Structural equivalence in the input-output field

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Abstract

The systematic study of the way in which intersectoral transactions are organized is an interesting source of information about the pattern of existing economic relationships in one country that allows comparison of its structural features with those of another economy of reference. With this aim, the Network theory is an useful methodology that allows us simplify and describe the main features of economic network and reveal the complexity and inner performance of structure. A new tool in the input-output context that allows us to reveal the functioning economic structure by determining the structural equivalent sectoral groups is proposed in this work. This concept is usual in Network Theory and is interesting for the input-output structural analysis. The structural equivalent definition refers to groups of sector with similar behaviors and common position in the structure. The concept is close to the Network and Graph theories. Its implementation is very flexible and can be applied both Boolean or valued graphs overcoming the usual criticisms of qualitative input-output studies.

Keywords: network theory, graph theory, input-output analysis, structural equivalence

Topic: 8. Sector Analysis

1. Introduction

The input-output model has been linked to economic structure analysis since its origins. "An old question concerning structural analysis is whether individual economies show particular characteristics helpful to explain the dynamics that these economies follow" (Aroche-Reyes, 2006). In this work, we propose the application and study of a new tool in the input-output context that allows us to reveal the functioning of the economic structure via the determination of structural equivalent sectoral groups.

The structural equivalence concept has been applied in the search of identical positions for a long time in network theory (Wasserman and Faust, 1994). There is a growing consensus that structural similarity is one of the key structural properties in network analysis (Borgatti and Everett, 1992; Burt, 1982; Wasserman and Faust, 1994).

In the input-output field, the term is interesting in structural analysis. Its application enables the identification of sectors which have similar roles and share a position from which the effects spread out over the economic network. The more traditional approach develops and uses methods of key sector analysis for uncovering similarities and differences between sectors. However, in general all these measures are not concerned with the location of the sectors in the economy network (Aroche-Reyes, 2006).

The scope of structural equivalence fits into the topic of the papers based on the graph and network theories in input-output analysis. The objective of these tools is to find a set of relationships between industries that enables the economic network as a whole to be characterized (Schnabl, 1994; Ghosh and Roy, 1998; Aroche-Reyes, 1996 and 2006). Almost all input-output graph methods are based on the degree of cohesion between sectors (Schnabl, 1994; Aroche-Reyes, 2002; Dietzenbacher and Romero, 2007; García, Morillas y Carvajal, 2008, 2010 and 2011). The structural equivalence concept offers a tool for discovering sector positions based on the links schemes regardless of the length of the paths and their interaction directly or indirectly. This structural equivalence model was highlighted by Burt (1982) who proposed that behaviour is better predicted by position scope than by a cohesion view.

The structural equivalent determination will be done by the algorithm CONCOR. In network theory, CONCOR is a widely used and accepted method designed for partitioning data into structurally equivalent clusters (Breiger, Boorman, Arabie, 1975; Faust, 1988; Wasserman and Faust, 1994; Weng et al., 2010).

The remainder of the paper is organised so that in the next epigraph we present the structural equivalence concept. The next section gathers the methodology employed to find the structural equivalence sectors. Using this methodology we will carry out a comparative study of the productive structures of Spain between 2000 and 2005. Finally, some conclusions are offered.

2. The structural equivalence concept

Many definitions of equivalence have been proposed[1] in the network theory field. The first equivalence class concept was proposed by Lorrain and White (1971). The original definition of structural equivalence considered two agents to be equivalent only when they had exactly the same relations to and from all others in the system. The concept is based on the configuration of the relations. Two agents may be structurally equivalent although they will have direct or non direct relations between them and in spite of the number of intermediary relations. The agents that show identical relations are structurally equivalent when holding the same position in the network (White,

[1] See Wasserman and Faust (1994) for further discussion.

Boorman and Breiger, 1976). In conclusion, the term structural equivalence refers to positions in the network that have the same structural features.

