

Cardenete, Manuel Alejandro; Congregado, Emilio; Pomares, Ignacio

## Conference Paper

# An analysis of two regional versions of a social accounting matrix in Spain: Catalunya vs. Andalusia

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An analysis of two versions of Social Accounting Matrices:  
Catalonia vs. Andalusia

Manuel Alejandro Cardenete Flores  
Emilio Congregado Ramírez of Aguilera  
Ignacio Pomares Hernández <sup>1</sup>

**Abstract**

*The goal of this paper is to compare a reduced version of a social accounting matrix (SAM) for Andalusia and Catalunya. Using available data for Regional Accounts, input-output tables, etc., we provide a complete picture of flow among economic agents (four producers, one consumer, the Government and one foreign agent). It is obvious this is a preliminary paper because for its usage we must avoid some statistic mistakes observed in our regional statistics nowadays, this chore we left for future works. The SAM may be useful to the Regional Agencies in charge of constructing the Regional Accounts, as well as researchers in applied general equilibrium. We want to present the structural differences between these regions by mean of multivariate analysis, using as data their respectives SAM.*

**Key words:** *social accounting matrix, National Accounts, input-output tables, applied general equilibrium models, multivariate analysis.*

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Department of Economy and History of the Economic Institutions, Univ. of Huelva.  
Plaza de la Merced, s/n 21002, HUELVA (Spain).  
e-mail: cardenete@uhu.es; congregado@uhu.es; pomares@uhu.es

## 1. Introduction.

The Applied General Equilibrium Models are abstract representations of national economies. They capture in a consistent and systematic way, the form in which the agents of an economy are interrelated. Their behavior hypotheses, the technological specifications, the parameters and their level of disaggregation, as in production as in consumption, they provide a new concept of the assignment of resources and of the distribution of the rent due to alternative politicians, based on an analysis of comparative static.

Forgetting their important normative value (it is possible to use Applied General Equilibrium Models to design reforms that improve the welfare, due to the relationship between this one and the General Equilibrium) it is important to remark its descriptive value.

Moreover, the approach to the real economy through this simulation model, it facilitates the collection of information because it provides, as the input-output analysis, a coherent benchmark, denominated Social Accounting Matrix (SAM), in which the counts are disaggregated by agents (consumers, companies and government). Some authors as St. Hilaire and Whalley (1984), Robinson (1986) Robinson and Roland-Holst (1990) and, applied for the Spanish economy, Kehoe et al. (1988), have showed the methodology of the SAM.

The purpose of this article is to compare the SAM of Andalusia<sup>2</sup> and the SAM of Catalonia<sup>3</sup>, elaborated so far with the available information. We will describe the structure of the two SAMs, trying later on to present the differences and structural likeness between these two regions, using measures of similarity for sectors and the global measure of similarity of Le Masne. Later on we carry out some non parametric tests: the tests of signs of Fisher and the T of Wilcoxon. The database of this analysis will be the previously mentioned SAMs. We hope the methodology can be good to impel to the elaboration of others SAMs for other regional economies in Spain and this way to possess enough information to carry out multivariate analysis in a bigger scale.

## 2. Sources and methodology of the social accounting matrix of Andalusia (1990) and Catalonia (1987).

In building a Social Accounting Matrix, you combine the available economic statistics on production, consumption, rents, taxes and expenditure of the Public Sector and purchases and sales of the foreign sector. To know the structure a SAM it is convenient to leave well of the macroeconomic identities that are verified in an economy, as a national level as a regional level.

In a first level the National Accounts (or Regional) we can represent them by means of the following expressions:

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See Cardenete Flores, M.A. (1997a).

