Title

Fundamental Economic Structure of Andalusian Economy over Social Accounting Matrices

Authors:

Prof. Dr. Manuel Alejandro Cardenete Flores.
Affiliation: Dpto de Economía. Universidad Loyola Andalucía
Adress: Campus Palmas Altas, C/Energía Solar, 1, Ed. G. E-41014, Sevilla, España
Tf: (+34) 955-641600
E-mail: macardenete@uloyola.es

Prof. Jorge Manuel López Álvarez
Affiliation 2: Dpto. de Economía. Universidad Loyola Andalucía
Adress: Campus Palmas Altas, C/Energía Solar, 1, Ed. G. E-41014, Sevilla, España
Tf: (+34) 955-641600
E-mail: jmlopez@uloyola.es

JEL codes: C67, E16, R15

Keywords: Fundamental Economic Structure, Social Accounting Matrix, Structural change

Abstract

Over the last 60 years, regional economic analysis has been interested in identifying common patterns and regularities of regional economic structure. The identification of such patterns suggests that there predictable relationships between different levels of structural regional development.

Since Social Accounting Matrices (SAM) are database containing the total transactions in an economy, to have several ones, maked up on a uniform basis, it allows comparison both in space and time. Comparison of these matrices implies the comparison of the economic structure embedded in them. As regional SAM provide a detailed description of the economic structure, they provide a valid basis for this category of analysis.

The aim of this paper is to determine those structural components and similarities in economic relationships within the regional economy (Andalusia) over a determined period of time (1990-2010), specifying the Fundamental Economic Structure, quantifying and classifying its components both individual and holistic sense. Highlighting the distinctive features of regional economic structure, watching and providing a temporary path in the evolution of the whole economy determining the main economic sectors and interrelations for a better understanding of regional economy. Being able to be a source capable of being

evaluated for the establishment of priorities, driven investments, and guide decissions that promote and accelerate the economic growth.

The FES methodology applies a set of complementary techniques, focused on revealing key components in the overall economy. Quantifying the features of each component will allow us ranking the core (fundamental part) and the periphery (non-fundamental part) of the economy.

The key features of that approach are predictability, existence of dynamic elements of economic structure that can be predicted through aggregate indicators representatives of the size of the economy and evaluated by different statiscal regression models; stability, represented by elements consistently present along the data series and determined by coefficient of variation and importance; and importance determined by the connectiviy of every cell with the rest of the system based on field of influence approach. The cells and activities that are highlitghted by the different features become the core of the Fundamental Economic Structure inside and economy and let the classification of every flow in the structure of the economy.

The results show us that the Regional Domestic Product is the variable that explains better the value of each cell over a linear logarithmic model, and the partitions of the economy related with the tertiary activities have a higher probability of been predicted in this model, specially in Commercial Services, Retail sales, Transport and Communications and Other Services.

In terms of stability, the component more consistents represent the 52,16% of total cells and reveal a stable structure of the economy supported in tertiary sector and some industrial activities like Electric energy, Chemical and Machinery, besides other activities like refinning or Mining and Steel.

In terms of connectivity analysis the principal interactions are brought about Retail sales, Transport and Comunications and Other Services located in tertiary-tertiary, secondary-tertiary and primary-tertiary partitions of the economy. There are also important cells in the secondary sector, Construction, Vehicles, Refining and Wood manufactures.

This type of interactions between secondary and tertiary sectors, and absence of primary activities, is corresponding with economies that has got over the first stages of development (Kuznets, 1966).

The behavioural pattern of FES for the andalusian economy are far away from those observed in former analysis of indonesian, indian or chilean economy where the presence of agricultural activities is higher.

It can be concluded that there is a temporal FES for the regional economy in Andalusia in the period of analysis and under this methodology it is possible to identify not just relevant activities but key flows of interactions in the economy and let to estimate and forecast the cell values of the core of the economy.

1. Introduction

Over the last 60 years, regional economic analysis has been interested in identifying common patterns and regularities of regional economic structure. The identification of such patterns suggests that there predictable relationships between different levels of structural regional development.

Since Social Accounting Matrices (SAM hereafter) are database containing the total transactions in an economy, to have several ones, maked up on a uniform basis, it allows comparison both in space and time. Comparison of these matrices implies the comparison of the economic structure embedded in them. As regional SAM provide a detailed description of the economic structure, they provide a valid basis for this category of analysis.

Pioneer works on the stability of structures from a temporal approach are found in Carter (1970) and Sevaldson (1970) and Agustinovics (1970), later systematized and clustered under the concept of Fundamental Economic Structure (FES hereafter) in Jensen et al. (1987) and West (2001), recently evolved with inputs from Imansyah (2000) and Thakur (2008, 2010) in order to obtain the economic structure in a methodical and orderly way. The Quantification of the features of each component will allow us ranking the core (fundamental part) and the periphery (non-fundamental part) of the economy.

The aim of this paper is to determine those structural components and similarities in economic relationships within the regional economy over the period 1990-2010 for Andalusia, specifying the Fundamental Economic Structure, quantifying and classifying its components both individual and holistic sense. Highlighting the distinctive features of regional economic structure, watching and providing a temporary path in the evolution of the whole economy based on SAM available and determining the main economic sectors and interrelations for a better understanding of regional economy.

The application of FES approach over SAM to identify the backbone of the regional economy it is a evolved line of study stepping forward former analysis based on Input-Output tables.

The structure of this paper is as follows: in section 2 a brief survey of the concept of structural change and metrics are presented. Next in section 3 the presentation of FES approach and different versions is made and the database in section 4. Section 5 contains the results of the application of FES methodology for the regional economy, and finally, in Section 6, the main conclusions of the analysis.

2. Structural change and metrics

The concept of structural change has been used to identify, interpret and understand the relationship between economic development and changes in the size and composition of the various sectors and actors that make up the economy. Moreover, structural economic change is defined as the temporal change in macroeconomic variables and simultaneous relationships existing in the economy and are represented by the circular flow of income (Jackson et al., 1989).

As economies grow up, the size of the economic sectors changes, increasing the interaction among them and the economic flows become more interdependent and intertwined. This complexity of interrelations is followed by higher levels of economic development. As shown in Figure 1, the degree of complexity in the economy increases the level of development does it too.

Two methods have been traditionally used to study the structural change. First one, developed by Syrquin and Chenery (1989), seeked to identify statistically relationships between economic growth and change in the economic structure over a sample time series of 100 national economies. Second one focuses on the historical change and the experiences of economies with similar conditions developing over time.

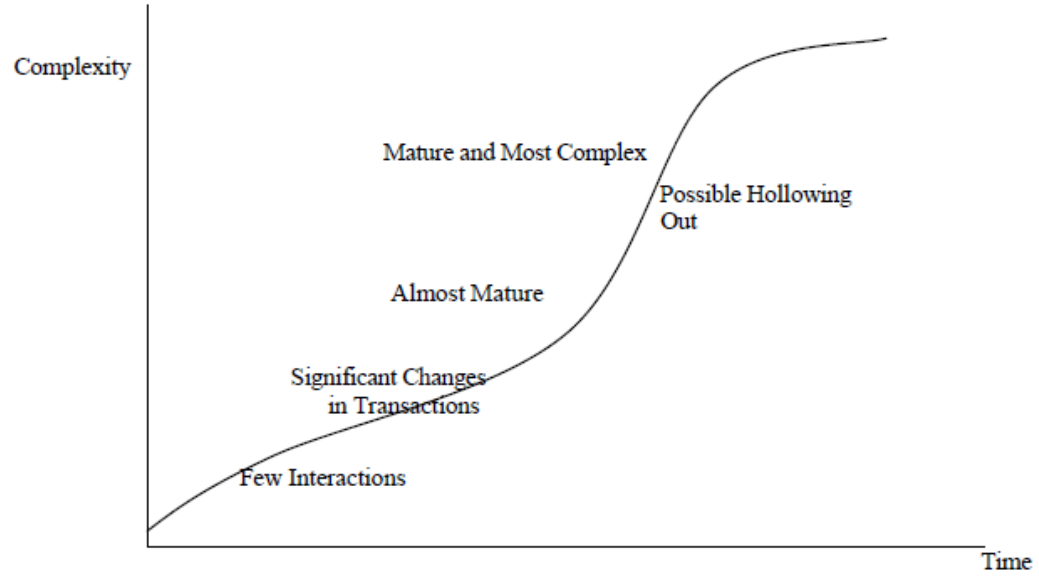
Within the framework provided by these theories, and based on the Input-Output methodology as a starting point, there are a wide range of techniques for the ascertain of the existence or absence of structural change.