In input-output analysis, the sector classification in structurally equivalent groups makes it possible to compare one sector with the rest in terms of its position in the structure. The concept allows the finding of clusters that gather sectors with similarities in their form of establishing transactions. So, the objective of this concept is of interest to structural input-output analysis.

As an illustration, consider the sectoral network proposed in figure nº 1 and gathered in the next adjacency matrix:

	1	2	3	4	5
1	0	0	1	1	0
2	0	0	1	1	0
3	0	0	0	0	1
4	0	0	0	0	1
5	0	0	0	0	0

Figure 1. Structural equivalent sectors

Structurally equivalent sectors have been marked with the same graphical shape in figure 1. Sectors are aggregated into a joint position or role to the extent that they have a common set of linkages to the other sectors in the network. So, three clusters of structurally equivalent sectors appear in the network. Three distinct positions emerge corresponding to the three roles. Each of the sectors which are peripheral in the network could be structurally equivalent. The cluster-peripheral sectors are expected to be similar to each other and different from others, for example, sectors which are central in the network. So, the sectors maritime transport services (3) and inland transport services (4) will be structural equivalents as both of them offer their services to recovery, repair services, wholesale, retail (5) and have established relations with industrial machinery (1) and transport equipment (2), respectively. Their position can be catalogued as central in the network. Furthermore, industrial machinery (1) and transport equipment (2) share the same structural position because they present identical links: both of them have linkages to maritime transport services (3) and inland transport services (4). Finally, recovery, repair services (5) show a peripheral position different from other sectors. In terms of the adjacency matrix, the structurally equivalent sectors have identical rows and columns[2].

This means, for perfect structural equivalence, all members of a cluster must have exactly the same ties to and from each other. The structural equivalence requires sectors to have exactly identical patterns of relations with the other sectors in order to be placed together in the same position.

However, some considerations must be taken into account when the concept is applied. In practice, the criterion of perfect structural equivalence is too stringent. It is not usual in a real network that agents are perfectly structurally equivalent, so in empirical research the requirement is relaxed to "partition agents in mutually exclusive classes of equivalent agents who have similar relational patterns" (Borgatti and Everett, 1992)[3]. Besides this, although in theory the applied criterion may allow the identification of substitute agents in some contexts (Sailer, 1978); this possible extension of the analysis cannot be applied in the input-output field. The Leontief model assumes that all inputs are bought by producers in fixed proportions; it is the production

[2] In the case, that there will be more than one type of relation gathered in different adjacency matrices then, the structurally equivalent sectors will have identical entries in their respective rows and columns in all these matrixes (Wasserman and Faust, 1994).

[3] Other works, generalized this concept to regular equivalence."Regularly equivalent points are connected in the same way to matching equivalents" (White and Reitz, 1983).

function is the complementary inputs type. For this reason, the classes of equivalent sectors will identify positions in the economic network but not substitutability between sectors.

Then in practice the implicit hypothesis is structural equivalent agents should have similar behaviours and so, outcomes (Burt, 1978; Friedkin, 1984). These sectors face the same risks and opportunities associated with position sharing. In the presence of environmental changes the structurally equivalent sectors will tend to be analogous in behaviour. Identical exogenous impacts will result in similar effects on structurally equivalent sectors because the demand impulses will spread in the same form. These are features to be taken into account in developing economic policies.

The partition generated by the structural equivalence concept can be applied to visualise the economic structure of a country by using graphs. By conceiving sectors as equivalence positions that relate in a similar way to other positions, the input-output network can be transformed into a simplified graph where equivalent sectors are grouped into positions and the relations between the positions are shown. "There is no loss of information by combining the two or more structurally similar actors into a single subset and representing them together as a single structural entity called an equivalence class or position" (Wasserman and Faust,1994).