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See Manresa, A. and Sancho, F. (1997).

$$\text{GDP} = C+I+G+(X-M) \text{ (GDP, perspective of the expenditure)} \quad (1)$$

$$\text{GDP} = W+\Pi +T_1 \text{ (GDP, perspective of the rent)} \quad (2)$$

$$W+ \Pi = C+S+T_2 \text{ (uses of the rent)} \quad (3)$$

$$D = T_1+T_2-G \text{ (National Accounts)} \quad (4)$$

$$F = X-M \text{ (Foreign Accounts)} \quad (5)$$

where we have noticed the variables as: GDP, Growth Development Product; C, Private Consumption; I, Investmen; G, Public Expenditure; X, Exports; M, Imports; W, Wages;  $\Pi$ , Profit; S, Private Saving; T1, Net Indirect Taxes; T2, Direct Taxes and F, Commercial Balance.

The structure of the National Accounts can be expressed in format of square of double entrance. In a simplified way it could be in the following way:

Table n° 1.

Social Accounting Matrix							
1. Companies	A	0	0	C	I	G	X
2. Labour	W	0	0	0	0	0	0
3. Capital	$\Pi$	0	0	0	0	0	0
4. Household	0	W	$\Pi$	0	0	0	0
5. Investement	0	0	0	S	0	D	-F
6. Government	$T_1$	0	0	$T_2$	0	0	0
7. Foreing Sector	M	0	0	0	0	0	0

So that the table 1 it reproduces all the information contained in the Aggregate National Accounts (or Regional). It is verified that the sum of the cells that form each column coincides with the sum of the cells of each line. For example, if we take those accounts of the GDP of the economy from the perspective of the expenditure and of the rent, they show:

$$C+I+G+(X-M) = W+\Pi+T_1 \quad (6)$$

reordering the expression we have:

$$C+I+G+X = W+\Pi+T_1+M \quad (7)$$

and incorporating the intermediate transactions of goods between the companies, denominated as A, we obtain:

$$A+C+I+G+X= A+W+\Pi+T_1+M \quad (8)$$

In the left part of the last equation we have the entrances of the first line in the SAM, while in the right one, the entrances of the first column are described. We can interpret the rest of sectors in the same way. To resume, the information of the input-output table is contained in the SAM. The SAM, summarizing, it includes the input-output table but integrated in the most general benchmark in the flow circular rent.

## 2.1. SAM of Andalusia.

The first decision that it is necessary to take in the process of building a SAM is to choose the base year. In our case, and keeping in mind that the last input- output table of Andalusia was of the year 1990, we proceeded to estimate it for this year.

The main used statistical sources were:

1. - Input-Output Table of Andalusia, 1990, Institute of Statistic of Andalusia.
2. - Regional Accounts of Andalusia, 1990, Institute of Statistic of Andalusia.
3. - Regional Accounts of Spain, 1990, National Institute of Statistic.
4. - Regional Accounts, 1990, Ministry of Economy.
5. - Family Budgets Enquiry, 1990-1991, National Institute of Statistic.

In second place, we define hierarchy of the different statistical sources settled down to use in the construction of the SAM, meeting with important problems among the data according to the different used statistical sources. This hierarchization it corresponds with the order in those ones have been previously mentioned.

The third decision refers to the degree of disintegration of the different sectors. Although we decided to carry out a SAM of 31 x 31 sectors, where the flows were described carried out in the Andalusian economy for the year 1990, - twenty-five productive sectors, three economic agents (Public Administration, Household and External Sector) and two productive factors (Labour and Capital) - we will carry out the comparative analysis using a reduced version, of only 10 x 10, where the productive sectors have decreased to the three traditional sectors (Agriculture, Industry and Services) more a differentiated Energy Sector of the Industrial Sector, three economic agents (Public Administration, Consumers and External Sector) and two productive factors (Labour and Capital).

Table n° 2. SAM of Andalusia (1990). Source: Cardenete (1997a and 1997b).