In general, these approaches has come associated to elaboration of an index comparing (in most cases) pairs of tables. There are a wide variety of calculations for determining the structural change based on individual comparisons between elements of TIOs in economic literature. These indicators have evolved over time from its original conception. It is observed indicators to identify structural change almost from the origin

of the Input-Output analysis. So, Chenery and Watanabe (1958) or De Mesnard (1990) proposed the identification of change through the intensity of demand for intermediate goods caused by changes in the technical coefficients. Also Dewhurst (1993) and Sonis et al. (1996) presented techniques to decompose the intermediate transactions of the economy to identify structural change. The similarity index of Le Masne (1988) is pointed out as one of the most paradigmatic ones due to the simplicity of calculation and synthesizing capacity of its results. Moreover, Antille et al. (2000) used the Gini index for comparing economic structures. Watanabe (1961) and Sevaldson (1970) tested the hypothesis of structural permanence of ratios and Östblom (1992) used contrasts analysis of significance for ascertain structural change. Evans (1954) used the sensitivity of technical coefficients, Rasmussen (1956) developed the power sensitivity dispersión. Sonis and Hewings (1989) determine the effects of simultaneous changes in the value of the technical coefficients of a input-output table through the concept of field of influence and Cassetti (1995) those coefficients necessary to collect changes in the patterns of behavior of the economy. The identification of structural features is also present in the works of triangulation of Grötschel et al. (1984) or Haltia (1992). While connectivity between sectors to measure the degree of complexity and the intensity of the flow between each component of the matrix are observed in Szyrmer (1986) or Dietzembacher (1992) among others.

All these indicators trying to synthesize the whole economic structure in a single indicator comparing elements from pairs of matrices. These two features could limit in some extent a comprehensive structural analysis when it is possible to work with broader sets of information with the attempt to obtain global results for the economy, and, at the same time, detailed for each element of it.

Figure 1 – Regional economic development



Source: Hewings et al. (1988)

3. Fundamental Economic Structure

Simpson and Tsukui (1965) developed the concept of the fundamental structure of production. This concept was reformulated and extended to formalize the term Fundamental Economic Structure (FES). It is posible to find this term in Jensen et al. (1987) like a first taxonomic approach, supplemented in later works of Hewings and Jensen (1988) and Jensen (1990).

Identifying similarities in a regional context has been the starting point of the FES methodology. Jensen et al. (1988) established empirical regularities statistically predictable and behavior patterns in intersectoral transactions applied to Queensland economy also. Similarly, it is posible to obtain empirical evidence of FES applications in Van Der Westhuizen (1992), Imansyah (2000), West (2000, 2001) or Thakur (2008, 2010, 2012) who identified structural patterns for South Africa, Indonesia, Australia, India and Chile, respectively. In all cases the presence of a Fundamental Economic Structure is suggested, either in space or temporal scope and always working with Input-Output tables.

So, it is posible to define the Fundamental Economic Structure like a set of economic activities that are inevitably required for the performance of an economy and those economic interrelations whose flows are consistently present at statistically predictable

levels. These flows can be regarded as fundamental and belonging to the core, those unpredictable, more volatile components, will be part of the non fundamental economic structure (NFES).

It is posible to distinguish a partitioned FES, where each matrix cell is classified between fundamental or not fundamental, and, in the other hand, the tiered FES is based on the idea that each cell contains two layers, the essential and non-essential (Jensen, et al., 1991), both of them have a spatial framework, and finally the temporal FES, whose analysis is centered in those elements of the economy that are predictable over time. It is possible to consider the partioned FES a singular case of the tiered FES where one of the layers is zero for every cell matrix.

In formal analysis using Input-Output tables[1], the final demand will be divided into fundamental and non fundamental components:

$$x = (I - A)^{-1}[f_F + f_N] \quad (1)$$

Where x is a $nx1$ dimesion vector with de levels of industrial production and represents the total output and A is the technical coefficients matrix[2] with a nxn dimension. F y N are the values of final demand of fundamental and non-fundamental activities, respectively.

The final demand can be separated in a number of different activities $(f_1, f_2, \dots, f_m)$, like household consumption, public expenses, capital expenses, exports and so, it is posible to express equation (1) as:

$$x = (I - A)^{-1}[(f_{F1} + f_{N1}) + (f_{Fk2} + f_{N2}) + \cdots + (f_{Fm} + f_{Nm})] \quad (2)$$

In this sense, it is posible to assigne a level x of output to any representation of the final demand like, for instance, to f_{Fi}:

$$x_{Fi} = (I - A)^{-1} f_{Fi} \quad (3)$$

Being T_{Fi} the value of the layer of each category of the final demand i $(i = 1 \dots m)$:

[1] Although the formulation is based in the original inception using Input-Output tables like the baseline, the formal analysis can be completely extrapoled to a Social Accounting Matrix.

[2] The technical coefficient is ascertained for $a_{ij} = x_{ij}/X_j$, the proportion of total value of sector j which is adquired por i sector.

$$T_{Fi} = A\hat{x}_{Fi} = A[(I - \widehat{A})^{-1} f_{Fi}] \quad (4)$$

Where ^ denotes a diagonal matrix. Summarizing every layer it is posible to obtain the total of both (fundamental and non-fundamental layer)..

$$T_F = \sum_{i=1}^{m} T_{Fi} \quad \text{y} \quad T_N = \sum_{i=1}^{m} T_{Ni} \quad (5)$$

Being the final sum of total transactions:

$$T = T_F + T_N \quad (6)$$

Spatial and temporal FES are considered complementary and not substitutes. Regarding the structure of the FES, there is evidence that the economic structure is predictable over time in the work of West (2000,2001) and Thakur (2008).

For the decomposition of these elements, the FES analysis uses three features: predictability, stability and importance; which are determined through different techniques and properly combined allow us to differentiate between those cells that are critical of that are not. It is posible also to identify the consistency of of each component inside the core structure through the combination of them.

Predictability: the basic hypothesis for the determination of this feature is the existence of dynamic elements of economic structure that can be predicted through aggregate indicators representatives of the size of the economy. So, there is a relationship between the levels of development and regional economic structure, and therefore they could identify structural regularities in the economy.

This systematic pattern in the transactions contained in a SAM is obtained through regression analysis, and indicates the characteristics of an economy that will vary with the size. Changes in the size of the economy causes an increase in the values of relationships between its component accounts. Increased complexity is associated with intensification of relations in the secondary and tertiary sector. This performance is revealed inside FES metodology by Jensen et al. (1988).

Four regression models have been performed. The dependent variable is the value of the transaction and the independent variables analyzed like proxies of the size of the ecoomy are: total population, working population, gross regional product, total sectoral output and total value added. All of them are posssible to be considered like proxies of the size of the economy:

Linear-linear model:

$$X_{ij}(r) = \alpha + \beta X(r) + \varepsilon \quad (7)$$

Linear-logarithmic model:

$$X_{ij}(r) = \alpha + \beta \log X(r) + \varepsilon \quad (8)$$

Linear-inverse model:

$$X_{ij}(r) = \alpha + \beta \frac{1}{X(r)} + \varepsilon \quad (9)$$

Linear-logarithimic inverse model:

$$X_{ij}(r) = \alpha + \beta \frac{1}{\log X(r)} + \varepsilon \quad (10)$$

Where $X_{ij}\ (r)$ is the flow economic transaction from sector i to sector j for the period r; α is the constant parameter, β is the regression coefficient and $X(r)$ the value of independent variable for the period r.

The use of a sole regressor avoids multicolineality problems. The model with a best adjust in fucion of standarized β coefficient will be chosen. In an early application of this methodology Jensen et al. (1988) showed that 75% of intermediate transaction cells are predictable at 10% of significance level in a model of 11 samples.

Stability: a second component for the clasification of the economic structure is determined by the stability and is represented by those cells that are consistently present and so, there is absence of changes in technical coefficients over time. This kind of analysis is executed under the assumption of structural stability, to make consistent basis of comparison.

The original root of this concept can be found in the approach of minimun requirements, developed by Ullman and Dacey (1960), designed for the determination of basic employment needed for the sustain of an urban area. Based on this methodology they noticed that the employment can be estimated with de calculation of minimum requirements of employment in non-basic sectors.

In the Input-Output framework the term stability is asoccitated with structural or technical change (Miller & Blair, 2009). In a regional context, stability is related to changes in direct requirements of coefficients.

The unit of measure used for the determination of degree of stability of each cell is the coefficient of variation (CV), using the information contained in SAMs. The calculation is expressed like the standard deviation divided by technical coefficients average:

$$CVa_{ij} = \frac{\sqrt{\left(\left(a_{ij} - \overline{a}_{ij}\right)^2\right)/N}}{\overline{a}_{ij}} \quad (11)$$

Where a_{ij} is the technical coefficient from SAM matrix, $\overline{a}_{ij}$ the average of coefficients of regional SAMs and N is the number of time periods.

Those cells with a value closer to the average show a lower coefficient of variation, are more stables and therefore, fundamental elements and candidate to conform the core of economic activities. The classification of each cell will be done using boolean algebra, categorizing each cell in stable or unstable.

