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Structural Path Analysis: Applications to structural changes in the Andalusian economy: 1990-1999*

M. Carmen Lima
University Pablo de Olavide at Seville

M. Alejandro Cardenete
University Pablo de Olavide at Seville & centrA

José Vallés Ferrer
University of Seville

ABSTRACT

Social accounting matrices (SAM) are an instrument that enlarges information provided by the input-output analysis. These matrices study the intersectorial relationships of an economy, the behaviour of consumers, the public sector or the foreign sector, while being able to complete the income flow of rent. In this work, we use the SAM for Andalusia corresponding to the years 1990, 1995 and 1999, elaborated in previous works. With this information we carry out a structural analysis of the Andalusian economy by means of the "path analysis" methodology. With this technique, we will obtain the changes experienced in productive structure and demand of this region in the last decade. We will also ponder what sectors have most strongly contributed to regional economic activity. Finally we will quantify the influence of sectorial shocks on they themselves and on the rest of sectors of the Andalusian economy.

Keywords: ***social accounting matrix, regional accounting, structural analysis.***

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correspondence to: M. Carmen Lima Díaz
Department of Economy and Business
University Pablo de Olavide at Seville
Ctra. Utrera, km.1
41013-Sevilla, Spain
Phone number: +(34) 954349353
e-mail: mlimdia@dee.upo.es

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1. Introduction

Social accounting matrices (SAM) are databases where economic transactions in terms of flows of rent are collected, allowing us to extract information on the different economic agents such as producers, consumers, the public administration and the foreign sector; as well as on the behaviour of productive factors.

While input-output analysis (from now on IOA) works from a more partial perspective derived from its own database, the SAM allow us to analyse behaviours apart from the intersectorial ones. This limitation of input-output methodology has been sufficiently discussed in the literature[1], for which we consider it unnecessary to expand upon this aspect. With regard to social accounting matrices, they start from IOA supplemented with information derived from the survey of family constraints or from national or regional accounting, and allow us to get further results.

If we have SAM for more than one year, it is feasible to carry out a complete analysis of the productive structure of the economy and also to obtain a perspective of the changes along the time. Diverse methodologies are able to outline such analysis in a particular economy. In the present work, we will use a methodology based on obtaining a three-dimensional landscape[2] denominated "structural path analysis". Using this methodology, we can extract the main rules of the behaviour of an economy. In later sections, we outline the characteristics of the mentioned methodology to conclude with an application in a regional case, using Social Accounting Matrices for Andalusia in 1990 and 1995 elaborated in previous works[3]. We will also use a first estimate of the SAM for Andalusia in 1999[4].

In the following sections we first present the "structural path analysis" methodology to develop a structural analysis of an economy. By means of the calculation of specific multipliers, we obtain a new matrix derived from the SAM. Next, we elaborate a three-dimensional landscape where we show key sectors hierarchization of the economy. Such sectors are obtained through the calculation of two types of indexes: the first one consists of analysing the "absorption effects" or forward linkages. The second one measures the "diffusion effects" or backward linkages. Within the methodological section, we obtain indicators directed to a more micro-economic scope that measure the effect of the shocks

generated inside a sector and also the ones involving the rest of sectors. These effects are called self-induced changes and non self-induced changes.

In the following section, we carry out the empiric application using the SAM for Andalusia. This exercise will point out not only the key sectors of the Andalusian economy, but also the type of interrelationships and the nature of linkages inside it through the decade of the nineties. Finally, we present the main conclusions that are completed by the Tables and an Appendix.

2. Methodology: the Multiplier Product Matrix and the structure of linkages

In SAM you can divide accounts in two blocks: exogenous and endogenous. The classification in one or another group will depend on the aspects that are to be studied. In this type of lineal general equilibrium models, it is possible from a mathematical point of view, to consider as endogenous variables (those whose rent level or production we want to explain) all the variables except one. Nevertheless, it is not very realistic to build a model without recognizing as exogenous those variables that are determined outside of the productive system or that ones that are used as instruments of the political economy (such as taxes, subsidies, transfers, public expenses,...) since, in fact, the changes in these ones determine the behaviour of the endogenous variables.

To carry out the structural analysis of an economy, and to know what type of linkages work inside it, we should observe the changes in the intermediate flows levels among sectors. Following Hewings & Sonis (1997), we use an instrumental that allows us to study an economy´s interrelationships by means of the calculation of a "Multiplier Product Matrix" (MPM), that we get from a SAM multipliers matrix.

Reordering sectorial relationships according to their importance, we can analyse how a change in the final demand of a sector affects the final demand of the economy (diffusion effect or backward linkage). We can also interpret how a change in the rest of sectors influences a particular one (absorption effect or forward linkage). These effects provide a clear orientation about the key sectors in the growth of an economy. They are useful to design performances about political economy as well, being supported by the high multiplier effect and the important influence that such interventions generate.

