ANALYSIS OF THE ECONOMIC IMPACT OF DIFFERENT MEANS OF TRANSPORT IN ANDALUSIA.

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Resumen:

The impact of the different means of transport in the economy has been an important point of discussion in last years due to the investment they require.

This paper analyses the impact of the different mans of transport in the economy of Andalusia and their position among all sectors, through the use of multiplier analysis based on Social Accounting Matrix (SAM) for the period of 2010. It has been performed a key sector analysis, a breakdown of multipliers as a sum of direct, indirect and induced effects, and also the salary and workload multipliers have been calculated, and an estimation of their economic impact through a simulation of a sock in the demand.

This analysis considers only the economic impact of the means of transport, not the impact in the economy of the passengers or goods transported or to favor the establishment of productive centers.

The starting point is the creation of a SAM from the existing one of Andalusia of the year 2010, but desegregating the sector of transport in the different means of transport

and a residual sector containing all the business aggregated to the transport sector but not being means of transport.

As a result it has been established the different impact in the economy of the means of transport. In terms of multipliers, some have high values, as transport of passengers by train or by sea, and some others low values, as air transport. The salary multipliers also have differences but all of them have high values. In terms of employment there is also a high variance in their values: air transport or high speed train have high values, and road transport low values. This different behaviour has to be taken into account by the policy makers when they plans to develop mans of transport, or have to decide between different alternatives.

Palabras Clave: Social Accounting Matrix, Input–Output Analysis, Transport

Clasificación JEL: O14, R40, L90, C67

1. Introduction

One of the main questions to be answered by the economic policy is to determine the economic structure of a certain area, and to identify the key sectors in terms their impact in the economy and the effect on the employment, wages and production in order to design policies that contribute to achieve the objectives of the policy makers.

In last years, starting in 2008, and due to the economic crisis, it has been heavily criticized the investment in some public infrastructures, especially those linked to transport means, such as airports or high speed trains. Taking into account this situation it has been envisaged the need to have studies that evaluated the impact of these means of transport in the whole economy of the area that is served by this infrastructure, adding helpful information for taking decisions about investing in transport infrastructures.

This paper is focused on achieving such kind of information in Andalusia, where studies about the impact of different means of transport has been done, mainly linked to

infraestructures such as sea ports or airports[1], in some cases making use of the input-output methodology but not of SAM with the different means of transport disaggregated.

Andalusia is an autonomous territory into the Spanish state, located in the south of the Iberian Peninsula. It has a surface of 87.597 square kilometers and in the year 2010 it has a population of 8.370.975 habitants, and active population of 3.969.775 people and an unemployment rate of 27, 97%. The GDP in 2010 reached 143.587,377 million of euros[2].

The study is structured as follows. In the next section we describe the basis of the SAM model as an extension of the Leontief model and that will allow the use of the multipliers theory afterwards. Later on we explain in a nutshell how the SAM has been built up, because it will be used as database for obtaining the results in next sections. In next section the multiplier theory is applied to the MAS model, using as data the SAM of Andalusia of year 2010 with sectors of means of transport disaggregated. Finally, we stated the conclusions and discuss constrains and possible extension of the model.

2. Methodology

Input Output (IO) tables give a detailed account of interindustry transactions in an equilibrium setup in which total supply matches the sum of intermediate and final demand, and they allow a structural analysis of the composition of the economy and the whole productive system. A Social Account Matrix (SAM) improves an IO table by introducing balanced accounts for factors, institutions, and other auxiliary accounts in order to close the process of income distribution and income spending. As Stone (1962) pointed out, a SAM is an efficient and transparent device that presents the circular income flow of an economy over a period of time by means of a square flow matrix. Each row and corresponding column in the matrix provides the resources and uses of an account; accounts represent industries, factors income (labor and capital), institutions, tax instruments, and so forth. Because total resources (income) equal total uses (expenditures) for every account, the information in a SAM can be interpreted, in some

[1] *El Aeropuerto de Málaga, Motor de Desarrollo Económico*, Analistas Económicos de Andalucía, 2007 *Evaluación del Impacto Económico del Puerto de Tarifa*. Universidad de Cádiz, 2009
[2] Source: Instituto de Estadística y Cartografía de Andalucía. Contabilidad Regional de Andalucía (Preliminary data)

cases, through zero benefit conditions, budget constraints, and market clearing equations.