The economic argument is that the most stable cells are transactions that thrives, in a consistent manner, the final demand, and are closely linked to household consumption, which means that if the economy decreases, non-fundamental activities were affected more than the fundamental (esencial elements for the sustain of economic structure). The non-fundamental part of the economy is subject to greater volatility in their fluctuations, and these changes may be due to the economic environment, recessions, inflation processes, tastes, technology, consumer preferences or economic cycle.

West (2001) and Thakur (2008) also determited the existence of stable technical coefficients in secondary-tertiary and tertiary-tertiary relationship. For Indonesia and

India, respectively, Imansyah (2000) and Thakur (2010) noticed stable coefficients in primary activities.

Importance: this analysis is focused in those components of FES that have significative influence in the rest of economic system in terms of global connectivity and it is defined like the degree in what each element of the matrix can be considered connected with the of elements.

Important cells are those that a with a small change in their own dimensión lead to bigger changes for all the system (Jensen, et al., 1987). They are the ones who have the maximun connectivity with the rest of the elements of the economy. An economy with a great number of important cells is an economy with a high level of integration and those type of activities more connected have a multiplier effect in employment, incomes, and output.

Jensen et al. (1979), Jensen and West (1980) and Israilevich (1986), assured than higher coeficients of field of influence exert greater influence in the complete system and therefore must be identified. Based on this idea Sonis and Hewings (1991) propose the use of the approach of "field of influence".

Formally, this methodology generates in one operation a complete Leontienf Inverse asociated to a change in a technical coefficient that let comparisons of complete systems. Hewings et al. (1988), Sonis and Hewings (1989), Sonis et al. (1996) and Okuyama et al. (2002) developed its mathematical formulation and application.

We supose a little change (ε) in the inputs of any technical coefficient, then the corresponding change in the components of the Leontief inverse can be determined by:

$$a_{ij} = a_{ij}(t+1) - a_{ij}(t) \tag{12}$$

a_{ij} is the technical coefficient and its change will come represented by equation (12). Being t and $t+1$ two moments in time, before and after perturbation. The descomposition of the technical coefficient can be expressed as:

$$a_{ij}(\varepsilon) = a_{ij}(t) + \varepsilon a_{ij} \tag{13}$$

Where ε is the transfer parameter whose valor keeps along the range $0 \leq \varepsilon \leq 1$. The asociated matrix $A(\varepsilon) = a_{ij}(\varepsilon)$ and its Leontief's Inverse can be expressed as:

$$C(\varepsilon) = [I - A(\varepsilon)]^{-1} \quad (14)$$

If $\varepsilon = 0$, then:

$$A(0) = a_{ij}(t) \quad (15)$$

The Leontief inverse will be:

$$C(0) = [I - A(t)]^{-1} \quad (16)$$

So, if $\varepsilon = 1$, then:

$$A(t+1) = a_{ij} \quad (17)$$

The asociated Leontief Inverse will be expressed as:

$$C(t+1) = [I - A(t+1)]^{-1} \quad (18)$$

If an input coefficient changes due to a perturbation ε, the field of influence can be measured by the following equation:

$$G(t+1, t) = \frac{C(\varepsilon) - C(0)}{\varepsilon} \quad (19)$$

There is a field of influence associated to each coefficient, so, it is posible to obtain:

$$S_{ij} = \sum_{i=1}^{n} \sum_{j=1}^{n} [g_{ij}\varepsilon] \quad (20)$$

Where g_{ij} represents each element of G matrix.

The unión and intersection of the features can establish different subsets of element that contain those cells with none, one, two or all the features extracted and shape the different levels of core FES and let the establishment of a core classification.

Table 1: Taxonomic features of FES core

Core FES	Set of features
Weak	$(P \cup E \cup I) \backslash [(P \cap E) \cup (P \cap I) \cup (P \cap I)]$

Mature	$[(P \cap E) \cup (P \cap I) \cup (P \cap I)] \setminus (P \cap E \cap I)$
Solid	$(P \cap E \cap I)$
TOTAL	$(P \cup E \cup I)$

Source: Own elaboration

This levels could be classificated in a weak core, shaped for the cells with just one feature (elements in the Surface of FES core and candidates to to leave the core if their relations are not been enhanced), a mature core form by elements that join two features and solid core, integrated for the most representatives elements of the economy. The union of all levels shapes the total core, and, so, the FES of regional economy.

Inside the solid core the more predictable, stable and interconected elements of the economy are represented, they are the more representative elements of the regional economy, but not all of them will have the same streghtening. It is possible to order them internally based in the values of their features by means of an indicator:

$$CNP_{ij} = \frac{p_{ij}}{Max(p_{ij})} \; x \; \frac{\overline{CV} - CV_{ij}}{\overline{CV}} \; x \; \frac{S_{ij}}{Max(S_{ij})} \qquad (21)$$

Where CNP_{ij} is the cell normalized powerful of component ij in the matrix. p_{ij} is the confidence level from the predictibility analysis and $Max(p_{ij})$ is the maximun value of confidence in the elements of solid core. CV_{ij} is the coeficient of variation of stability analysis for the component ij and $\overline{CV}$ the average stability coefficient, and S_{ij} the value asociated to the field of influence of cell ij, and $Max(S_{ij})$ the maximun value.

Every coefficient is normalized. CNP_{ij} indicator will raise 1 at maximun if the value is the first top in all the features, in any other case, the value will be lower than 1 and greater than zero. The highest indicators values are associated with the most representative and identfying components ot the economic structure, more stable and with greater connectivity with the rest of the economy. Items that would be considered at the regional level in a special way for the design of economic policies.

4. Database

The principal advantage in the use of a Social Accounting Matrix versus an Input-Output table is that is posible to close and capture de circular flow of income and so, a more complete vision of the structure of the economy.

Table 2 – Final structure of SAMs for FES analysis

1	Agriculture	18	Transportation equipment
2	Livestock and Forestry	19	Other industries
3	Fishery	20	Construction
4	Extractives	21	Retail sales
5	Refined	22	Transport and comunication
6	Electricity	23	Other services
7	Gas	24	Sales services
8	Water	25	Non sales services
9	Food Industry	26	Labour
10	Textile and leather	27	Capital
11	Wood industry	28	Consumption
12	Chemical	29	Gross capital formation
13	Mining and Steel	30	Direct taxes
14	Elaborated metal products	31	Indirect taxes
15	Machinery	32	Public sector
16	Vehicles	33	Foreign sector
17	Construction materials		

Source: Own elaboration

For the identification of regional FES in andalusian economy temporal SAMs will be used. These SAMs has been elaborated in differents papers, for 1990 in Cardenete (1998), for 1995 in Cardenete and Moniche (2001). For year 2000 the one proposed by Cardenete et al. (2010), for 2005 the one presented by Cardenete et al. (2010) and for 2010 in the work of Cardenete (2012). There have been a homogeneization process of all of them and finally the structure clusters 25 productive activities and 8 endegenous accounts (table 5).

5. Results

Under the feature of predictability the values are shown in table 3. The results are presented over the 25 productive sectors in a 25x25 matrix. From these, 29 cells will not be evaluated for not containing interactions (zero value) with another productive sectors, so the applied analysis will be done for 596 cells on each period (2980 total components).

Table 3: Significance of estimations by regression model and independent variable.

		Total population		Working population		Regional GDP		Sectoral Output		Value added	
Signific.	Model	Signif. cells	%	Signif. cells	%	Signif. cells	%	Signif. cells	%	Signif. cells	%
1%	Lineal-Lineal	1	0%	52	9%	256	43%	265	44%	222	37%
	Lineal-logarithmic	1	0%	94	16%	379	64%	381	64%	372	62%
	Lineal-Inverse	1	0%	132	22%	210	35%	231	39%	193	32%
	Lineal-log. Inverse	1	0%	97	16%	378	63%	375	63%	375	63%
5%	Lineal-Lineal	93	16%	268	45%	442	74%	443	74%	424	71%
	Lineal-logarithmic	103	17%	320	54%	445	75%	445	75%	444	74%
	Lineal-Inverse	108	18%	375	63%	434	73%	434	73%	431	72%
	Lineal-log. Inverse	103	17%	329	55%	444	74%	445	75%	444	74%
10%	Lineal-Lineal	261	44%	412	69%	467	78%	467	78%	465	78%
	Lineal-logarithmic	274	46%	438	73%	462	78%	462	78%	464	78%
	Lineal-Inverse	284	48%	464	78%	452	76%	451	76%	452	76%
	Lineal-log. Inverse	278	47%	441	74%	460	77%	460	77%	460	77%
	Total estimated cells	**596**		**596**		**596**		**596**		**596**	

Source: Own elaboration.