The proposed approach complements the traditional input-output view of other studies which are based on the degree of cohesion between sectors (Schnabl, 1994; Aroche-Reyes, 2002; Dietzenbacher and Romero, 2007, among others). Most methods for cluster analysis and qualitative input-output analysis can determine which sectors are strongly connected to each other. It is a cohesion or relational approach focus on tracing the direct and indirect connections. In contrast, the structural equivalence concept follows the so called positional approach (Doreian, 1988) which may be helpful to conceptualize a position based on the links pattern. Two sectors are structurally equivalent whether they have direct linkages or not and regardless of the length of the path connecting them indirectly. Structural equivalence is based on the configuration of the relations that sectors have and not in the relationship degree. This feature is considered an advantage for some researchers such as Rey and Mattheis (2000), O'hUallachain (1984) among others in group determination.

3. Structural equivalent sectors determination

The development of methods to identify equivalence classes have been the object of recent efforts in social network research (Hsieh and Magee, 2008). CONCOR (McQuitty and Clark, 1968; Breiger et al., 1975; White et al.,1976), STRUCTURE (Burt, 1989), Generalized Blockmodeling (Doreian et al., 2005; Žiberna, 2007), stochastic models in cluster analysis (Handcock et al., 2007) are some of the possibilities.

In this work, the CONCOR method (CONvergence of iterated CORrelations) is followed with the aim of focusing on the equivalence structural concept. In network theory, CONCOR is a widely used and accepted method designed for partitioning data into blocks (Breiger, Boorman, Arabie, 1975; Faust, 1988; Wasserman and Faust, 1994; Weng et al., 2010). The algorithm compares the patterns of relations for any two agents by correlating the values in each cell of the column (row) of the network matrix that are associated with each member of the pair. So, CONCOR is an iterative algorithm based on the calculation of correlation coefficients.

The use of a correlation matrix as an input matrix in the input-output field is a normal option in cluster studies through factorial methodology (Czamanski, 1974; Feser and Bergman, 2000). However, these types of transformations have been criticized due to the absence of clear interpretation of the matrix and the obtained clusters (Roepke et al., 1974). The CONCOR algorithm overcomes this problem. The formed groups are structurally equivalent. The concept is usual in network theory but new and interesting in structural input-output analysis.

Furthermore, CONCOR is very flexible and can be applied on both Boolean or valued graphs. The algorithm can use all the information avoiding the use of exogenous filters as well as binary arrays. It offers the means of overcoming some of the usual criticisms[4] of the use of qualitative analysis in the input-output field. In order to overcome them, quantitative matrices and valued graphs are required (Lantner 1974 and 2001, among others).

The methodological development of CONCOR has inspired more recent techniques in other scientific fields. Dubnov et al. (2002) presents a non parametric cluster algorithm based on the iterative estimation of distance profiles through the Jensen-Shannon divergence. The method has properties and characteristics analogous to the CONCOR algorithm.

[4] Generally, many Graph Theory theorems and applications are focused on Boolean structures. In an input-output context, these Graph-Theory applications convert the transaction matrix into a Boolean structure. This is done by replacing the value of each coefficient that links one industry i with another sector j by a Boolean coefficient. Thereby some information is lost because all values under the filter are set to zero and all values equal or above the filter are set to one (de Mesnard, 2001).

Obviously, correlation can be one of the dependence indicators to measure the structural equivalence degree. Structural equivalence modeling by Euclidian distance can yield substantially different results from those of CONCOR (Knoke & Kuklinski, 1982). The main problem with using Euclidian distance, as in the STRUCTURE (Burt, 1989) and other cluster methods, is that it does not yield structurally equivalent blocks and a description of the relations between them, which is useful for the interpretation of results (Faust and Romney, 1985).

3.1. CONCOR algorithm

The CONCOR (CONvergence of iterated CORrelations) is an iterative algorithm based on a process of re-estimation of intercolumnnar (inter-rows) correlations. The algorithm is not difficult to operate. Begin with a square matrix in which each column (row) represents a sector, later the correlation coefficient between each column (row) with the rest is calculated and then this process continues to iterate.