	1	2	3	4	5	6	7	8	9	10
1.Agriculture	65873	0	379324	59249	0	0	253670	23179	0	257374
2. E energy	29027	385181	181823	156090	0	0	242800	4909	0	269934
3. Industry	143175	22336	1066131	512197	0	0	1690661	1402161	0	1419691
4. Services	99923	92713	622601	1282492	0	0	2875513	106490	907088	142999

5. Labour	114012	52646	682076	1738184	0	0	0	0	0	0
6. Capital	421405	113086	757170	1218598	0	0	0	0	0	0
7. Household	0	0	0	0	2586918	2510259	0	0	1403838	40935
8. Investment.	0	0	0	0	0	0	523717	0	-198272	1211294
9. Pub. Adm.	-19613	198012	452896	525770	0	0	955589	0	1528910	0
10. Foreign.Sec.	184867	405790	2114331	637239	0	0	0	0	0	0

## 2.2. SAM of Catalonia.

As the same as the SAM of Andalusia, the regional statistics of Catalonia presented limitations. The last Input-output Table of Catalonia was built in 1987 as a result of an initiative of the Generalitat of Catalunya and the Chamber of Commerce, Industry and Sailing together with the University Autonomous of Barcelona.

We combined those statistical available on production, consumption, rents, taxes and expenditure of the Public Sector, purchases and sales of the foreign sector, using the mentioned Input-output Table of 1987, and the Regional Accounts of Catalonia for the same period.

In the table 3, this SAM is presented where the flows are described carried out in the economy of Catalonia in 1987. The structure is exactly the same as that of Andalusia, for our analyses (10 x 10), although it was elaborated a more complete version originally with 34 differentiated productive sectors.

Table nº 3. SAM of Catalonia (1987). Source: Manresa and Sancho (1997).

	1	2	3	4	5	6	7	8	9	10
1. Agriculture	39672	1	458163	30403	0	0	154414	6426	4377	67228
2. E energy	9093	230651	244903	152430	0	0	224255	2346	4056	75640
3. Industry	182041	17390	2585841	718516	0	0	1710705	1312559	825	3270340
4. Services	45735	29819	748307	1379932	0	0	2400507	137373	830691	539798
5. Labour	20724	49506	1139706	1379932	0	0	0	0	0	0
6. Capital	136435	251611	1366938	1451848	0	0	0	0	0	0
7. Household	0	0	0	0	2589868	3206832	0	0	908958	26729
8. Investment.	0	0	0	0	0	0	1505263	0	349538	539031
9. Pub. Adm.	22325	64028	705142	569707	0	0	737243	0	1365473	0
10. Foreign.Sec.	304659	300368	2549217	429394	0	0	0	935128	0	0

## 3. Structural analysis of the Social Accounting Matrix of Andalusian and Catalonia<sup>4</sup>.

It constitutes the objective of this section the detection, based on the use of different

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The comparison of the two matrices is done with database of different periods. It could be dared to present these results without deflaction. This matter haven't an easy solution. On one hand, to use differents deflactors couldn't maintain the consistency of the matrices, and on the other hand, to use only one deflator doesn't alter the technical coefficients matrices.

technical of analysis of data, of the differentiating characters more accused among the SAMs. The origin of the data -two only observations and a only one period - they condition, in great measure, the possible techniques to use, and the power of the results of the analysis.

To carry out this task, it has been proceeded to the realization of different exercises that allow us to aim certain significant differences among the structures of both economies. Using the technical coefficients of the SAMs-tables 4 and 5 -, it is looked for, in the first place, a measure of seemingly between both groups of observations. Of the different measures, we have opted to use the proposal of Le Masne whose value is obtained by the following expression:

$$S_{ij}^{C-A} = 100 \cdot \left(1 - \frac{1}{2} \sum |a_{ij}^C - a_{ij}^A|\right) \quad (9)$$

where *C* and *A* denote the ownership from the element to the Catalan or Andalusian SAM<sup>5</sup>.