Three levels of significance has been taken: 1%, 5% and 10% respectively. At 1% level of significance the best percentages are offered by the linear-logarithmic model using as independent variable sectoral output or regional domestic product, in both cases, a 64 % of values are statistically predictable, 381 values of cells predictable for the sectoral output and 379 for the regional domestic product. At 5% of significance level the linear-logarithmic model with the former independent variables appears with the greater percentage susceptible of estimation (75% in this case), join as inverse linear-logarithmic model with the sectoral output as regressor. Finally, at 10% of significance level the linear and linear-logarithmic model present 78% of precitable cells. The same result of applied the inverse model using the occupied population as regressor.

There is a high similarity in the values of lineal-lineal and lineal-logarithmic taking 5% and 10% of significance. However, at 1% of significance there are sensitive differences between the results of both models. The lineal-lineal model is more sensitive at the level of significance and, so, less stable in the results than the lineal-logarithmic one.

Taking in account all the levels of significance (10%, 5% and 1%), the lineal-logarithmic estimation performs a better adjust of the values of transactions in the SAM. The choice of a level of significance involves a trade-off between the number of predictable cells and the confidence level. The higher the level of confidence, the lower the number of predictable cells and the lower the level of confidence. There is a jump among 1% and 5% so, this lack of stability in this intervale suggests to choose 1% as appropriate level.

There are two independent variables that provide similar number of predictable cells (Regional Domestic Product and Sectoral Output). Average R^2 adjusted will be computed for all the regressions (table 8) of both models for the determination of the regressor chosen. The results yield a slight higher average value for Regional Domestic Product, so, it will be chosen like proxy independent variable of size of the economy.

Table 4: R^2 adjusted for the lineal-logarithmic model at different levels of significance.

Signif. Level	Regional GDP	Sectoral Output
1%	0,956	0,955
5%	0,940	0,939
10%	0,927	0,926

Source: Own elaboration.

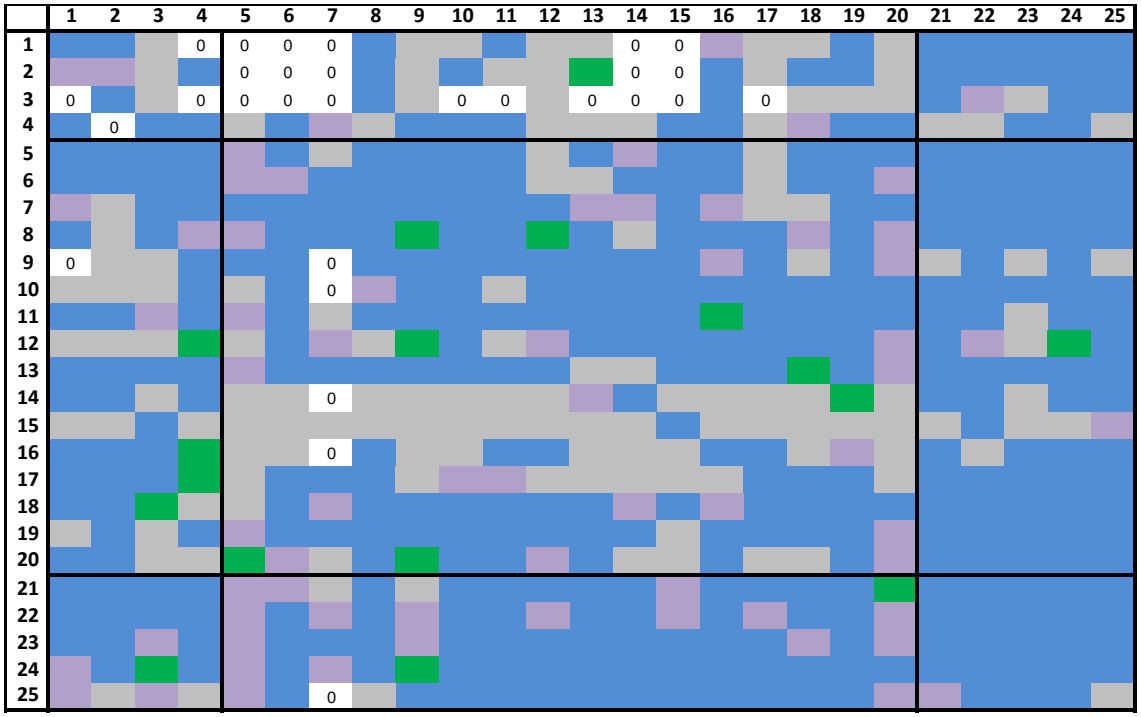
The most of predictable values are located in tertiary-tertiary, secondary-tertiary and primary-tertiary partitions (table 6). In these partitions, more than 75% of cells are predictable. A lower percentage of predictable cells are located in primary-secondary, primary-primary, secondary-secondary and secondary-primary partitions.

In comparison with previous works, there is a higher presence of tertiary sector activities than in Indonesian (Imansyah, 2000) or Indian economy (Thakur, 2008). These are economies with an early stage of development with great presence of primary activities in predictable cells. Nevertheless, conclusions for australian economy in West (2001), pointed out economic activities biased towards primary and tertiaty sector based in people-oriented more than urban-oriented[3] activities. This is a feature of economies with a high degree of complexity[4] (Jensen, et al., 1987).

Figure 2: Significative cells for the lineal-logatithmic model

[3] People-oriented activities are those that are located in economies that has overcomed the industrialization stage and are focused towards activities like education or healthy, in front of urban-oriented activities that try to exploit competitive advantage of location and are located, principally, in primary sector.

[4] See figure 1.



Source: Own elaboration.

In tertiary sector, activities with higher number of predictable cells are found in Commercial Services (24), Retail sales (24), Transport and Communications (21), Other Services (23). In the secondary sector highlight Other industries (19). Principally, it is posible to observe a higher presence of predictable cells in the tertiary sector.

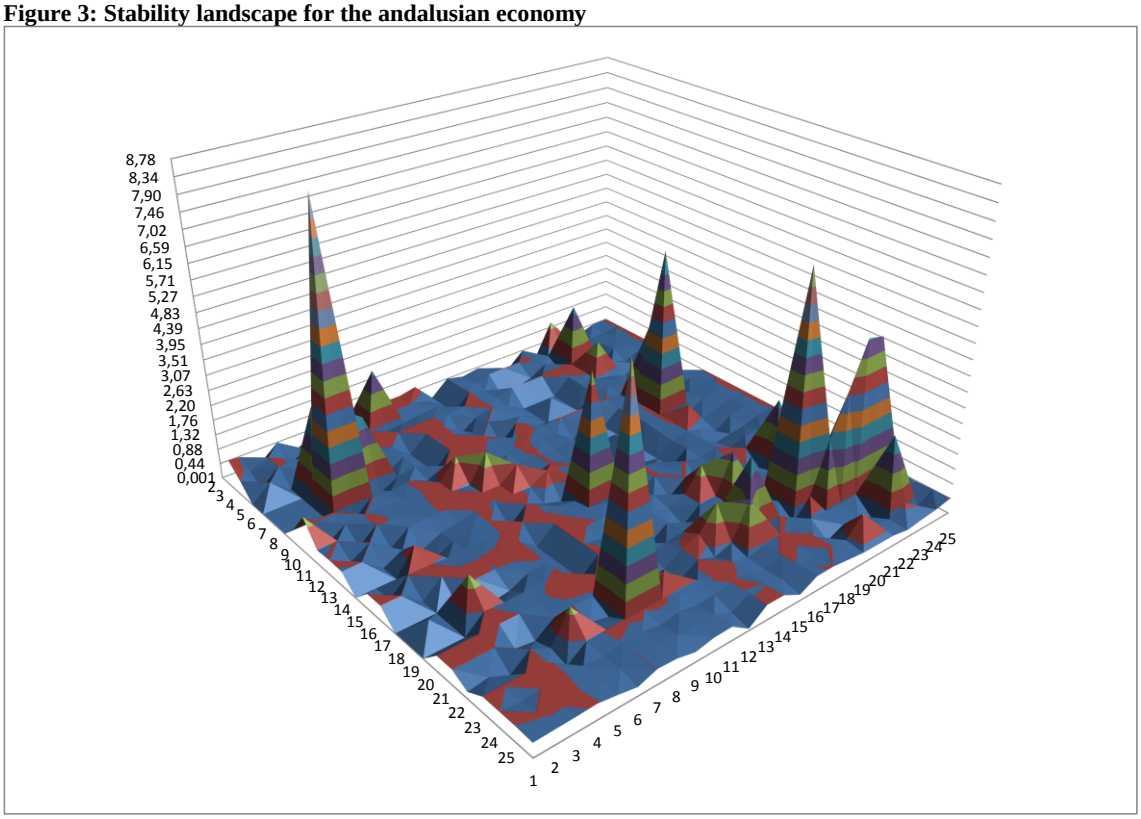
Table 5: Distribution of predictable cells in partitions of the economy

	Primary		Secondary		Tertiary	
Primary	7	(44%)	18	(28%)	15	(75%)
Secondary	37	(58%)	143	(56%)	67	(84%)
Tertiary	13	(65%)	56	(70%)	23	(92%)

Source: Own elaboration.