Formally, given a matrix **X** of size (nxn) whose elements can be flows or coefficients:

$$\mathbf{X}=\begin{bmatrix} x_{11} & \dots & x_{1n} \\ \dots & \dots & \dots \\ x_{n1} & \dots & x_{nn} \end{bmatrix} \tag{1}$$

The correlation coefficients between columns are calculated so that the relationships between sectors can be gathered:

$$\mathbf{R}=\begin{bmatrix} r_{11} & \dots & r_{1n} \\ \dots & \dots & \dots \\ r_{n1} & \dots & r_{nn} \end{bmatrix} \tag{2}$$

Treat the columns of **R** as vectors and calculate a new correlation matrix $R^{(1)}$:

$$\mathbf{R}^{1} = \begin{bmatrix} r_{11}^{1} & r_{12}^{1} & \cdots & r_{1n}^{1} \\ r_{21}^{1} & r_{22}^{1} & \cdots & r_{2n}^{1} \\ \cdots & \cdots & \cdots & \cdots \\ r_{n1}^{1} & r_{n2}^{1} & \cdots & r_{nn}^{1} \end{bmatrix} \quad (3)$$

where the index (1) is referred to first iteration of the correlation matrix.

The process continues repeatedly iterating the matrix to obtain $R^{(2)}, R^{(2)}, ..., R^{(t)}$. In general, the t iteration of algorithm CONCOR can be represented as follows (Schwartz, 1977):

$$\mathbf{R}^{(t)} = \hat{\mathbf{d}}_{S}^{(t)} \mathbf{S}^{(t)} \hat{\mathbf{d}}_{S}^{(t)} \quad (4)$$

where the index "t" refers to the t iteration, $\hat{\mathbf{d}}_{S}^{(t)}$ gathers the diagonal matrix whose elements are the reciprocals of the square roots of the diagonal of the covariation matrix, $\mathbf{s}^{(t)}$ is the covariation matrix defined as:

$$\mathbf{S}^{(t)} = \frac{1}{n} \mathbf{R}^{(t-1)} \boldsymbol{\Psi} \mathbf{R}^{(t-1)} \quad (5)$$

and $\boldsymbol{\Psi}$ corresponds to a (nxn) matrix calculated as: $\boldsymbol{\Psi} = \left(\mathbf{I} - \frac{1}{n} \mathbf{ii}' \right)$ where **I** is the identity matrix and **i** a column vector of ones.

So, the correlation coefficients of t-1 iteration appear in the calculation of the t-iteration correlation coefficient. The matrices **R** sequences tend (Breiger et. al., 1975; White et. al., 1976) to a matrix $\mathbf{R}^{(\infty)}$ which shows the basic structure of the sectors relationship. If the data matrix **X** does not present a symmetrical form[5], $\mathbf{R}^{(\infty)}$ converges to a rank one matrix whose elements are $+1,-1$ and so it is divided into two different groups or blocks. Successive applications of the method over the precedent groups allow us to divide them progressively.

4. Structural equivalent sectors in Spain

In this work, the structural equivalent sectors of Spain in 2000 and 2005 are determined. This empirical exercise allows us to form some conclusions about the Spanish sectoral performance evolution in the last years. The information used as a starting point is supplied by the input-output tables of Spain in 2000 (IOT-00) and in 2005 (IOT-05) with a 25 desegregation level. The identification of structurally equivalent sectors can be realized from any type of graph -Boolean and / or valued - associated with the studied structure. In this article, we use the valued graphs associated with the internal input-output coefficients. It means overcoming some of the usual criticisms of the use of qualitative analysis in the input-output field (de Mesnard, 2001). In any case, the results for Boolean graphs are very similar to those presented.

The Spanish structural equivalent sectors in 2000 and 2005, determined by the CONCOR algorithm[6], are gathered in Table nº 1. This table groups together the branches which present similar relations in 12 and 15 clusters, respectively. Each cluster has been indicated with a letter. If the group of the year 2005 has part of the composition of some cluster of the year 2000 a number is added to the letter. If the group in 2005 is formed by a combination of previous clusters then an asterisk is added.