As you can see, the coefficient reaches bigger values when the differences are smaller between the elements of the SAMs. The biggest theoretical value in this measure it is 100%, and therefore, with values next to 100% we speak of cases of maximum similarity, while otherwise, we consider scarce the likeness among the two sources of data. After obtaining the differences matrix, we can obtain measures of similarity for sectors and a measure of global similarity whose results are showed in the chart 7. According to this measure we can identify two kinds of sectors, with high similarity and low similarity.

Table nº 4: Technical Coefficients: SAM-87 Catalonia.

	1	2	3	4	5	6	7	8	9	10
<b>1. Agriculture</b>	0.0521	0.0000	0.0467	0.0050	0	0	0.0229	0.0044	0.0012	0.0148
<b>2. Energy</b>	0.0119	0.2444	0.0249	0.0255	0	0	0.0333	0.0016	0.0011	0.0167
<b>3. Industrie</b>	0.2393	0.0184	0.2639	0.1202	0	0	0.2541	0.8998	0.0002	0.7237
<b>4. Services</b>	0.0601	0.0316	0.0763	0.2078	0	0	0.3565	0.0941	0.2398	0.1194
<b>5. Labour</b>	0.0272	0.0524	0.1163	0.2309	0	0	0	0	0	0
<b>6. Capital</b>	0.1793	0.2667	0.1395	0.2430	0	0	0	0	0	0
<b>7. Household</b>	0	0	0	0	1	1	0	0	0.2624	0.0059
<b>8. Investment.</b>	0	0	0	0	0	0	0.2235	0	0.1009	0.1192
<b>9. Pub.Adm.</b>	0.0293	0.0678	0.0719	0.0953	0	0	0.1095	0	0.3941	0
<b>10. Foreign. Sec.</b>	0.4005	0.3183	0.2601	0.0718	0	0	0	0	0	0

Table nº 5: Technical Coefficients: SAM-90 Andalusia.

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It could be used another tests. In the same case, it could be possible to use the tests of Wilcoxon or the Signes ones, for each pair of variables (sectors in this sample), and not use it as a whole, as in this paper.

	1	2	3	4	5	6	7	8	9	10
<b>1. Agriculture</b>	0.0634	0	0.0606	0.0096	0	0	0.0387	0.0150	0	0.0770
<b>2. Energy</b>	0.0279	0.3033	0.0290	0.0254	0	0	0.0371	0.00319	0	0.0807
<b>3. Industrie</b>	0.1378	0.0175	0.1704	0.0835	0	0	0.2584	0.9124	0	0.4247
<b>4. Services</b>	0.0962	0.0730	0.0995	0.2092	0	0	0.4395	0.0692	0.2490	0.0427
<b>5. Labour</b>	0.1097	0.0414	0.1090	0.2835	0	0	0	0	0	0
<b>6. Capital</b>	0.4057	0.0890	0.1210	0.1987	0	0	0	0	0	0
<b>7. Household</b>	0	0	0	0	1	1	0	0	0.3855	0.0122
<b>8. Investment.</b>	0	0	0	0	0	0	0.0800	0	-.0544	0.3624
<b>9. Pub.Adm.</b>	-.0188	0.1559	0.0723	0.0857	0	0	0.1460	0	0.4198	0
<b>10. Foreig.Sec.</b>	0.1779	0.3195	0.3379	0.1039	0	0	0	0	0	0

Table n° 6: Matrix of Differences, in absolute value, between the elements of the Technical Coefficients.  
 $A_{ij}=A_{ij}(cat)-A_{ij}(and)$ .