From the previous analysis, we could infer a group of macro-economic implications, but this exercise would be incomplete if we do not try to respond to questions such as the effect of a change in a sector´s multiplier on its supplier sectors. With this information, we want to know if the percentage each supplier contributes to the final production of another sector would remain the same or not if a change in the other sector took place. When a study is on the interindustrial and intraindustrial relationships, the most appropriate predictors should adopt a more micro-economic vision, to evaluate the origin of the intermediate inputs that each sector uses as well as their modifications after a shock. In this part of the work, we need to analyse the internal structure of SAM using multipliers that are able to detect the so-called self-induced changes, that is a sector's modifications in the input or in the output due to a change within itself (in its final demand or in the technology, for example). On the contrary, they can be due to another sector and will be called non self-induced changes.

2.1 Multiplier Product Matrix (MPM)

To analyse the sectorial interdependences in an economy, we should calculate the Multiplier Product Matrix, MPM, starting from the average tendency matrix of SAM. We identify these matrices by a subindex, *t*, according to the base year (A_{90}, A_{95} and A_{99} in this case). These matrices have been calculated dividing every SAM column vector by the corresponding sum of that column, being *n* the number of endogenous variables (the productive sectors, the production factors and the consumers).We calculate the associate inverse matrix $B_t = (I - A_t)^{-1}$, being *I* an $n \times n$ identity matrix. The sub-indexes *i, j* make reference respectively to the rows and columns of the corresponding matrices. Following the path analysis methodology, we begin by obtaining multipliers vectors, where each element corresponds respectively to the sum of a column or a row:

$$B_{.j} = \sum_{i=1}^{n} b_{ij} \qquad j = 1...n \qquad (1)$$

$$B_{i.} = \sum_{j=1}^{n} b_{ij} \qquad i = 1...n \qquad (2)$$

being b_{ij} components of the associated inverse matrix B_t.

Next we define the Multiplier Product Matrix as the product of the row multiplier and the column multiplier, corrected by a factor that we call "global intensity" (V) that corresponds with the sum of all the elements of the associate inverse matrix:

$$MPM = \frac{1}{V} \| \ B_{i.} B_{.j} \ \| \qquad i, j = 1...n \tag{3}$$

where

$$V = \sum_{i=1}^{n} \sum_{j=1}^{n} b_{ij} \tag{4}$$

This new matrix will allow us to identify sectors whose structural connections generate a superior impact than the average upon the rest of the economy, whether they experience a change in their own sector or as an answer to modifications detected in the rest of the system. Rasmussen (1956) and Hirschman (1958) classify these sectors as "key sectors." In short they include two indexes:

- Diffusion effect or backward linkage, BLj:

$$BL_j = \frac{B_{.j}}{\frac{1}{n} V} \qquad j = 1...n \tag{5}$$

- Absorption effect or forward linkage, FLi:

$$FL_i = \frac{B_{i.}}{\frac{1}{n} V} \qquad i = 1...n \tag{6}$$

The interpretation of these coefficients is as follows: if the backward linkage is greater than 1 (*BLj* greater than 100% in percentage terms), a unit change in the final demand of sector *j* will generate an increase above the average in the global activity of the economy. If the forward linkage is greater than 1 (*Fli* greater than 100% in percentage terms), a unit change in all the sectors of the final demand will generate an increment above the average in sector *i*. A key sector is that one with both indexes greater than one.

2.2 Structure of connections based on the concept of changes within itself or on the rest of sectors (self and non self-induced changes)

This analysis will allow us to answer other questions where the temporary scenario (*t*), with the corresponding SAM of 1990, 1995 or 1999 takes on a more relevant importance. For example, if a multiplier´s value of a sector increases or falls, how is this change counted? Would it be reasonable to assume that the relative importance in which each sector contributes to the production of the one that has suffered the exogenous interference remains constant after this change?, or on the contrary, do intermediate consumptions modify their values? In this case, we are interested in the ordinal ranking of the data net of the initial injection (B(t)-I). To give an answer to these questions, we evaluate the relative contributions of each element with regard to the row and column multipliers:

$$\frac{b_{ij}}{B_{.j}(t)} \qquad i,j = 1...n \qquad (7)$$

$$\frac{b_{ij}}{Bi.(t)} \qquad i,j = 1...n \qquad (8)$$

Each component of change can be divided into its own sector contribution and into another due to the remainder activities (self and non self-induced changes). This calculation can be carried out from the input side or from the output side. We will differentiate these expressions using a subindex "$_I$ ", or "$_O$" according to the indicator that we are calculating at each moment. The equations (9), (10), (11) and (12) present respectively the effect generated by their own sector from the input side, the effect generated by the rest of sectors from the input side and similar expressions for the output:

$$s_{j(I)} = b_{ii} - 1 \qquad j = 1...n \qquad (9)$$

$$ns_{j(I)} = B_{.j} - 1 - s_{j(I)} \qquad j = 1...n \qquad (10)$$

$$s_{i(O)} = b_{ii} - 1 \qquad i = 1...n \qquad (11)$$

$$ns_{i(O)} = B_{i.} - 1 - s_{j(O)} \qquad i = 1...n \qquad (12)$$

In percentage terms, we obtain expressions that can also be calculated from the point of view of the output by a simple vertical reading of SAM databases:

$$Ps_{j(I)} = \frac{s_{j(I)}}{s_{j(I)} + ns_{j(I)}} \qquad j = 1...n \qquad (13)$$

$$Pns_{j(I)} = \frac{ns_{j(I)}}{s_{j(I)} + ns_{j(I)}} \qquad j = 1...n \qquad (14)$$

This second methodology has the advantage that it allows us to extract behaviour patterns for each sector detected through every specific coefficient. These values provide information about a possible reorganization of the internal structure of production in the region, to be able to contrast if they increase the interindustrial relationships (non self-induced changes) or, if by contrast, intraindustrial relationships (self-induced changes) take on a higher relevance through time.