[5] This fact is usual in the applied works in economy. Clark and McQuitty (1970) and Chen (2002) gather examples for which CONCOR does not converge to a rank one matrix of plus and minus ones.

Table nº 1. Structural equivalent sectors. Valued graph

The sectors gathered in the same cluster keep a similar capacity and economic influence in the production network. Their production activities weight may logically be very different, but their position in the network is similar, as the algorithm CONCOR has revealed.

The number and composition of the obtained clusters show that the Spanish structure in 2000 presents similarities with the Spanish structure in 2005, but at the same time it develops important differences. Therefore, the Spanish economy has presented a significant sectoral evolution over the five years of this study.

In this work, the clusters A, B and F are common to both temporal moments. So, the same structural equivalent position is held by these sectors in 2000 and 2005. Basically, they are sectors related with agriculture, energy and construction. The vertical integration schemes of these sectors can be influenced in this result. Other studies such as West (2001) and Thakur (2008), among others, provide empirical evidence of the regularities existing in economies over time.

However, there are some differences in the sector position in 2000 and 2005. Clusters as C and K, L present a similar position but more differentiated in 2005. The D and E clusters are gathered in one structural equivalent position in 2005. Finally, the rest of clusters have arisen from combinations of previous groups of 2000. The alteration in the position of the sectors allows us to emphasize some important changes in the performance of the Spanish economy in 2005. It is interesting to note the diverse structural equivalent positions of the services segment. The greater role of services can

Nevertheless, these are very restrictive conditions in the input-output field and without practical repercussion.

[6] The results are obtained with the software Netminer. See http://www.netminer.com.

reflect a shift in consumer demand, which is linked to high incomes, elasticity of services, increased business demand as well as some outsourcing of manufacturing to specialised services providers. This service group includes health, social services, market, associative, sporting activities… and other activities of personal services whose growth has been relevant in the last years due to economic and sociological transformations. Likewise, this sector gathers together some services to firms whose development has been relevant as an answer to new ways of industrial organization. The search for flexibility in product production and distribution has influenced the process of externalization and expansion of these services which nowadays play an important role in the economies. This fact can be in relationship with the changes driven by globalization and evolving manufacturing patterns, such as JIT (Just-in-Time Delivery) and new business opportunities linked to telematics. It gives an image of the current production/distribution mechanics built around a competitive edge in developing subcontracting system, exploring modulation techniques, and constructing efficient vertical value chains (Jones and Kierzkowski, 2005).

As well, the position of the industrial segment has changed during those years. The low technological industrial sectors are contained in the DE cluster. However, the high and medium industrial sectors present a more differentiated position in 2005. The minor development in the past of Spanish high technological manufacturing branches in Spain could cause their position in 2000. The advances and efforts in the R&D policy contribute to establishing new roles in the technological industries.

This structural equivalent sectors determination allows us to define a simplified graph to visualise the economic structure and explore the relationship between positions. The simplified graph can be obtained after having reduced the sectors into a set of clusters and the density of links between the positions is calculated. The overall density can be used as a cut-off value for the reduce graph determination (Scott, 2000; Weng et al., 2010): if the density between clusters is above the overall density then it is coded 1 and in the cases where it is below overall density it will be coded 0. This step allows us to show the more important links between clusters. The figures 2 and 3 show the reduce graphs for Spain in 2000 and 2005.

Figure 2. Spanish reduce graph in 2000

Figure 3. Spanish reduce graph in 2005

These structures may be studied in deep applying graph measures (Lantner, 1974 and 2001; Wasserman and Faust, 1994; Aroche Reyes, 1996; García et al., 2008; among others). As the objective of this work is to present the equivalence structural concept, an initial descriptive analysis of the structures is exposed. In this sense, the size of the nodes of the graph is proportional to the number of their established relations. So this representation of the clusters network gathers the basic information about the measure called degrees.