In terms of stability, the average coefficient of variation corresponding with the stability calculation is 0,439. The total number of cells above that measure is 226 (36,16%), they are unstable components of the economy (variability greater tan average), and 326 components (52,16%) show high levels of stability (value of the coefficient of variation lesser tan average and higher than zero).

Figure 3: Stability landscape for the andalusian economy



Source: Own elaboration

A stable structure of the economy is shown, in comparison with former studies in temporal frame, Thakur (2008) just identifies a 25,4% of stable cells for a regional analysis of the indian economy, and is similar to the analysis of West (2001) for the australian economy that shows 53,17% of stable components for the australian economy.

In landscape (figure 5) it could be seen the stability patterns, a higher surface is linked to a lesser component stability. Those lesser stable cells are determined by economic activities that change with fashion, tastes, environment or general progress in the economy. Cells with lower variability will be part of the core of FES .and this feature explains no relevant changes in size of them with economic changes.

Table 6: Ten top components with lower coefficient of variation

Cell			CV
Transport and comunications	-	Mining and steel	0,004
Mining and steel	-	Transportation equipment	0,004
Refining	-	Agriculture	0,007
Refining	-	Chemical	0,012
Chemical	-	Refining	0,014
Refining	-	Construction	0,015
Refining	-	Fishery	0,017
Transport and comunications	-	Other services	0,020
Other industries	-	Retail sales	0,023
Electricity	-	Gas	0,025

Source: Own elaboration

There is a concentration of stable cells in tertiary-secondary, tertiary-primary, secondary-tertiary and tertiary-tertiary partitions. Inside tertiary sector activites with higer stability are Commercial Services (24), Other services (23) and Transport and Communications (22). It is interesting to notice high levels of stability in industial cells like Electric energy (6), Other industries (19), Chemical (12) and Machinery (15). This type of interactions between secondary and tertiary sectors, and absence of primary activities, is corresponding with economies that has got over the first stages of development (Kuznets, 1966).

Activities like refinning (5) or Mining and Steel (13) are stable components for what it is posible to considered basic activities for the sustain of economic structure and with a lower dependancy of the economic cycle in relative terms. The lack of primary sector in stable components for the andalusian economy it is not alike Thakur and Alvayvay (2012) or West (2001) analysis. They noticed stable elements for the primary sector in chilean or austrialian economy, respectively.

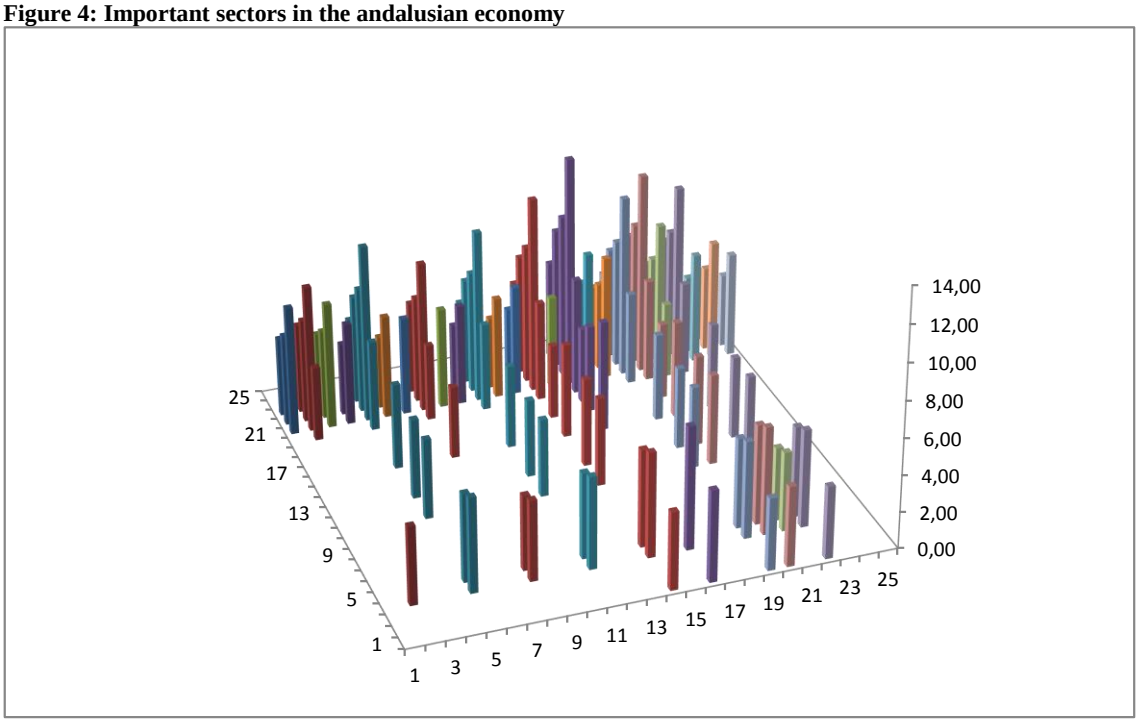
The results of importance are applied over the table of average references and taken in account 20% of cells with the highest field value associated influence (125 interactions), which are the cells with higher connectivity in the system, and therefore, more important to the regional economy will be selected[5].

[5] It is habitual to take 25% of values with higher connectivity. The reason to choice a different treshold is because just 50% of cells affects to multipliers meaningfully (Jensen & West, 1980) and 50% of cells in former anlyasis are non zero cells like the study of development countries like Indonesia (Imansyah, 2000). So, it implies that 25% of cells cover 50% of non zero cells. In our case 20% will be taken as treshold for important analysis becuase of, first, a lesser presence of zeros in the matrix, corresponding

Those sectors that group cells with higher level of connectivity in the regional economy (figure 4) are Retail sales (21), Transport and Communications (22) and in a lesser extent Other Services (23). The principal interactions are located y tertiary-tertiary, secondary-tertiary and primary-tertiary partitions. There are also important cells in the secondary sector, specially Construction (20), Vehicles (16) Refining (5) and Wood manufactures (11), in their interactions with tertiary and secondary sector, specially.

It is relevant to point out the connectivity of Retail sales (21) with all the productive sectors in the economy and Transport and Communications (23) that is a sector that physically connect transaction flows between goods, people and markets (Rietveld, 1989).

Figure 4: Important sectors in the andalusian economy



Source: Own elaboration

The behavioural pattern of FES for the andalusian economy are far from observed in former analysis of indonesian economy (Imansyah, 2000), that are focused in primary-primary, primary-tertiary and secondary-secondary. However, critical cells observed are quite similar that in studies for Australia (West, 2001) and South Africa (Van Der Westhuizen, 1992), with a greater relevance of tertiary sector in the economy.

Table 7: Greater 20 interactions measure in function on its field of influence

---

with an economy with a higher degree of complexity and, second, for constitute a relevant magnitude y paretian sense.

Cell	Field of influence	Cell	Field of influence
Retail sales - Vehicles	12,593	Transport and comunications - Elaborated metal products	7,586
Retail sales - Construction	10,992	Retail sales - Construction materials	7,136
Retail sales - Elaborated metal products	10,724	Retail sales - Agriculture	7,061
Retail sales - Transport and comunications	9,972	Transport and comunications - Transport and comunications	7,054
Retail sales - Other industries	9,922	Transport and comunications - Other industries	7,018
Retail sales - Refining	9,701	Retail sales - Fishery	6,886
Retail sales - Wood Industry	9,435	Transport and comunications - Refining	6,862
Transport and comunications - Vehicles	8,908	Retail sales - Transportation equipment	6,744
Retail sales - Water	8,228	Extractives - Vehicles	6,726
Retail sales - Retail sales	8,055	Other services - Construction	6,699
Retail sales - Livestock and Forestry	8,009	Transport and comunications - Wood Industry	6,674
Transport and comunications - Construction	7,775	Retail sales - Sales services	6,539
Other services - Vehicles	7,674		

Fuente: Own elaboration

The value of field of influence (table 8) for the 25 largest values swing from 12,593 in interaction Retail sales-Vehicles to 6,539 in interaction flow Retail sales-Commercial Services. It is highlighted the spread respect to the average (2,752) and the median (2,527) values. So, it is conclusive that there are broad differences in terms of connectivity between sectors with greater and lesser field of influence in the andalusian economy.

A suitable combination of former features will lead to the classification of the components of the FES, which may distinguish between core components of the basic economic structure classified as weak, mature or consolited components. The elements belonging to the superficial part (weak core) only have some of the characteristics, predictability (P), stability (E) or importance (I), the mature core contain two of them, and the solid core contain the three characteristics simultaneously.