The use of SAM was started by Stone (1964) who first published a SAM for the United Kingdom. SAMs for countries in development were published later on, due to its usefulness to know the cross-sectorial economic links and the income distribution, in order to implement policies to reduce the poverty in these countries.

Among others, it could be underlined the SAMs for Sri Lanka drawn up by Pyatt (1974) due to the boost that it gave to this methodology and to its applications, in particular to the use of the multiplier analysis (Pyatt and Round, 1979). Later on, once the usefulness of the applications of the SAMs was confirmed, the SAMs were also used for developed countries, in many cases to be used with Dynamic General Equilibrium Models (DGEM) together.

SAMs have been already used to perform impact analysis of industrial sectors in the Andalusian economy, like the one for the petrochemical industry (Cardenete and Sancho, 2006) or the one for the Aeronautical Industry (Cardenete and López, 2013).

SAM matrixes can be split in four, each of them with its own meaning:

- Intermediate Consumption Matrix: It gathers the links among all the productive sectors participating in the economy. The columns represent the purchases of one sector to the others. The rows represent the sales of one sector to the others
- Primary Factors Matrix: It gathers the consumption that the productive sectors require from the accounts of labor, capital, social contribution and imports.
- End Use Matrix: It gathers by column the expenditures in the different productive sectors of households, government, savings, investment and exports.
- Closing Matrix: It is the one that added to the previous ones gives as a result the SAM, and makes the difference from the IO tables. This matrix gathers the links between the added value and the final demand, closing the circular flow of the economy. For the households and the administration, the total expenditures in consumption and investment are shown by row. By column the expenditures in final consumption, taxes and savings are shown.

In figure 1 the brief version of the SAM is shown, that in our case it accounts for 33 productive sectors, the 25 original ones where the transport sector has been replaced by 9 new sectors: load transport by road, passenger transport by road, passenger transport by train, load transport by train, high speed train, passenger transport by air, passenger transport by sea, load transport by sea, plus an additional sector covering all the annexed services.

Figure 1. Brief structure of SAMAND2010

	Productive Sectors (1…25)	Productive Factors: - (26) Labour - (27) Capital	Institutions: - (28) Household and institutions - (30) Direct tax - (31) Indirect tax - (32) PPAA (Public Administrations)	(29) Savings/Investment	(33) Foreign Sector
Productive Sectors (1…25)	INTERMEDIATE CONSUMPTION MATRIX (1)	FINAL USE MATRIX (3)			
Productive Factors: - (26) Labour - (27) Capital Institutions: - (28) Household and institutions - (30) Direct tax - (31) Indirect tax - (32) PPAA (Public Administrations) (29) Savings/Investment (33) Foreign Sector	PRIMARY FACTORS MATRIX (2)	CLOSING MATRIX (4)			

Source: Own Elaboration

Table 1. Account structure of SAM of Andalusia in 2010 with means of transport disaggregated

1	Agriculture	22	Transport of passenger by road
2	Cattle	23	Transport of cargo by road
3	Fishery	24	Transport of cargo by train
4	Extractivas	25	Treansport of passenger by train (excluding high speed)
5	Oil refining and treatment of nuclear waste	26	Transport of passenger by high speed train (AVE)
6	Electrical generation and distribution	27	Transport of passenger by air
7	Generation and distribution of gas, steam and hot water.	28	Transport of passenger by sea
8	Water capture, tratment and distribution	29	Transport of cargo by sea
9	Food	30	Activities Annexed to transport, mail and telegraph
10	Fabric and leather	31	Other Services
11	Wood made goods	32	Sale Services
12	Chemistry	33	No Sale Services
13	Mining and foundry	34	Labor
14	Metallic made goods	35	Capital
15	Maquinaria	36	Households and private institutions
16	Vehicles	37	Savings/Investment
17	Building Materials	38	Indirect Tax
18	Transport	39	Direct Tax
19	Other goods	40	Government
20	Building	41	Foreign Sector
21	Commerce		

Source: Own elaboration

The information in a SAM can be used to develop a SAM model in the same way that IO tables are employed to develop IO models.

SAM consist in a *nxn* matrix denoted as $Y=(Y_{ij})$ of income flows among the N accounts in the economy. Some accounts are productive sectors, others are economic actors, such as consumers or institutions, and others are accounts of capital, labor, taxes…in such a way that the account equality of the economy is satisfied: total income equals total expenditure.