3. Empirical application

In this section, we will apply the methodology shown before for the Andalusian economy in the double sense anticipated in the previous section. We have added to 16 accounts the SAM for 1990, 1995 and 1999. The first thirteen sectors correspond to ten productive sectors, two productive factors ("Labour (11)" and "Capital (12)") and "Consumers (13)." These first sectors will be considered endogenous, while the rest ("Savings/Investment (14)", "Government (15)" and "Foreign sector (16)") are considered to be exogenous[5].

3.1 Landscape

After MPM calculations for the three cited years, we can obtain a classification following the definition of key sectors, by means of the analysis of the backward and forward linkages. We note that the value of these indicators allows us to select those cases in which an above-average reaction is expected for the whole economy due to a modification in sector demand, or sector reaction as a consequence of a demand change in the rest of the economy.

Sectors with the highest forward and backward linkages will show a position that also corresponds with the greatest coefficient in the MPM matrix. Therefore the MPM hierarchical structure is related with ordinal classification of these vectors. For example, the greatest forward linkage value in percentage terms is 312.50% for 1990 and it corresponds to "Consumers (13)". The greatest one for backward linkages is 125.50% for

"Commercial services (9)". Applying the MPM matrix, the greatest coefficient is precisely located in (13, 9) position[6]. We can reorder the MPM so that the highest multipliers are located in the main diagonal. Following Hirschman and Rasmussen, we obtain a graphical representation of the MPM with this new ordination, getting a nested descending landscape.

In table 1, the backward and forward linkages have been calculated for 1990, 1995 and 1999 from greater to the smaller values. To analyse the information from an aggregate point of view, we also present one three-dimensional graphic –landcape-, for each period. These landscapes are drawn with the previously mentioned reordering so the localization and comparison between one period and another is more immediate.

In the three graphics that can be consulted in the Appendix at the end of the work, we observe in a first approach an activity reduction in 1995 and a recovery that slightly overcomes the initial situation of 1990. These results show the better behaviour of the Andalusian economy for the last SAM corresponding to 1999, once the crisis of the first years of the nineties has been overcome.

(table 1)

Note the meaning of key sector using the case of the "Capital (12)" in 1990 as an example. By consulting table 1, we see that a change in the final demand of the mentioned sector generates an increase in the activity of the economy, that is, a reaction on the part of the rest of the sectors of 13% above the expected average reaction. This fact is interpreted to mean that when capital increases in the Andalusian economy, it generates a pulling effect in the rest of sectors even above its own experienced shock. This is called "diffusion effect" or backward linkage. As for the "absorption effect" or forward linkage, a change of one unit in the final demand of all the sectors produces an increase of the "Capital (12)" activity of something more than 52%, again, above the average. We could conclude that capital strongly reacts in moments of economic well-being and it is also impulsed by the rest of sectors more than would correspond in average terms.

As the two previous behaviours are greater than 100%, the "Capital (12)" account is classified among the key sectors for the Andalusian economy in 1990. Other key sectors

for this year are “Consumers (13)” (although its “diffusion effect” did not exactly reach 100%, we consider that 92.84% is a high enough percentage, specially when the sector presents the highest “absorption effect” with a triple reaction over the expected average when reacting to an increase in the rest of activity sectors) and “Labour(11).”

For 1995 “Capital (12)” repeats and “Commerce (6)” is positioned among the relevant sectors in terms of generation of economic activity. “Consumers (13)” are taken out as a key sector because although they register an even higher absorption effect than in 1990 (close to 318.90%), they continue accentuating the decreasing tendency of the diffusion effect, maintaining the behaviour of the previous period. A similar process appears in the “Labour (11)” sector.

For 1999, we highlight the growth of the “diffusion effect” and “absorption effect” in the “Capital (12)” account that strengthens itself as a key sector for the Andalusian economy, “Labour (11)” recaptures its position of 1990 as a key sector, and “Commerce (6)” consolidates its category acquired in 1995. “Consumers (13)” recover positions ending up improving their capacity to influence the rest of sectors through increases in demand. They also increase their capacity to take advantage of the expansion moments reflected in increments in the final demand of the rest of sectors. Finally, “Other services (8)” reaches for the first time the group of growth accelerators in this region.

3.1.1 Backward linkages

We will now study those sectors which, although they do not behave as key sectors because they register a low forward linkage value, they certainly do have a great capacity to accelerate economic activity when they experience a change in their own final demand, that is to say, when they register a high “diffusion effect” or backward linkage. Such is the case for “Commercial Services (9)”, with the highest value in this category, and “Other Services (8)” in 1990; once again “Commercial Services (9)” and “Non commercial Services (10)” in 1995; and, finally for 1999, “Commercial Services (9)” which repeats again, being confirmed as a sector of high “diffusion effect” for the whole decade, the same behaviour as for “Non-commercial Services (10)” in 1995. These data show the high relevance of services in the Andalusian economy, once we have confirmed the important

influence of a demand increment both in commercial services and in public services, on the rest of activity sectors.

