel, Communication, Wood and products of wood and cork, Pulp,paper products, printing and publishing . Simillar to the results for Iran, all of the sectors with high immediate effects enjoy relatively high mediative effects in Turkey's economy.

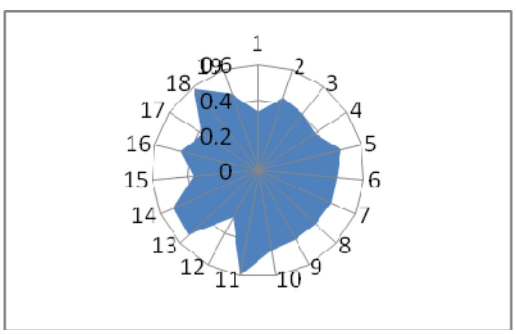

Figure 8: Mediative Effects in Turkey

According to figure (9) sectors which have outstanding mediative effects in South Korea are: Other Manufacturing,Construction, Hotels and restaurants,Other services,Textiles, textile products, leather and footwear, Food products, beverages and tobacco, Distribution of water, Gas and Electricity,Wood and products of wood and cork, Machinary and equipment Products.It is interesing that results from mediative effects for South Korea are consistant with results for Iran and Turkey.

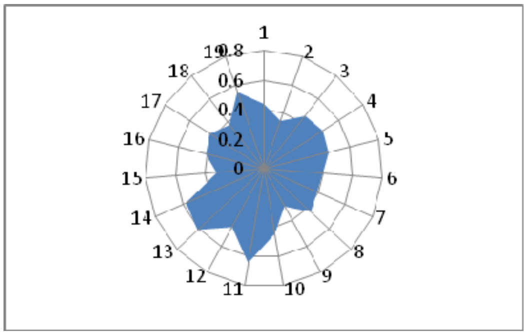

Figure 9: Mediative Effects in South Korea

Influenced index and Revised total effect

As explained in detaile before, the applied assumption when there is no additional information, is an influence coefficient α whose value is equal for all sectors and tend to the unit ($\alpha \rightarrow 1^-$). This hypothesis is really restrictive in the IO frame because exogenous changes in the network affect each sector differently. Applying diferent α for different sectors causes different total effect values. As figure (10) represents, sectors with high revised total effects in Iran . This chart shows that the results are almost identical with this index instead of total effects index. According to this criterion, only a few other activities can be added to the key sectors of Iran. These sectors are: Textiles, textile products, leather and footwear, Health and social work, Wood and products of wood and cork, Non-metallic mineral products and Education.

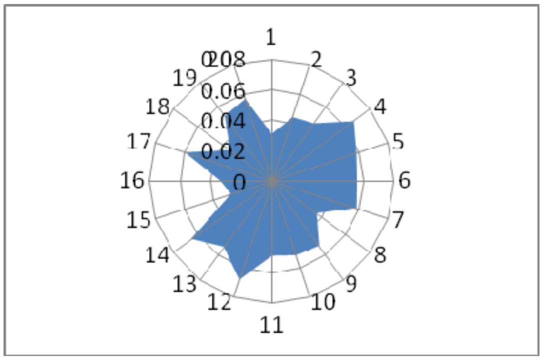

Figure 10: Revised Total Effects in Iran

For Turkey, Figure (11) represents that sectors with relatively high revised total effects. The results of the Turkish economy in Revised total effect and total effect index is almost identical. Only the activities of transportation, chemical and petrochemical products and communications to key sectors were added.These results show that all of the sectors with total effects above the mean also enjoy revised total effects above the mean. Although this sector has relatively high total effects, the revised total effects of this sector is below the mean. The results from comparing revised total effects and immediate effects are exactly the same in Turkey's economy.