	1	2	3	4	5	6	7	8	9	10
<b>1. Agriculture</b>	0.0112	0.0000	0.0138	0.0045	0	0	0.0158	0.0106	0.0012	0.0621
<b>2. Energy</b>	0.0159	0.0588	0.0040	0.0000	0	0	0.0038	0.0015	0.0011	0.0640
<b>3. Industrie</b>	0.1014	0.0008	0.0935	0.0367	0	0	0.0043	0.0126	0.0002	0.2989
<b>4. Services</b>	0.0360	0.0414	0.0231	0.0013	0	0	0.0829	0.0248	0.0092	0.0766
<b>5. Labour</b>	0.0825	0.0110	0.0072	0.0525	0	0	0	0	0	0
<b>6. Capital</b>	0.2263	0.1776	0.0422	0	0	0	0	0	0	0
<b>7. Household</b>	0	0	0	0	0	0	0	0	0.1230	0.0063
<b>8. Investment.</b>	0	0	0	0	0	0	0.1435	0	0.1553	0.2431
<b>9. Pub.Adm.</b>	0.0482	0.0880	0.0004	0.0095	0	0	0.0365	0	0.0256	0
<b>10. Foreig.Sec.</b>	0.2225	0.0011	0.0777	0.0320	0	0	0	0	0	0

Table n° 7: Measures of Similarity between sectors.

Sector	1	2	3	4	5	6	7	8	9	10
Similarity	67.77	81.04	88.07	90.94	100	100	85.64	97.51	84.19	62.43
Classification respect to global measure of simiailty: (85.26)	Low	Low	High	High	High	High	High	High	Low	Low

Based on this classification, you can see a prevalence of sectors with a high degree of similarity. In this sense, we can remark the level of similarity reached for the “Labour” and “Capital” sectors, although it is possible that this fact is due to the methodology applied in the



elaboration of the social accounting matrices.

In other hand, the “Agriculture”, “Energy”, “Public Administrations” and “Foreign” sectors present some bigger differences between the two tables.

The following exercise consists on the realization of some non-parametric tests, that is, you haven’t any previous supposition neither on the distribution nor on those parameters, that allows to relate the two samples. Therefore, you carry out two non-parametric tests: the test of the signs of Fisher and the T of Wilcoxon, whose election is justified based on the type of data that we have. It is obvious that the test of Wilcoxon, it is the most useful and potent, since it doesn’t only consider the direction of the differences, but also the magnitude of those ones.

To make these tests we have used two auxiliary matrices: a matrix of differences and matrix of ranks. For some operability reasons and to eliminate the accounts that are used as instrument of political economics, we only use the Endogenous Accounts of the SAM of Andalusia and Catalonia like source. In this matrix you have the “Intersectorial Relations”, “Household”, “Labour” and “Capital” sectors, leaving the Exogenous Accounts (“Public Administration”, “Investment” and “Foreign” sectors)<sup>6</sup>.

Table nº 8: Matrix of Differences: SAM-Catalonia and SAM-Andalusia.

	1	2	3	4	5	6	7
<b>1. Agriculture</b>	-0.0112	0.0000	-0.0138	-0.0045	0	0	-0.0158
<b>2. Energy</b>	-0.0159	-0.0588	-0.0040	0.0000	0	0	-0.0038
<b>3. Industrie</b>	0.1014	0.0008	0.0935	0.0367	0	0	-0.0043
<b>4. Services</b>	-0.0360	-0.0414	-0.0231	-0.0013	0	0	-0.0829
<b>5. Labour</b>	-0.0825	0.0110	0.0072	-0.0525	0	0	0
<b>6. Capital</b>	-0.2263	0.1776	0.0184	0.0442	0	0	0

*The test of the signs of Fisher.*

In this test we contrast the null hypothesis of equal occurrence probability in the appearance of positive and negative signs:

$$H_0: p(+)=p(-)=0,5 \quad (10)$$

This probability is calculated based on the following expression:

$$P(\text{signe}) = \frac{dp - n/2}{\sqrt{n/4}} \quad (11)$$

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See Curbelo Ranero, J.L.(1988) or Polo, C., Roland-Holst,D.W. and Sancho, F. (1991) where they explain the composition of a social accounting matrix.

where  $dp$  is the number of positive differences, and  $n$  the total number of differences, this statistical is contrasted taking a binomial  $B(np, \sqrt{npq})$ .