Now we focus on the sectors that exert the least impulse on activity when they experience an increase on their final demand, that is, those that are not able to transmit their growth to the rest of sectors given their low "diffusion effect". We can highlight the "Extractives (2)" and the "Manufacturer Industry (6)" for the three years. We should like to point out that the first sector keeps a specially marked downward tendency in 1995 and later some-what less but still diminishing in 1999. However, it is important to remark the behaviour of "Manufacturer Industry (4)" which in the early nineties registered a 27% below average, also experiencing a drastic fall all along the period, concluding with an "diffusion effect" of only 35.06%, the smallest value among those registered in 1999. With this result we see the reduced capacity of the secondary sector to reactivate the Andalusian economy.

Regarding the evolution along time of the sectors that generate important backward linkages, the decade shows that "Commercial Services (9)"(where public services and machinery renting are included) stay to the head throughout the whole temporal horizon. "Other Services (8)" (financial intermediation services, insurance services and pensions), move from second position at the beginning of the nineties, slowing down to fourth place in 1995 and concluding the decade in eighth place, being an example of continuous descent. Similar behaviour is observed for "Agriculture, Cattle & Forestry and Fishing (1)." The opposite case is true for "Commerce (6)" which begins in ninth position, reaching second place by the middle of the decade and staying in the top positions, only losing one position in 1999. To highlight the volatility of the "Labour (11)" sector we see that it moves from third place in 1990 to eleventh position in 1995, returning to the lead in the ranking at the end of the period. The other sectors remain relatively stable.

3.1.2 Forward linkages

In this section we will consider those sectors which, although they do not behave as key sectors, they are very elastic to increases in the final demand of the rest of activity branches. Such is the case of the "Manufacturer Industry (4)" and "Commerce (6)" in 1990 and the "Manufacturer Industry (4)" again, plus the "Labour (11)"sector in 1995. Finally, in 1999, the "Manufacturer Industry (4)" changes its behaviour, going to seventh place in

the ranking of the "absorption effects", staying below what is considered a half reaction at the end of the decade. This means that 1999 is an inflection point for Andalusian industry which passes from an "absorption effect" of 151.09% to a modest 71.70%.
If we consider the sectors with a low "absorption effect", we encounter "Non-commercial Services (10)" and "Construction" (5) for 1990 and for 1995, although the third and fourth positions are different for those years: "Electricity and Natural Gas (3)" and "Commercial Services (9)" in 1990 and "Extractives (2)" along with "Agriculture, Cattle & Forestry and Fishing (1)" for 1995. With regard to 1999, the sectors are the same ones as in the preceding period.

If we follow the evolution along time of strong backward linkages in order to establish a similar hierarchy as that with the backward linkages, we conclude that the first along the three periods analysed is for "Consumers (13)" which triplicates the so-called average reaction. Between 1990 and 1995 significant position changes do not take place, but we must highlight the ascent of "Commercial Services (9)" that changes from the tenth to seventh place. Between 1995 and 1999, this sector is stabilized to the middle of the ranking. The rest of the sectors are characterized by the absence of relevant changes.

(figure 1)

3.2 The structure of connections based on the concept of changes upon themselves or upon the rest of sectors (self-induced and non self-induced changes)

In this second analysis, we wish to detect if a reorganization of the internal structure of production took place in the decade of the nineties in the Andalusian economy. In short, by means of a more micro-economic point of view we want to detect how a modification in a sector's multiplier is due to changes originated inside the sector itself (self-induced changes) or on the contrary, if it can be explained by changes in the rest of the sectors (non self-induced changes). Towards such an end, we should centre our observations in the ten productive sectors, considered to be aside from Productive Factors, Consumers, Savings/Investment, Government and the Foreign sector. For all ten activity sectors, we calculate coefficients for the input and output in which we evaluate the degree of intra and interindustrial dependence or the degree in which a sector's production depends on itself or

depends on the rest of sectors. This information is obtained in the equations (9) and (14) of Section 2. The results are presented in percentage terms in tables 2 and 3.

3.2.1 Input analysis

From the input point of view, the year which presents greater intra-industrial dependence values (self-induced changes) is 1990 with sectors that end up surpassing 20%, such as "Manufacturer Industry (4)" with 22.24% or "Extractives (2)" with 24.16% (which means that in 1990 the mentioned before sector used almost a fourth part of its input for its own production). In 1995, a reduction of most of the values is noted, however it is still necessary to highlight the relatively high figures for manufacturing although they are descending. The drastic fall in the value of "Extractives (2)" (close to just 4%) is a widespread example in sectors in 1999. Only "Electricity and Natural Gas (3)" get to 15% of intermediate inputs coming from their own production in 1999, the remainder of sectors are below 10%.

We turn our attention now to the sectors with the most important interindustrial dependence on input (high non self-induced changes, with behaviours close to 100%). We can point out "Non-commercial Services (10)", "Construction (5)",(although it falls as time lapses), "Commercial Services (9)", "Agriculture, Cattle & Forestry and Fishing (1)" and "Transportation & Communications (7)." "Manufacturer Industry (4)" shows intermediate inputs coming from other sectors which increases in 1995, a tendency that stabilizes at the end of the period.