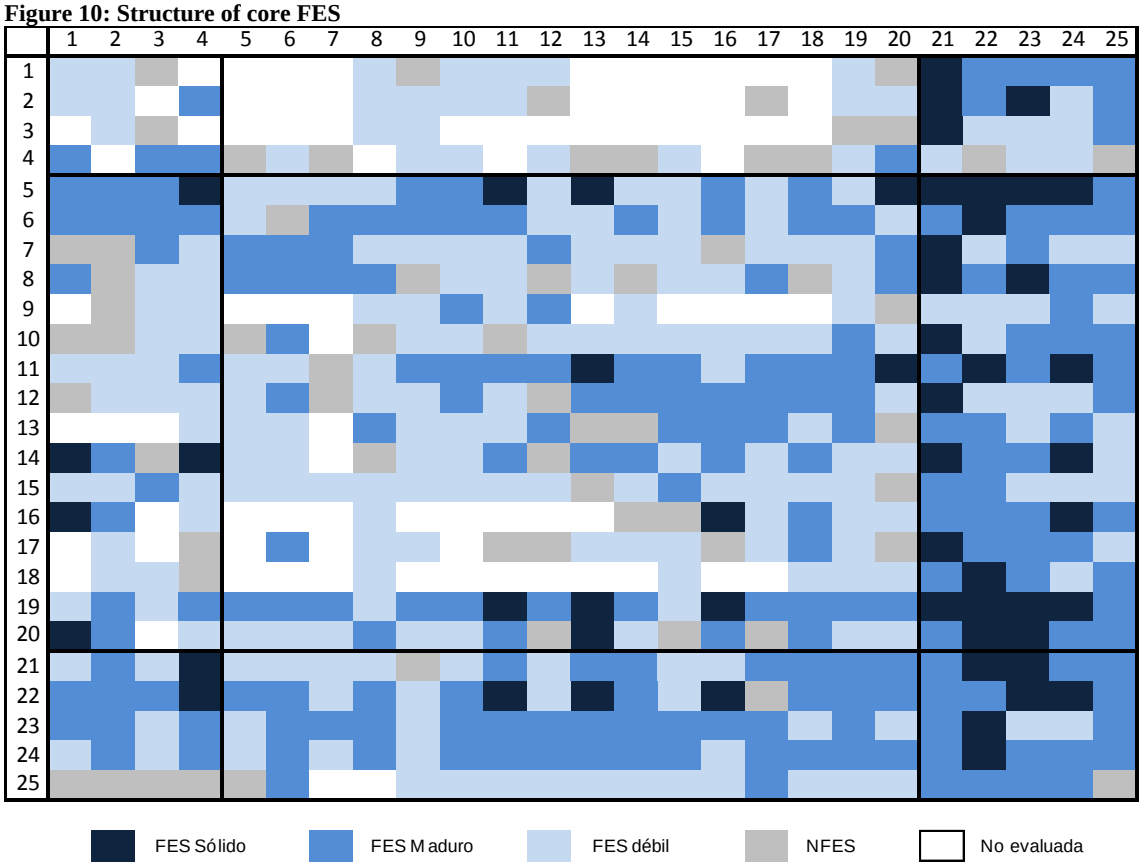
Table 8: Feature scheme of andalusian FES

	Features	Weak core		Mature core		Solid core		core FES	
Weak core	P	108	19,85%	190	34,93%	53	9,74%	351	64,52%
	E	94	17,28%	178	32,72%	53	9,74%	325	59,74%
	I	18	3,31%	48	8,82%	53	9,74%	119	21,88%
	(P∪E∪I)\[(P∩E)∪(P∩I)∪(P∩I)]	220	40,44%						
Mature core	P∩E			160	29,41%				
	P∩I			30	5,51%				
	E∩I			18	3,31%				
	[(P∩E)∪(P∩I)∪(P∩I)] \(P∩E∩I)			208	38,24%				
Solid core	P∩E∩I					53	9,74%		
core FES	P∪E∪I							481	88,42%

Source: Own elaboration

There are 80 zero cells are eliminated for not distorting the analysis. Therefore we will work on 87% of the total cells in the productive sectors. The 88.42% of the cells belong to the core of the FES, 53 components (9.74%) to its inner core, 208 (38.24%) to the intermediate core and 220 (40.44%) to the more superficial side of the core. Of these, 351 cells are considered predictable, 325 stable and 119 important.

Figure 10: Structure of core FES



Source: Own elaboration

Table 9: Value of CNP of solid core

Order	Cell		CNP	Order	Cell		CNP
1	Other industries	- Retail sales	0,747	28	Sales services	- Transport and comunications	0,128
2	Fishery	- Retail sales	0,510	29	Refining	- Extractives	0,096
3	Refining	- Transport and comunications	0,499	30	Other industries	- Mining and Steel	0,085
4	Refining	- Retail sales	0,466	31	Retail sales	- Transport and comunications	0,074
5	Transport and comunications	- Other services	0,461	32	Livestock and Forestry	- Other services	0,055
6	Other industries	- Other services	0,423	33	Construction	- Transport and comunications	0,053
7	Vechicles	- Vechicles	0,418	34	Other industries	- Sales services	0,041
8	Water	- Retail sales	0,392	35	Refining	- Sales services	0,040
9	Refining	- Construction	0,376	36	Vechicles	- Agriculture	0,037
10	Elaborated metal products	- Retail sales	0,360	37	Refining	- Other services	0,036
11	Transport and comunications	- Mining and Steel	0,352	38	Transport and comunications	- Vechicles	0,035
12	Wood industries	- Construction	0,339	39	Refining	- Wood industries	0,029
13	Transport and comunications	- Extractives	0,312	40	Wood industries	- Sales services	0,026
14	Agriculture	- Retail sales	0,306	41	Other industries	- Transport and comunications	0,022
15	Chemical	- Retail sales	0,305	42	Other industries	- Vechicles	0,020
16	Refining	- Mining and Steel	0,264	43	Other industries	- Wood industries	0,016
17	Transport and comunications	- Wood industries	0,255	44	Wood industries	- Transport and comunications	0,014
18	Construction	- Agriculture	0,238	45	Electricidad	- Transport and comunications	0,012
19	Livestock and Forestry	- Retail sales	0,224	46	Otro material de transporte	- Transport and comunications	0,010
20	Other services	- Transport and comunications	0,193	47	Water	- Other services	0,006
21	Construction	- Other services	0,175	48	Elaborated metal products	- Agriculture	0,005
22	Wood industries	- Mining and Steel	0,175	49	Construction	- Mining and Steel	0,004
23	Textile and leather	- Retail sales	0,161	50	Vechicles	- Sales services	0,001
24	Gas	- Retail sales	0,145	51	Retail sales	- Extractives	0,001
25	Transport and comunications	- Sales services	0,141	52	Elaborated metal products	- Sales services	0,000
26	Retail sales	- Other services	0,136	53	Elaborated metal products	- Extractives	0,000
27	Construction materials	- Retail sales	0,135				

Source: Own elaboration

The cells located in solid core are composed of those components with greater corresponding with the size of the economy, less dependent on the economic cycle and with higher level of connectivity with other sectors. So, regional governments should direct their investments towards activities and businesses located in solid core because they could generate major impacts on regional economic system.

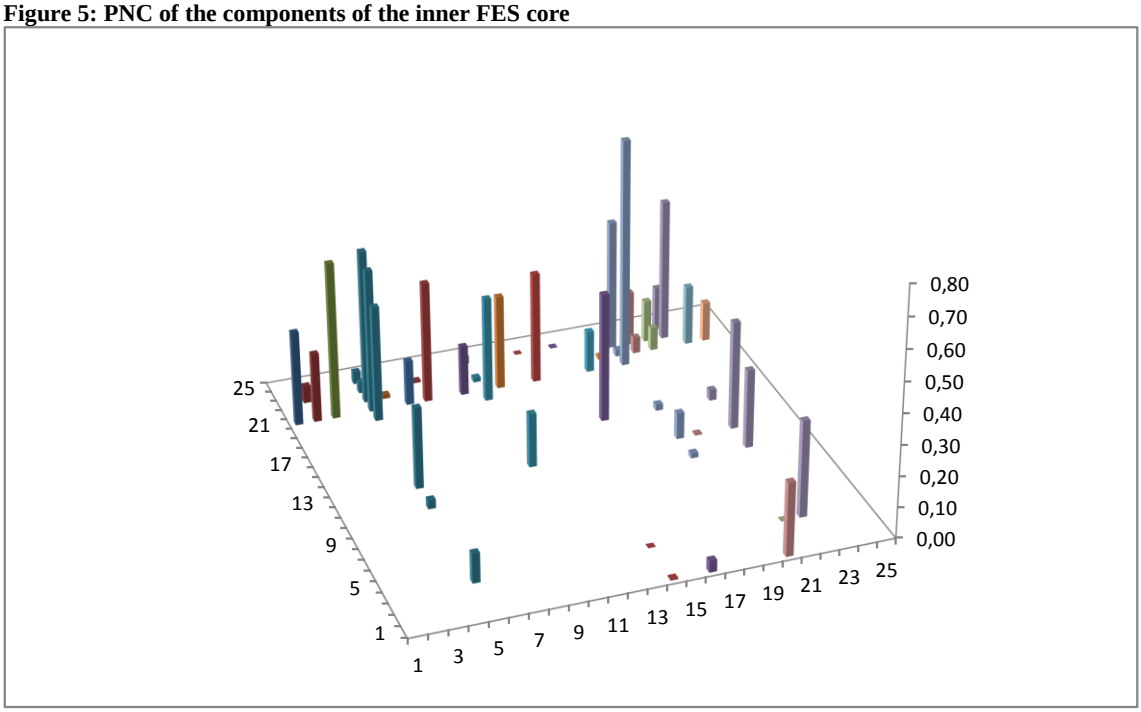
The secondary-tertiary, tertiary-tertiary and primary-tertiary partitions agglutinate most fundamental cells of the solid core. There is evidence of absence of fundamental cells in primary-primary and primary-secondary partitions. Being its presence sporadic in the secondary-secondary, secondary-tertiary, tertiary-primary and tertiary-secondary partitions.