Isolated clusters don´t appear in the reduce graphs. There is a central role of some clusters such as B, C, I, G and L in 2000. Basically, they are formed by the metal sectors, energy and some services such as transports and other market services. The rest of the services are on the periphery of the Spanish structure in 2000 with a few established relations.

The economic structure in 2005 is more cohesive. In general, all the clusters have an important role for structure articulation. The Spanish economy has evolved toward a compact network. This feature illustrates a stronger and more developed economy. The sectors with a few established relations are services: lodging and catering services (K1), credit and non-market services (K2) and maritime and air transport services (L2).

5. Conclusions

The development of social network techniques in sector group analysis is promising (Feser and Bergman, 2000). Recent works have appeared presenting this view (García et al., 2007 and 2010). All of them are based on a cohesion approach. However, the concept of structural equivalence is based on the relationship configuration that sectors have and not the degree of relationship. This work supposes a complementary view of the classic cohesion view and follows the studies that have highlighted the positional approach for the explanation of possible behaviours in a network (Borgatti and Everett, 1992; Burt, 1982).

The structural equivalence concept, usual in the sociological network theory field, is useful in structural input-output analysis. Its application enables the identification of sectors which have similar roles and share a position from which the effects spread out over the economic network. These types of sectors should face the same risks and opportunities associated with position sharing (Friedkin, 1984). Not only the structural equivalence concept complements the classic key linkages studies and the cohesion measures of qualitative input-output field but it predict better the behavior of the agents (Burt, 1982).

Based on this logic, the structural equivalence model develops a partition of the network based on the sector´s common patterns of links with all other sectors. The partition can be applied to visualise the economic structure using a reduce graph. The key interest in studying the links patterns among these clusters gathered in the reduce graph is to discover underlying influence, articulation and/or coordination sectoral features.

Diverse blockmodeling tools are used in response to different notions of equivalence (Žiberna, 2007; White, 2005; among others). In this work, the determination of structural equivalent sectors has been done by algorithm CONCOR. CONCOR is a widely used and accepted method in network theory for partitioning data into blocks (Breiger et al., 1975; Faust, 1988; Wasserman and Faust, 1994; Weng et al., 2010)

The results obtained for Spain in 2000 and 2005 indicated important changes in the studied economy during those years. Some common patterns are in the Spanish economy in 2000 and 2005. The same structural position is kept by agriculture, energy and construction. Their dynamic of economic relations has not changed, but they are the only ones. The high technological sectors have obtained a differentiated position in the economic network that allows them to generate bigger backward and forward effects.

The blockmodel analysis also shows the key role of clusters related with some services. Sociological changes -elderly population, incorporation of women in the labour market…- have created new ways of life and new needs focused on health, leisure and cultural services included in the other market services (cluster IJ). The central role played by the transport services stands out as other works have corroborated (García et al, 2010). These are not the only service links for connecting parts of the production process and encouraging a better economic performance. The services sectors play an outstanding role in the articulation of the Spanish economic network in

2005, through more differentiated positions. The strategic value of these activities can be related with the increasing complexity of company organization and environment and the search for flexibility in product production and distribution (Jones and Kierzkowski, 2005).

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Tables:

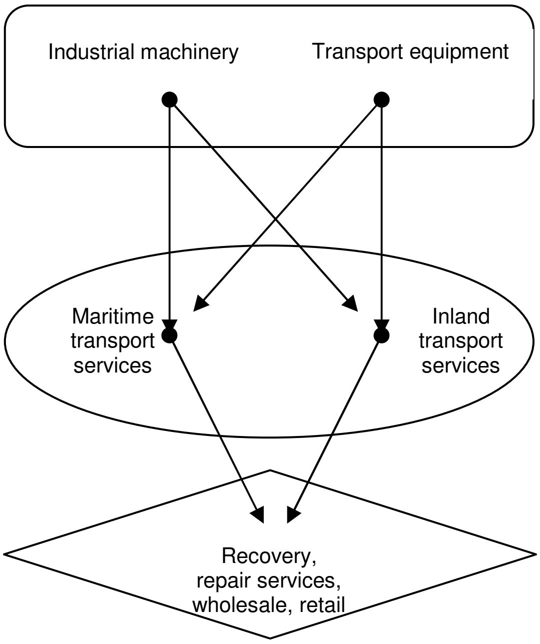
Table 1

<table>
<tr><th>Clusters</th><th>2000</th><th>2005</th><th>Clusters</th></tr>
<tr><td>A</td><td colspan="2">1. Agriculture, forestry and fishery products
11. Food, beverages, tobacco</td><td>A</td></tr>
<tr><td>B</td><td colspan="2">2. Fuel and power products</td><td>B</td></tr>
<tr><td rowspan="2">C</td><td rowspan="2">4. Non-metallic mineral products
5. Chemical products</td><td>4. Non-metallic mineral products</td><td>C1</td></tr>
<tr><td>5. Chemical products</td><td>C2</td></tr>
<tr><td>D</td><td>10. Transport equipment</td><td rowspan="2">10. Transport equipment
12. Textiles and clothing, leather and footwear
13. Paper and printing products
14. Rubber and plastic products
15. Other manufacturing products</td><td rowspan="2">DE</td></tr>
<tr><td>E</td><td>12. Textiles and clothing, leather and footwear
13. Paper and printing products
14. Rubber and plastic products
15. Other manufacturing products</td></tr>
<tr><td>F</td><td colspan="2">16. Building and construction</td><td>F</td></tr>
<tr><td rowspan="2">G</td><td rowspan="2">3. Ferrous and non-ferrous ores and metals
6. Metal products except machinery</td><td>3. Ferrous and non-ferrous ores and metals</td><td>G1</td></tr>
<tr><td>6. Metal products except machinery
7. Agricultural and industrial machinery
9. Electrical goods</td><td>GH*</td></tr>
<tr><td>H</td><td>7. Agricultural and industrial machinery
8. Office and data processing machines
9. Electrical goods</td><td>8. Office and data processing machines</td><td>H1</td></tr>
<tr><td>I</td><td>24. Other market services</td><td rowspan="2">22. Communication services
24. Other market services</td><td rowspan="2">IJ*</td></tr>
<tr><td>J</td><td>21. Auxiliary transport services
22. Communication services</td></tr>
<tr><td rowspan="3">K</td><td rowspan="3">17. Recovery, repair services, wholesale
18. Lodging and catering services
23. Services of credit
25. Non-market services</td><td>17. Recovery, repair services, wholesale
21. Auxiliary transport services</td><td>IK*</td></tr>
<tr><td>18. Lodging and catering services</td><td>K1</td></tr>
<tr><td>23. Services of credit
25. Non-market services</td><td>K2</td></tr>
<tr><td rowspan="2">L</td><td rowspan="2">19. Inland transport services
20. Maritime and air transport services</td><td>19. Inland transport services</td><td>L1</td></tr>
<tr><td>20. Maritime and air transport services</td><td>L2</td></tr>
</table>