(table 2)

3.2.2 Output analysis

The sectors with a greater degree of dependence as regards their own output (they register high values in self-induced changes), experienced behaviours far from stability. An example of growth could be "Electricity and Natural Gas (3)" with more than 25% in 1990, a percentage that increases until almost 44% in 1995, and that continues growing to 54% at the end of the period. The same situation, although with more moderate values, is true for

the sector of “Agriculture, Cattle & Forestry and Fishing (1)” or ”Transportation & Communications (7).” “Construction (5)” is the most surprising sector which presents irregular behaviour through 1990, registering very low percentages, values very close to 51% in 1995 and with 99.25% in 1999. Sectors that grew to finally stop and descend in 1999 are those like “Non-commercial Services (10).”

In summary, the data show a small widening in of the Andalusian economy specially in output that is confirmed by the growth of the dependence percentages in the same sectors in most activities from 1990 to 1995. Such behaviour is maintained in most cases for 1999, although we should comment that there are some services that have increased the volume of intersectorial relationships in a widespread way as shown in table 3 for “Other services (8)” in 1999, “Commercial Services (9)” or “Non-commercial Services (10).”

(table 3)

4. Conclusions

The goal of combining fields of industrial concentration with a development strategy which takes advantage of the endogenous character of each region and its own internal dynamics[7], makes it necessary to study those sectors that are able to generate growth and distribute the value added in a national or regional economy.

In this work we have outlined a structural analysis of the Andalusian economy using Social Accounting Matrices. The temporal scenario considered was the decade of the nineties, using the SAMs for the years 1990, 1995 and a first version of 1999.

The methodology used, called “structural path analysis”, has allowed us to graphically represent a “three-dimensional landscape” that captures the structure of relationships among the productive sectors of the Andalusian economy. These linkages provide information to analyse the effect of a change in the final demand of a sector on the whole Andalusian economy or to measure the influence of the expansion of one sector on the rest of them. All the necessary information has been collected in the backward linkages or “diffusion effects” and forward linkages or “absorption effects”.

Moreover, the results obtained for the Andalusian economy show that the productive factors along with the consumers generate important multiplier effects on economic activity through the decade, with the exception of the "Labour (11)" factor. From 1995 on, growth-employment elasticity decreased considerably (the labour factor was displaced to third place at the end of the ranking as regards generation of "diffusion effects" in this year). It is also important to remark that "Construction (5)" stayed between seventh and fifth positions during the whole decade as regards the "diffusion effect", demonstrating its capacity as an incentivator of economic activity.

It is important to mention that the "Manufacturer Industry (4)" is unable to function as an impulsor of economic activity on the Andalusian economy, ending the decade with a very limited capacity of influence on the rest of sectors even in moments when manufacturer demand increased. The weakness manifested previously is even more remarkable if we keep in mind that the capacity for reaction in times of optimal behaviour of the rest of the sectors becomes worse. Therefore we could summarize that "Manufacturer Industry (4)" stays at the end of the chart during the whole decade as regards "diffusion effect", and what is more, although starting at a very good place as "absorption effects", it advances along the period with a permanent loss of positions for this important indicator. Such a weakness considerably restricts the effectiveness of certain investment policy, due to the apparent rigidness of the sector. We do not imply a disappearance of them, but rather a redefinition based on the information extracted from the database used.

As for services, in a widespread way they show a high "absorption effect" of growth during the whole period considered. This result was expected by these investigators due to the weight of the services sector in the Andalusian economy. We highlight the good behaviour of commercial services as well as non-commercial services or public services to generate multiplier effects on the Andalusian economy. The sector with an exemplary behaviour from its middle ranking for the nineties was the one of "Commerce (6)", since it brings together the capacity to generate huge linkages in both senses.

Following the macro-economic perspective, we were interested in capturing more micro-economic details, fundamentally in the type of sectorial interrelationships and their evolution along time from both sides: purchases or inputs and sales or outputs. Sectors like "Manufacturer Industry (4)" and "Other Services (8)", register an important consumption of their own inputs as intermediate consumptions. Behaviours with high dependence of a

sector on itself as the one cited before are also present in the output as in the case of construction at the end of the decade. Correctly focused development policies about interindustrial relationships can be of great use for the take-off of these sectors.

In this work we have outlined those "key sectors" of an economy which can be instrumental in analysing problems of regional planning by means of lineal general equilibrium models obtained using SAMs. The main goal has been to analyse the internal arrangements by Andalusian activity sectors are governed, to be able to determine their potentialities and weaknesses, from an aggregate point of view as well as from another that delves into the internal structure of the interrelationships. Information of this type can give some idea to economic politicians about how to develop the most important sectors taking into account their capacity as generators of economic activity. We also argue the idea of space association in order to obtain integrated regional development and a greater effectiveness of the efforts of regional policy.

5. Notes

[1] See in this respect Roland-Holst, D.W. (1990).

[2] For more details, see Hewings, G.J.D. et al. (1997), or Sonis, M. et al. (1997), about the economies of Chicago and Indonesia respectively.

[3] See Cardenete, M.A. (1998), and Cardenete, M.A. (2000).