For evaluating each component of this part of the core of the FES the core normalized power indicator (CNP) is calculated for the components of the solid core. This indicator let a hierarchy of cells inside the core indicating its relative power versus another cells.

In three-dimensional graph in Figure 11, is constructed from the values of CNP indicator of Table 11 by sector shows that the activities of Retail sales (21) Transport and Communications (22) Other Services (23) Other industries (19) and refiners (5) are those that bring together the largest number of components of the inner core and

therefore must be taken into consideration especially with respect to the economic decision-making in Andalusia.

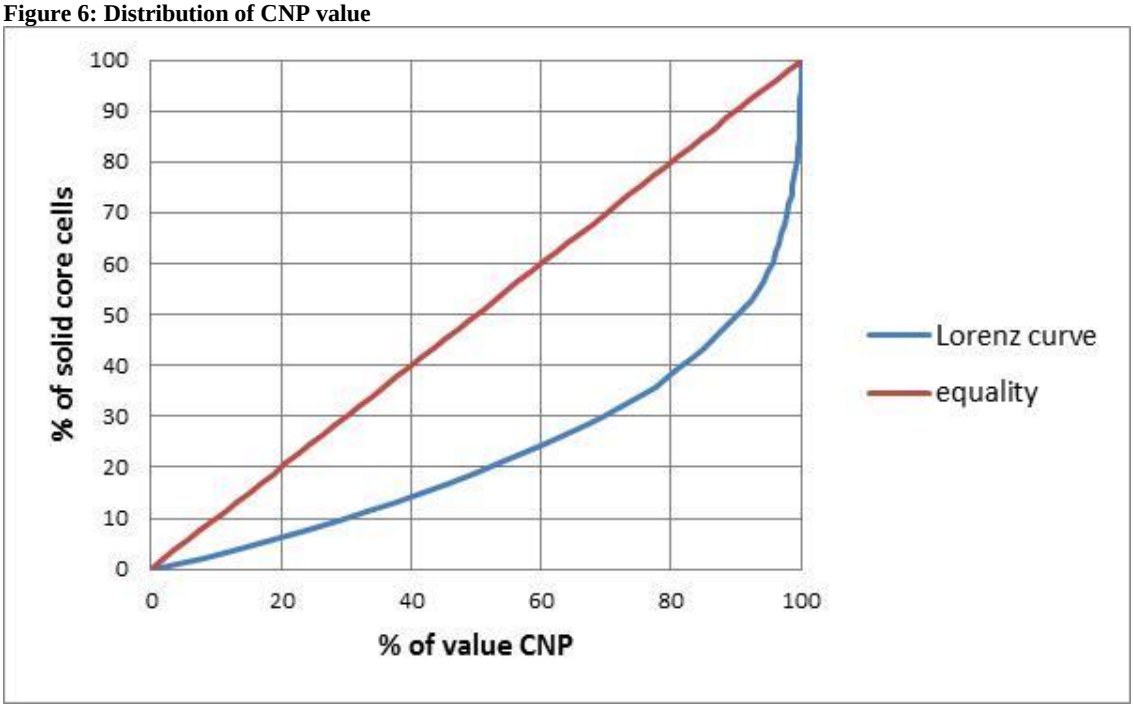
Figure 5: PNC of the components of the inner FES core



Source: Own elaboration

Finally, in the cumulative value of CNP measurement is observed in the lorez curve a high concentration a high concentration in a few cells. 50% of solid core cells accumulate 90% of CNP value. These are the ten top interactions in table 11

Figure 6: Distribution of CNP value



Source: Own elaboration

6. Conclusions

We can define a temporal FES as the interrelations in an economy that give shape to the regional economic system over time. These components are consistently present and statistically predictable at specified levels of significance. The FES methodology overcomes limitations of individual ratios that tried to capture all the information about structural change in a single value and also need pairs of data for calculation.

There is a temporal FES for the regional economy in Andalusia and has been determined using the SAM quinquennial period between 1990 and 2010. In this process we have analyzed the three features of this type of structural analysis approach: predictability, stability and importance obtaining different levels of core economic structure. Five independent variables related to the size of the economy has been tested: total population, working population, gross regional product, sectoral output and value added. The linear-logarithmic model performs a better adjust over the variable gross regional product at all levels of significance analyzed, 1%, 5% and 10%. The results show us 372 matrix components as significant at 1%, representing 64% of productive cells. The stability analysis reveals 52% of stable components (below the average coefficient of variation) and top 20% matrix components ina importance analysis were taken.

In the analysis of the economic sectors most significant values for each criteria are located in the tertiary-primary and tertiary-tertiary partitions of the economy. Being sector Retail sales (21) and Transport and Communications (22) the drivers of the fundamentals of the andalusian economic structure characterized by a high tertiary sectors presence. More stable cells are located in the secondary-secondary partition in Production and Distribution of Electricity (6) Other manufacturing (19) and Chemical (12). Among the more stable cells interactions in the secondary sector were highlighted in which the processes of production or distribution or treatment of energy products as Refiners (5), or Mining and steel (13) and stresses involved in the tertiary sector. That is a strong persistence of that kind of industrial performance for these sectors that are unavoidably necesary for the running of the economy, specially in their interaction with Transport and Comunications (22) sector. The results from analysis of significance, confirming the strength level of tertiaritation of the regional economy.

To obtain a more comprehensive and detailed picture of the economic situation a classification of cells based in the union and intersection of the characteristics has been made. According to meet one of the criteria, two, or all three simultaneously, this leads to different classifications of the core: weak, mature and solid respectively. The greater strength of the cell, the more likelihood of being predictable, stable and important inside the system. The fact is that 9.74% belongs to the solid core, 38.24% to the mature core and 40.44% to the weak core. In the periphery of the cells core all non-fundamental (NFES) will be placed.

Sorting the solid core components by an indicator of the stregth of the cell offers that the interactions in Retail sales (21), Transports and Communications (22) and Other services (23) Vehicles (16) are the more developed and more intrinsically linked to the regional economy. At level of cell, there is a high concentration of power of elements in solid core in just ten cells. These must be carefully considered for policy makers to design economic policies.

The research on FES is a fairly open field with an interesting way to go, and researchs in this area promise to be even more useful in the future, since it can be used to determine the growth and future development of economies (Hewings & Jensen, 1988).

Finally, as suggested by Thakur (2008) and West (2001), if the fundamental economic structure is identified for an economy, then economic structure is susceptible to prediction.

7. References

Agustinovics, M., 1970. Methods of international and intertemporal comparison of structure. En: A. P. Carter & A. Bródy, edits. Applications of input-output analysis. Amsterdam: North Holland publishing company.

Antille, G., Fontela, E. & Guillet, S., 2000. *Changes in technical coefficients: The experience with Swiss I/O Tables.* Macerata, Italia, 13th International Conference on Input-Ouput Techniques.

Cardenete, M. A., 1998. Una Matriz de Contabilidad Social para la economía andaluza: 1990. *Revista de Estudios Regionales*, III(52), pp. 137-155.

Cardenete, M. A., 2012. Una estimacion de la SAM de Andalucia para 2010 a traves de CEM. *mimeo.*

Cardenete, M. A., Fuentes, P. & Ordoñez, M., 2010. Una estimación de la matriz de contabilidad social de Andalucía de 2005 a precios de adquisición. *CLM Economía,* 15, pp. 121-151.