Columns show the payments form a sector to the rest of accounts. In the same way rows show the sales of a sector to the rest of accounts. Each component Y_{ij} of the matrix shows the bilateral flow between the account *i (row)* and the account *j (column)*.

The average income flow from account *j* directed to account *i* is $a_{ij} = Y_{ij} / Y_j$, $i, j=1,.., n$. Given this definition, the total income of account *i* can be written as the product of average income flows directed to account *i* multiplied by the corresponding income levels:

$$Y_i = \sum_{j=1}^{n}\left(\frac{Y_{ij}}{Y_j}\right)Y_j = \sum_{j=1}^{m}\alpha_{ij}Y_j + \sum_{j=m+1}^{m+k}\alpha_{ij}Y_j ; m+k=n \qquad (1)$$

Indexes *m* and *k* represent the split of accounts between exogenous and endogenous accounts. Taking into account this split, the average income flow matrix, *A*, can be divided in four: A_{mm}, A_{mk}, A_{km}, y A_{kk}. Y_m and Y_k denote the vectors that represent the total income of the endogenous and exogenous accounts respectively. Then the part of the previous identity referred to the endogenous accounts can be expressed as: $Y_m = A_{mm}\, Y_m + A_{mk}\, Y_k$, and the income vector of the endogenous accounts can then be $Y_m = (I-A_{mm})^{-1}(A_{mk}\, Y_k) = M \cdot Z$, where Z is the vector $A_{mk}\, Y_k$ of exogenous income directed to the endogenous accounts[3] *and* $M = (I- A_{mm})^{-1}$ is the square generalized multiplier matrix, that can be interpreted as the income accruing to account *i* when the vector of exogenous income directed to account *j* increases by just one unit. It has a similar meaning than the Leontieff inverse, with the particularity that when extended to SAM models the links between the production, the factors income, the income distribution and the final demand are taken into account.

The same identity written as a differential equation, where *dZ* denotes the changes in the vector of exogenous accounts[4]:

$$dY_m = MdZ = Md\left(A_{mk}Y_k\right) = MA_{mk}\,dY_k \qquad (2)$$

Which accounts are selected as endogenous and which ones are selected as exogenous depend on the analysis that are being performed, which ones are being explained (endogenous) by changes in others (exogenous). Obviously the solution depends on the partition chosen: the larger the subset of endogenous accounts, the greater the income directed to all accounts when there is a one unit increase in exogenous income directed to the endogenous accounts.

Once the SAM linear model has been established, the same methodology that is used in the Leontieff models is also applied in this analysis, making it applicable also to the linear SAM models.

[3] Submatrix A_{mk} shows how the income flows from the exogenous accounts are shared between the endogenous accounts.

[4] Polo, Roland-Host, y Sancho (1990).

3. Statistical Information

The starting point has been the SAM already drawn up for the Andalusian economy for the year 2010 (Cardenete, 2010). This SAM is an update of the one for the year 2005 (Cardenete, Fuentes & Ordoñez, 2010) done by the cross entropy method. To split the sector *Transport*, it has been used the data from the IO tables for Andalusia in the period 2005[5], as well as the accounts for the satellite sector of tourism for the year 2005[6] and the IO tables for Spain for the year 2005[7]

To split the intermediate consumption of transport sector by columns it has been used data from the transport companies used as proxy[8], and data from the IO tables of Spain and Andalusia of year 2005. The split of the primary consumption of transport sector by columns has been done based on data from the accounts for the satellite sector of tourism and the data from the Spain and Andalusia IO tables from the year 2005. Finally data has been updated to year 2010 based on data from the yearly survey of services in Andalusia for year 2010[9].

To split the demand from productive sectors by rows, it has been used data also from IO tables of Spain and Andalusia of year 2005. The rest of the demand has been estimated also with data from the accounts for the satellite sector of tourism and the data from the Spain and Andalusia IO tables from the year 2005, being pondered to equals total production already estimated when splitting the SAM by columns.

Finally the data of the split of transport sector in SAM of Andalucía of year 2005 is expressed in percentage, and these percentages are applied to SAM of Andalucía of year 2010.