[4] This first version has been calculated by the application of an updating technique called CEM (*Cross Entropy Method*) on the SAM for Andalusia 1995, carried out by Cardenete, M.A.& Sancho, F. (2002).

[5] The complete list of the 16 sectors is presented in the Appendix at the end of this work.

[6] MPM calculation has not been included in the paper in order to avoid a wider Appendix, any consultation will be attended.

[7] For more information see Curbelo, J.M. (1988).

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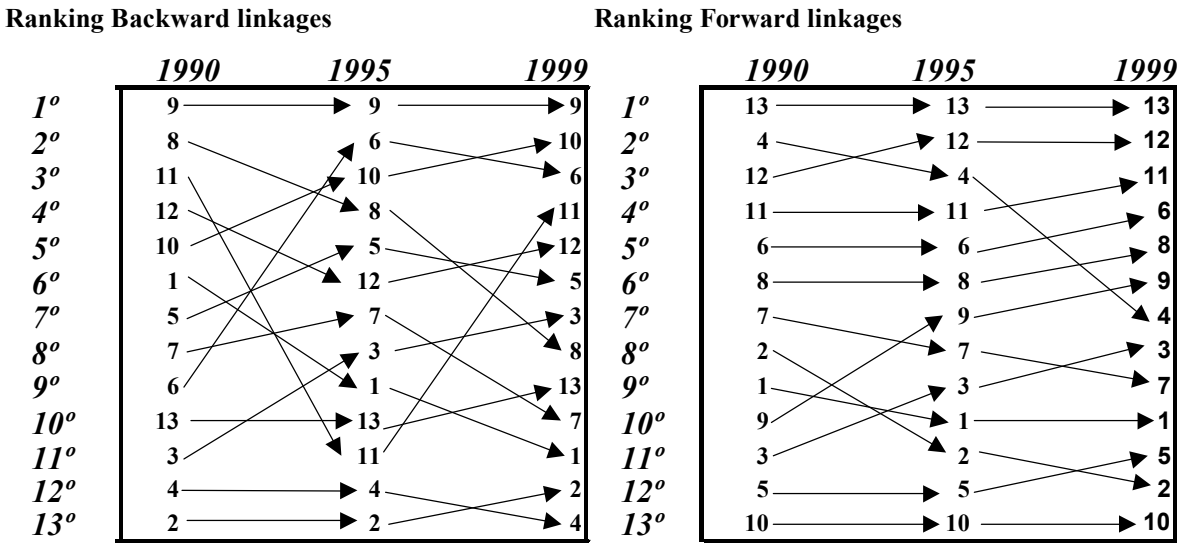
7. Tables

Table 1:Backward and forward linkages 1990, 1995 y 1999. (in percentage terms).

ANDALUCÍA 1990						ANDALUCÍA 1995						ANDALUCÍA 1999					
Backward BLj			Forward Fli			Backward BLj			Forward Fli			Backward BLj			Forward Fli		
1º	9	125.50	1º	13	312.50	1º	9	129.02	1º	13	318.90	1º	9	136.53	1º	13	367.74
2º	8	121.86	2º	4	177.23	2º	6	121.17	2º	12	186.13	2º	10	126.49	2º	12	215.08
3º	11	113.45	3º	12	152.34	3º	10	120.10	3º	4	151.09	3º	6	123.83	3º	11	126.81
4º	12	113.45	4º	11	139.55	4º	8	114.63	4º	11	148.80	4º	11	121.14	4º	6	108.21
5º	10	109.59	5º	6	117.87	5º	5	113.63	5º	6	119.61	5º	12	121.14	5º	8	96.61
6º	1	108.00	6º	8	81.00	6º	12	111.46	6º	8	73.00	6º	5	108.21	6º	9	81.73
7º	5	107.40	7º	7	65.03	7º	7	102.14	7º	9	59.80	7º	3	103.43	7º	4	71.70
8º	7	101.33	8º	2	58.28	8º	3	100.74	8º	7	55.16	8º	8	101.36	8º	3	51.50
9º	6	95.44	9º	1	51.17	9º	1	100.45	9º	3	50.21	9º	13	95.29	9º	7	51.41
10º	13	92.84	10º	9	49.85	10º	13	88.86	10º	1	44.39	10º	7	94.09	10º	1	35.78
11º	3	84.91	11º	3	42.79	11º	11	88.39	11º	2	35.83	11º	1	92.77	11º	5	31.79
12º	*4*	*72.78*	*12º*	*5*	*31.57*	*12º*	*4*	*70.78*	*12º*	*5*	*33.38*	*12º*	*2*	*40.67*	*12º*	*2*	*31.63*
13º	2	53.45	13º	10	20.82	13º	2	38.63	13º	10	23.70	13º	4	35.06	13º	10	30.02

Source: Own elaboration through SAMs for Andalusia 1990, 1995 and 1999.

Figure 1: Evolution of activity sectors in Andalusia: 1990-99.



Source: Own elaboration through SAMs for Andalusia for 1990, 1995 and 1999.

Table 2: Self-induced changes and non self-induced changes from the input point of view

(in percentage terms).