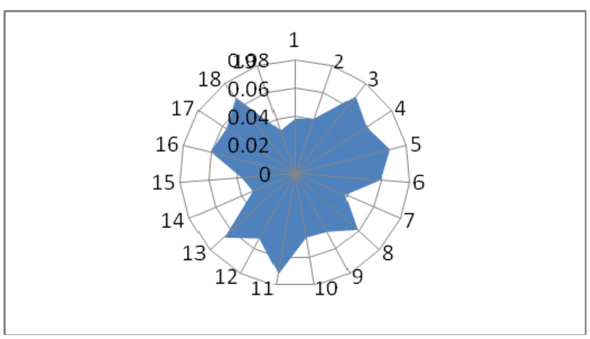

Figure 11: Revised Total Effects in Turkey

Figure (12) represents that sectors with revised total effects above the mean in South Korea which are:Sectors with high total effects enjoy high revised total effects in South Korea's economy.Also, the results of the Korea economy in Revised total effect and total effect index is almost identical. Only the activities of construction, Health and social work, education, Water, Gas and electricity, Basic Metal products to the key sectors were added.

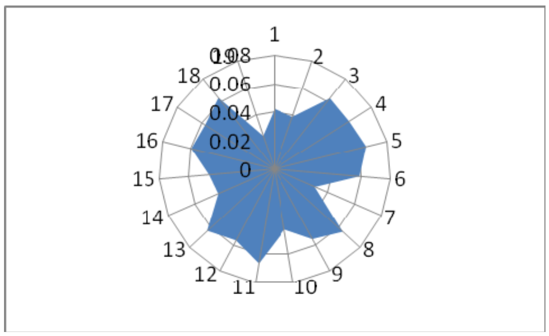

Figure 12: Revised Total Effects in South Korea

5- Conclusion

This study is an effort to identify key sectors for Iran, Turkey and South Korea’s economy on the basis of network theory by using Input-Ootput tables of 1999 for Iran, 2002 for Turkey, and 2005 SouthKorea. For this purpose three centrality measures- total effects, immediate effects, mediative efects- and also influence index and revised total effects are measured for these three countries. Results from calculating the three multilevel indicators with demand model show that, Other manufacturing, Food products, beverages and tobacco,Constraction, Communication ,Pulp, paper products , Textiles, textile products ,Health,Wood and products of wood and cork, Electricity, Water and Gas,Non-metallic mineral products,Education and Bsic Metal Products are key sectors in Iran economy.

Country	Revised Total Effect
Iran	Other manufacturing, Food products, beverages and tobacco,Constraction, Communication ,Pulp, paper products , Textiles, textile products ,Health,Wood and products of wood and cork, Electricity, Water and Gas,Non-metallic mineral products,Education and Bsic Metal.
Turkey	Other manufacturing ,Food products, beverages and tobacco ,Wood and products,Health,Constraction, Communication, Pulp, paper products, Textiles, textile products, Non-metallic mineral products, Education and Electricity, Water and Gas.
South Korea	Other manufacturing ,Wood and products of wood and cork , Non-metallic mineral products, ,Constraction, Health Food products, beverages and tobacco, Textiles, textile products, Communication, Pulp, paper products, printing and publishing, Education, Electricity, Water and Gas,Basic Metal products.

Other manufacturing ,Food products, beverages and tobacco ,Wood and products,Health,Constraction, Communication, Pulp, paper products, Textiles, textile products, Non-metallic mineral products, Education and , Electricity, Water and Gas are key sectors in Turkey economy and Other manufacturing ,Wood and products of wood and cork , Non-metallic mineral products, ,Constraction, Health Food products, beverages and tobacco, Textiles, textile products, Communication, Pulp, paper products, printing and publishing, Education, Electricity, Water and Gas,Basic Metal products are key sectors in South Korea's economy.

Considering results from calculating influence index and revised total effects, we can show that the results are almost identical with this index instead of total effects index in three country. According to this criterion, only a few other activities can be added to the key sectors of these country.In fact analysing the results imply that considering the role of final demand for some economic activities are really important in identifying key sectors of Iran,Turkey and Korea although it is less important in some sectors of Turkey and South Korea.Comparing the results from immediate and mediative effects in all three countries show that all of the relatively high immediate effects sectors also enjoy high mediative effects. This point outstands the importance of these sectors in the related countries. Another interesting observation is that sectors with high total effects also enjoy relatively high revised total effects in all three countries.

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