Cardenete, M. A., Fuentes, P. & Polo, C., 2010. Sectores clave de la economía andaluza a partir de la matriz de contabilidad social regional para el año 2000. *Revista de Estudios Regionales,* 88, pp. 15-44.

Cardenete, M. A. & Moniche, L., 2001. El nuevo marco input-output y la SAM de Andalucía para 1995. *Cuadernos de Ciencias Económicas y Empresariales,* 41(2), pp. 13-31.

Carter, A. P., 1970. A linnear programming system analysing embodied technological change. En: A. P. Carter & A. Bródy, edits. *Applications of input-output analysis.* Amsterdam: North Holland publishing company.

Cassetti, M., 1995. A New Method for the Identification Patterns in Input-Output Matrices. *Economic Systems Research,* 8(3), pp. 363-381.

Chenery, H. B. & Watanabe, T., 1958. An International Comparison of the Structure of Production. *Econometrica,* 26(4), pp. 487-521.

De Mesnard, L., 1990. Biproportional Method for Analysing Interindustry Dynamics: the Case of France. *Economic Systems Research,* 2(3), pp. 271-293.

Dewhurst, J. H. L., 1993. Descomposition of Changes in Input-Output Tables. *Economic Systems Research,* 5(1), pp. 41-53.

Dietzembacher, E., 1992. The Measurement of Interindustry Linkages. Key Sectors in Netherlands. *Economic Modelling,* Volumen 9, pp. 419-437.

Evans, W. D., 1954. The effecto os structural matrix errors on interindustry relation estimates. *Econometrica,* Volumen 22, pp. 461-480.

Grötschel, M., Jünger, M. & Reinelt, G., 1984. Optimal Triangulation of Large Real Wrold Input-Output Matrices. *Statistische Hefte,* 25, pp. 261-295.

Haltia, O., 1992. A Triangularization Algorithm without Ringshift Permutation. *Economic Systems Research,* 3(3).

Hewings, G. J. D., Sonis, M. & Jensen, R. C., 1988. Fields of influence of technological change in input-output models. *Papers of Regional Science Association,* 64(1), pp. 25-36.

Hewings, G. J. D., Sonis, M. & Jensen, R. C., 1988. Technical Innovation and Input-Output Analysis. En: P. Nijkamp, I. Orishimo & G. J. D. Hewings, edits. *Information Technology: Social and Spatial Perspective.* Berling: Springler-Verlag, pp. 161-193.

Imansyah, M. H., 2000. *An Efficient Method for Constructing Regional Input-Output table: A Horizontal Approach in Indonesia.* Macerata, Italia, 13th International Conference on Input-Ouput Techniques.

Israilevich, P. R., 1986. *Biproportional Forecasting of Input-Output Tables.* University of Pennsylvania, Ph. dissertation.

Jackson, R. W., Hewings, G. J. D. & Sonis, M., 1989. Decomposition approaches to the identification of change in regional economies.. *Economic Geography,* 65, pp. 217-231.

Jensen, R. C., 1981. A Model of Regional Economic Growth and Decline in Agricultural Regions. En: W. C. Buhr & P. Friedrich, edits. *Regional Development under Stagnation.* Baden Baden: Nomos-Verlagsgesellschaft, pp. 109-123.

Jensen, R. C., 1990. Construction and use of regional input-output models:progress and prospects. *International Regional Science Review,* 13(1-2), pp. 9-25.

Jensen, R. C., Dewhurst, J. H., West, G. R. & Hewings, G. J. D., 1991. On the Concept of Fundamental Economic Structure. En: J. H. Dewhurst, R. C. Jensen & G. J. D. Hewings, edits. *Regional Input-Output Modeling: New Development and Interpretations.* Sydney: Avebury, pp. 228-249.

Jensen, R. C., Hewings, G. J. D. & West, G. R., 1987. On a Taxonomy of Economies. *Australian Journal of Regional Studies,* 2, pp. 3-24.

Jensen, R. C., Mandeville, T. & Karunaratne, N. D., 1979. *Regional Economic Development: Generation of Regional Input-Output Analysis.* London: Croom, Helm.

Jensen, R. C. & West, G. R., 1980. The Effect of Relative Coefficient Size on Input-output multipliers. *Environment and Planning A,* 12, pp. 659-670.

Jensen, R. C., West, G. R. & Hewings, G. J. D., 1988. The study of regional economic structure using input-output tables. *Regional Studies,* 22(3), pp. 209-220.

Kuznets, S., 1966. *Modern Economic Growth.* New Haven: Yale University Press.

Le Masne, P., 1988. *Le système productif français face a ses voisins européens.* París, Troisième Colloque de Comptabilité Nacionale.

Miller, R. E. & Blair, P. D., 2009. *Input-Output Analysis: Foundations and Extensions.* 2 ed. New York: Cambridge University Press.

Okuyama, Y., Hewings, G. J. D., Sonis, M. & Israilevich, P., 2002. Structural change in the Chicago economy: a field of influence analysis. En: G. J. D. Hewings, M. Sonis & D. Boyce, edits. *Trade, Networks and Hierarchies: Modeling Regional and Interregional Economies.* Berlin: Springer, pp. 201-224.

Östblom, G., 1992. Technological Change, Projection of the Technology Matrix and the Hipotesis of Negative Coefficient Changes: Parametric and Non-parametric Test with Swedish Input-Output Data. *Economic Systems Research,* 4(3), pp. 235-243.

Rasmussen, P., 1956. *Studies in Intersectoral Relations.* Amsterdam: North Holland.

Rietveld, P., 1989. Infraestructure and Regional Development: A Survey of Multiregional Economic Models. *Annals of Regional Science,* Volumen 23, pp. 255-274.

Sevaldson, P., 1970. The Stability of Input-Output Coefficients. En: C. y. Brody, ed. *Applications of Input-Output Analysis.* s.l.:North Holland, pp. 207-237.

Simpson, D. & Tsukui, J., 1965. The fundamental structure of input-output tables, an international comparison. *The Review of Economics and Statistics*, 47(4), pp. 434-446.

Sonis, M. & Hewings, G. J. D., 1989. Error and sensitivity input-output analysis: a new approach. En: R. E. Miller, K. R. Polenske & A. Z. Rose, edits. *Frontiers in Input-Output Analysis.* Oxford: Oxford University Press, pp. 232-244.

Sonis, M. & Hewings, G. J. D., 1991. Fields of Influence and Extended Input-Ouput Analysis: a Theoretical Account. En: J. H. L. Dewhurst, G. J. D. Hewings & R. C. Jensen, edits. *Regioanl Economic MOdeling: New Developments and Interpretations.* Sydney: Avebury, pp. 141-158.

Sonis, M., Hewings, G. J. D. & Guo, J., 1996. Sources of structural change in input-output systems: a field of influece approach. *Economic Systems Research*, 1(8), pp. 15-32.

Syrquin, M. & Chenery, H. B., 1989. *Patterns of Development:1950 to 1983.* Discussion papers. Nº 41 ed. Wahington DC: World Bank.

Szyrmer, J. M., 1986. Measuring connectedness of input-output models: 2. Total flow concept. *Environmental and Planning A*, Volumen 18, pp. 107-121.

Thakur, S. & Alvayvay, J. R., 2012. Identification of regional fundamental economic structure (FES) of Chilean economy: A field of influence approach. *Structural Change and Economic Dynamics*, Volumen 23, pp. 92-107.

Thakur, S. K., 2008. Identificacion of Temporal Fundamental Economic Structure (FES) of India: An Iput-Output and Cross-Entropy Analysis. *Structural Change and Economic Dynamics*, 19(2), pp. 132-151.

Thakur, S. K., 2010. Identification of Regional Fundamental Economic Structure (FES): An Input-Output and Field of Influence Approach. En: A. U. Santos-Paulino & G. Guanghua Wan, edits. *The Rise of China and India: Impacts, Prospects and Implications.* forthcoming: Palgrave-Macmillan.

Ullman, E. L. & Dacey, M. F., 1960. The Minimum Requirement Approach to Urban Economic Base. *Papers and Proceedings of the Regional Science Association*, 6, pp. 175-194.

Van Der Westhuizen, J. M., 1992. *Towards Developing a Hybrid Method for Input-Output Table Compilation and Identifying a Fundamental Economic Structure*, Philadelphia: Ph. D. Dissertation. University of Pennsylvania.

Watanabe, T., 1961. A Test of the constancy of input-output coefficientes among countries. *International Economic Review*, 2(3), pp. 340-350.

West, G. R., 2000. Updating Input-Output Tables with the Help of a Temporal Fundamental Economic Structure. *Australina Journal of Rregional Studies*, 6(3), pp. 429-449.

West, G. R., 2001. Structural change and fundamental economic structure: the case of Australia. En: M. L. Lahr & E. Dietzenbacher, edits. *Input-Output Analysis: Frontiers and Extensions.* London: Palgrave, pp. 318-337.