Self-induced changes: input				**Non self-induced changes: input**			
Sectors	**1990**	**1995**	**1999**	***Sectors***	**1990**	**1995**	**1999**
1	4.12	3.99	2.65	***1***	95.88	96.01	97.35
2	24.16	3.93	3.76	***2***	75.84	96.07	96.24
3	9.06	15.48	15.51	***3***	90.94	84.52	84.49
4	22.24	19.08	8.55	***4***	77.76	80.92	91.45
5	0.86	5.66	3.46	***5***	99.14	94.34	96.54
6	8.90	9.56	8.05	***6***	91.10	90.44	91.95
7	4.48	6.37	5.35	***7***	95.52	93.63	94.65
8	12.41	10.30	9.67	***8***	87.59	89.70	90.33
9	2.57	3.82	5.53	***9***	97.43	96.18	94.47
10	0.02	0.39	0.66	***10***	99.98	99.61	99.34

Source: Own elaboration through SAMs for Andalusia for 1990, 1995 and 1999.

Table 3: Self-induced and non self-induced changes from the output point of view (in percentage terms).

Self-induced changes: output				**Non self-induced changes: output**			
Sectors	**1990**	**1995**	**1999**	**Sectors**	**1990**	**1995**	**1999**
1	11.78	14.26	35.78	*1*	88.22	85.74	64.22
2	21.06	4.76	12.46	*2*	78.94	95.24	87.54
3	26.27	43.80	53.91	*3*	73.73	56.20	46.09
4	7.41	7.15	22.92	*4*	92.59	92.85	77.08
5	6.80	47.83	99.25	*5*	93.20	52.17	0.75
6	6.85	9.72	13.09	*6*	93.15	90.28	86.91
7	8.14	15.58	22.68	*7*	91.86	84.42	77.32
8	20.81	18.82	15.32	*8*	79.19	81.18	84.68
9	9.21	10.94	8.33	*9*	90.79	89.06	91.67
10	7.82	34.58	10.40	*10*	92.18	65.42	89.60

Source: Own elaboration through SAMs for Andalusia for 1990, 1995 and 1999.

8. Appendix

Table A.1. Social Accounting Matrices for Andalusia. Structure (1990-95-99)

Note: Endogenous sectors: from 1 to 13. Exogenous sectors: from 14 to 16.

1	Agri1culture, cattle & forestry and fishing
2	Extractives
3	Electricity and natural gas
4	Industrial manufacturing
5	Construction
6	Commerce
7	Transport and Communications
8	Other Services
9	Commercial services
10	Non commercial services
11	Labour
12	Capital
13	Consumers
14	Savings/Investment
15	Government
16	Foreign sector

Source: Own elaboration.