Structural equivalent sectors. Valued graph

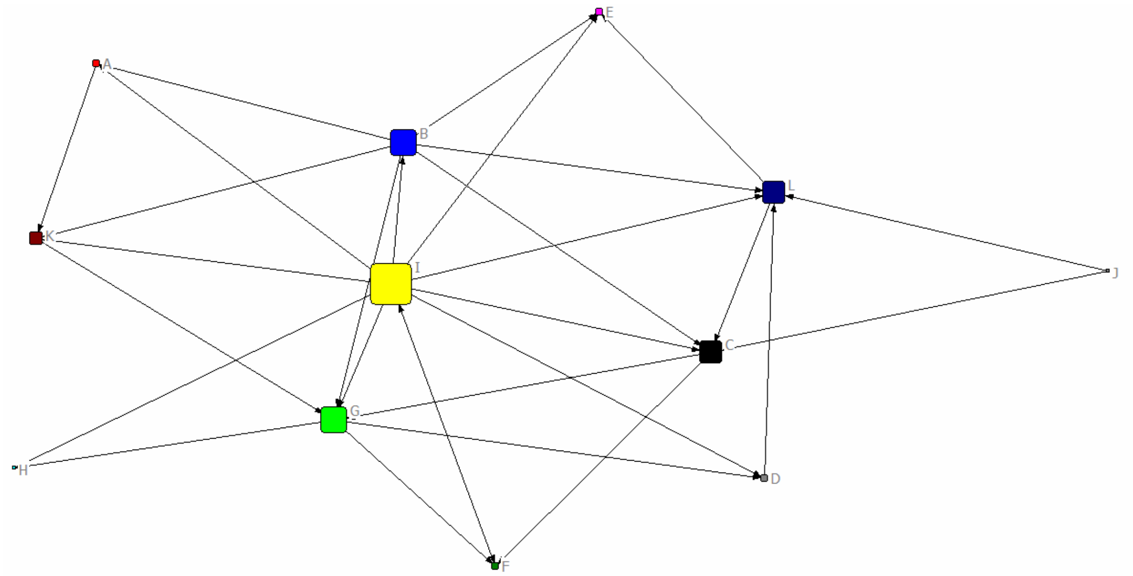
Figures:

Figure 1



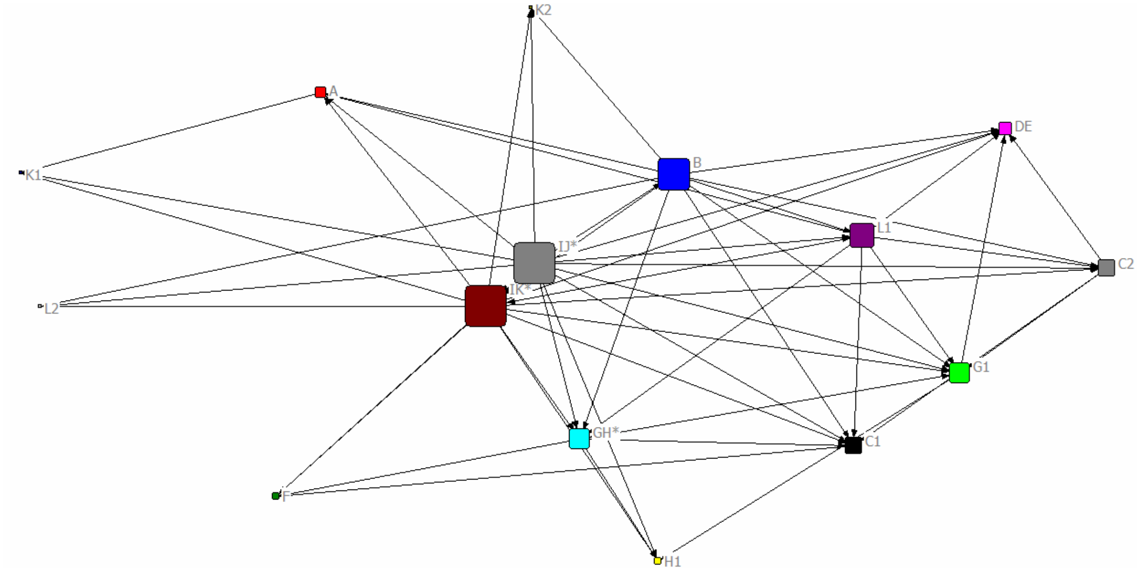
Structural equivalent sectors

Figure 2



Spanish reduce graph in 2000

Figure 3



Spanish reduce graph in 2005