The basic hypothesis of this contrast is the nonexistence of significant differences between the two matrices. The statistical takes the value -3.857, and therefore we must reject the null hypothesis, and think that it is the possible existence of significant differences between the matrices of SAM of Andalusia and Catalonia.

Table nº 9: Matrix of Positive Differences.

	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
<i>1. Agriculture</i>	0	0.0000	0	0	0	0	0
<i>2. Energy</i>	0	0	0	0.0000	0	0	0
<i>3. Industrie</i>	0.1014	0.0008	0.0935	0.0367	0	0	0
<i>4. Services</i>	0	0	0	0	0	0	0
<i>5. Labour</i>	0	0.0110	0.0072	0	0	0	0
<i>6. Capital</i>	0	0.1776	0.0184	0.0442	0	0	0
<i>7. Household</i>	0	0	0	0	0	0	0

Table nº 10: Results of the contrast of signs of Fisher.

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H0: don't exist significant differences between both matrices  
 Number of positive differences: 11  
 Number of negative differences: 49  
 Value of the statistical : -3.857  
 The null hypothesis is rejected

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*The test of Wilcoxon.*

In this test the null hypothesis is that the sum of positive ranges is equal to the sum of negative ranges, that is, the nonexistence of mainly positive differences and therefore is used the following statistical<sup>7</sup>, that it is tabulated:

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<sup>7</sup>

See Pulido, A. and Fotela, E. (1993), pp. 192-193.

$$T_w = \frac{w - [(n+1)/4]}{[n(n+1)(2n+1)/24]^{1/2}} \quad (12)$$

The value of the statistical is  $W = -0.119$ , so you can accept the null hypothesis, that is equal to think that significant differences don't exist between the matrices of technical coefficients of both regions<sup>8</sup>.

Table n° 11: Matrix of ranges or Matrix of differences more than zero.

	1	2	3	4	5	6	7
<b>1. Agriculture</b>	0	1	0	0	0	0	0
<b>2. Energy</b>	0	0	0	1	0	0	0
<b>3. Industrie</b>	1	1	1	1	0	0	0
<b>4. Services</b>	0	0	0	0	0	0	0
<b>5. Labour</b>	0	1	1	0	0	0	0
<b>6. Capital</b>	0	1	1	1	0	0	0
<b>7. Household</b>	0	0	0	0	0	0	0

Number of differences superiors to zero: 11.

Summatory of positive differences: 0.4912537.

#### 4. Conclusions.

To conclude, we can obtain as a first conclusion that considered as a whole, they can't show big differences between the social accounting matrices. In spite of this, when you study sector by sector, you can see significant negative differences between the agricultural, energy, foreign sectors and their public administrations. The applied techniques and therefore the obtained results, they are conditioned, in great measure, for the nature of the database.

On other hand, the high similarity between the two matrices, it could be because of the methodology of disaggregation used in the social accounting matrices. In such a way, we can doubt about the definitive conclusions obtained. It could be necessary to have more periods for using another type of techniques that they allow to arise more useful conclusions.

The development of technical of simulation based on social accounting matrices in Spain, it has not been realized too late although it has not been paid the necessary attention. Now, the government are starting to keep in mind these models for making political economic

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We have selected the second the results of the second test because this one is more robust, taking not only the magnitudes else the directions.

decisions, although it is not generalized.

In this article we have presented a Social Accounting Matrix for Andalusia (10 x 10), for 1990, taking the methodology of the SAM for Catalonia, for the year 1987 (10 x 10) and we have tried to compare them, finding a lots of important statistical problems because of the different sources of database. The missing information is not an easy problem to find a solution. In spite of this one, you can be able to replace those statistical deficiencies with some ingenious idea, although it could be more efficient that the institutions which elaborate the data, they coordinate their efforts and results. Thus it is ideally suited to improve in this way because it is a useful shortcut for a modeler.

The benchmark proposed in this work could help to show the problem and to point out some useful areas to improve, but it can provide only a mark for the analysis, it can't give a unique solution.

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