Figure A.1: LANDSCAPE ANDALUSIA 1990

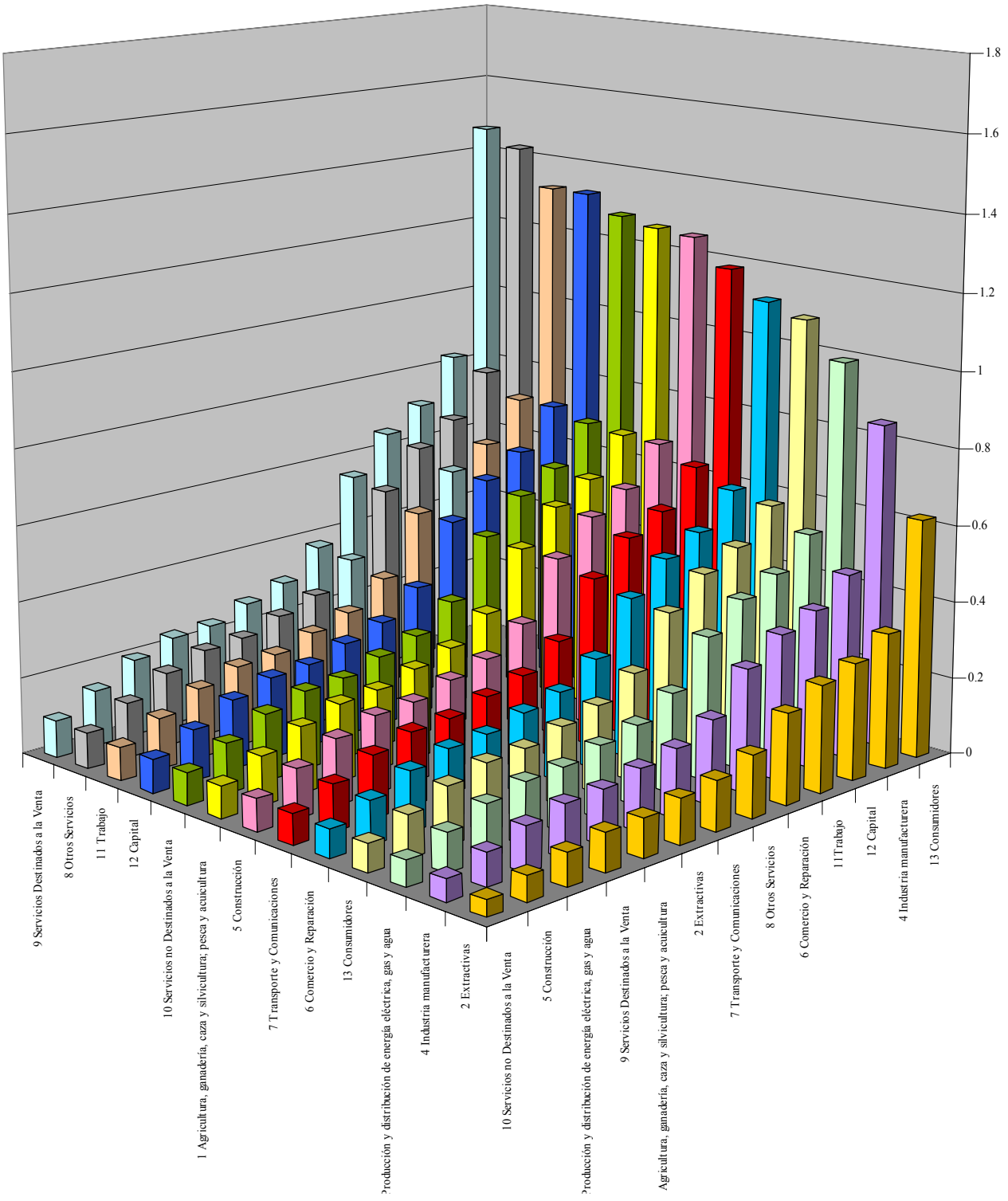


Figure A.2: LANDSCAPE ANDALUSIA 1995

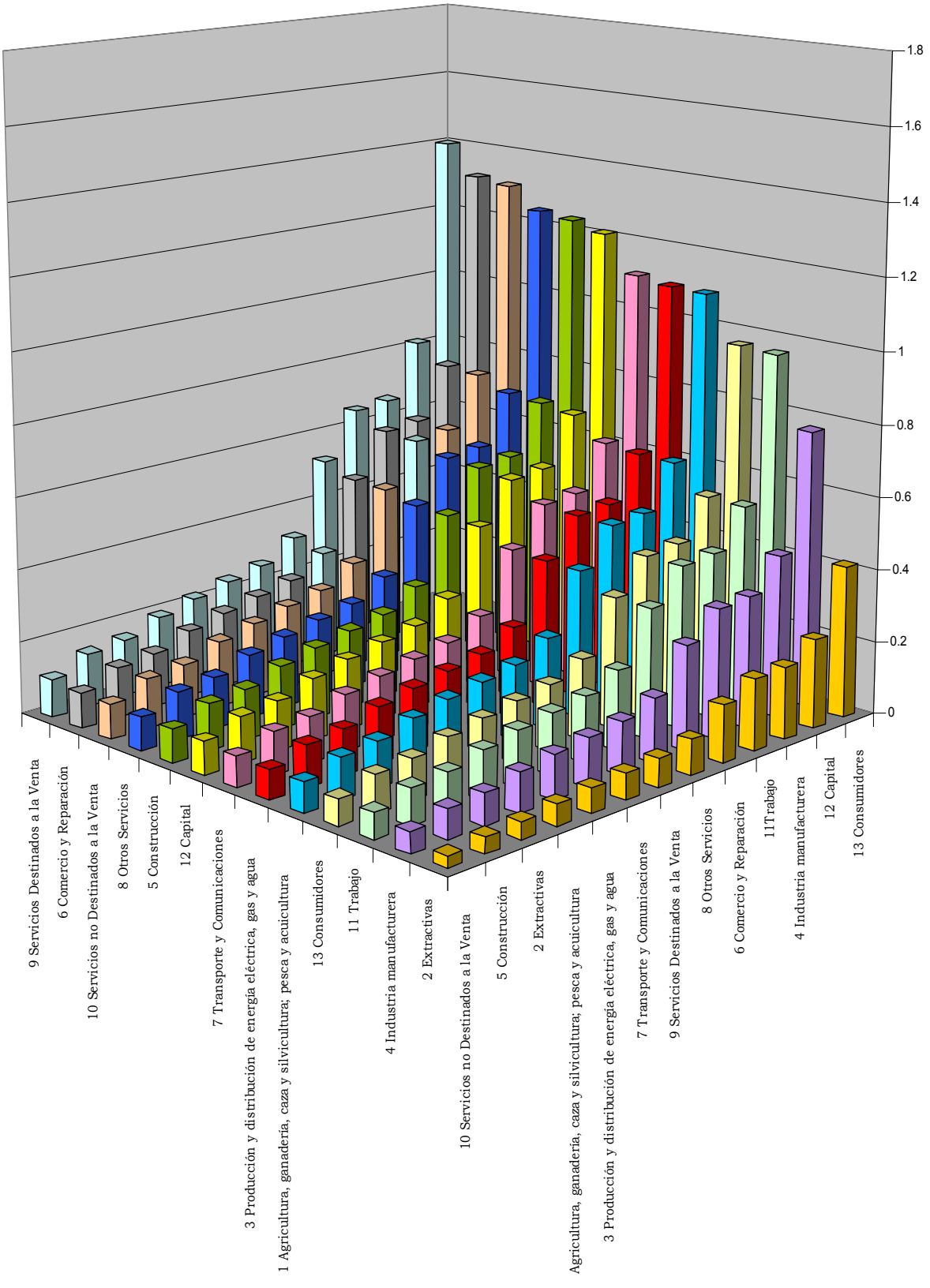


Figure A.3: LANDSCAPE ANDALUSIA 1999