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[5] Marco IO de Andalucía 2005. Instituto de Estadística y Cartografía de Andalucía. *http://www.juntadeandalucia.es/institutodeestadisticaycartografia/institutodeestadisticaycartografia/mioan/mioan2005/index.htm*

[6] CSTA2005 Tablas. Consejería de Turismo y Comercio. Junta de Andalucía. *http://www.juntadeandalucia.es/turismocomercioydeporte/publicaciones/143372506_tablas05.pdf*

[7] Marco IO 2005. Instituto Nacional de Estadística, INE. *http://www.ine.es/daco/daco42/cne00/cneio2000.htm*

[8] Vueling for air transport (Economic report of 2005) and Renfe for transport by train (all types, economic report of 2007)

[9] Encuesta Anual de Servicios 2010. Instituto de Estadística y Cartografía de Andalucía. *http://www.juntadeandalucia.es/institutodeestadisticaycartografia/iea/consultasActividad.jsp?CodOper=831&sub=49873*

It has to be pointed out that the High Speed train (AVE) from Madrid to Malaga started to operate in 2007, and based on the economy of Malaga, where the tourism has an important weight, the demand from other productive sectors and households could be slightly different from the one assumed in the SAM, based on the data of 2005 (IO tables and satellite sector of tourism) when the AVE Madrid Malaga was not still working.

4. Application to the different means of transport in Andalusia and results

Before starting to present the result of the analysis, it has to been clarified that this paper treat about the impact of the different means of transports in the economy, but it does not consider the potential impact of the people and goods transported (tourism) neither the impact in terms of the effect as facilitators to improve the allocation of other sectors or the impact of the construction of the infrastructures. This paper do not have either as an objective to go deeper in the analysis of the strategic sector for the Andalusian economy, in terms of their capability to promote the growth of the economy, the employment or wages, which have been already analyzed in a detailed way in previous works (Cardenete, Mainar and Delgado, 2011).

Labor (34), capital (35) and consumption (36) accounts have been considered as endogenous accounts in order to take into account the circular income inflow of the economy, gathering the feedback effects from the accounts receiving incomes to the rest of sectors.

4.1. Key Sector

The theory of multipliers was started by Stone (1978) and Pyatt and Round (1979), being further developed later on by works as the ones from Defourney and Thorbecke (1984). As any other analysis performed with IO Tables as source, or SAM as this is the case, it starts with the Leontieff (1941) and Ghosh (1958) inverse matrixes. These matrixes can establish the way of how changes in demand or in cost are transmitted to the different sectors of the economy. The capability that a sector has to transmit these effects to the rest of the economy is gathered by two different kinds of linkages, which were drawn up by Rasmussen (1956): the Backward Linkages (*BL*), and the Forward Linkages (*FL*). The backward linkages of a sector are measured by the intensity of its

links with sectors providing inputs, establishing the capability of one sector to spread increases on the demand towards the others sectors, through the inputs required from them. The *FL* is a complement to *BL*, then FL of a sector represents the increase in its output needed to supply the inputs required to produce a unit of the final demand output in the other sectors.

Attending to the values of these linkages the different sectors can be organized in four different categories:

- Key Sectors: are those that to answer to an increase of the demand they require an amount of intermediate inputs higher than the mean of all sectors in the economy. On the other hand and increase in the demand of other sectors also requires inputs from this sector in an amount higher than the mean of all sectors. These sectors can generate a generalized increase of the economic activity.
- Basic sectors: are those that show a demand of inputs from other sectors lower than the mean of all sectors, being mainly the use as inputs by other sectors the destiny of its outputs.
- Promoting sectors: are those that require an amount of inputs higher than the mean of all sectors, but their outputs are not required by other sectors in the same way. These are important sectors as an increase in its demand can promote a more important economic growth than others.
- Independent sectors: are those with forward and backward linkages lower than the mean of all sectors, so they affect and are affected by the other in a lower way that the mean of all sectors.

Table 2: Classification of sectors attending to the Forward and Backward Linkages:

	BL<1	BL>1
FL<1	Independent	Promoting
FL>1	Basic	Key

Source: Own elaboration

In table 3 the classification of the productive sector in terms of key, basic, promoting and independent sectors is shown, for the Andalusian economy, including the transport sector disaggregated in the different means of transport. In this classification the

requirement for BL and FL to classify sectors has been relaxed from 1 to 0.9, in order to not lose those sectors with values of BL and FL close to one but not reaching this value.

Table 3. Classification of key sectors in the Andalusian economy according to the SAM of Andalusia in year 2010, with the means of transport disaggregated.

	Sectors	FL	BL	Type
1	*Agriculture*	0,53	1,25	Promoting
2	*Cattle*	0,36	1,11	Promoting
3	*Fishery*	0,26	0,85	Independent
4	*Extractivas*	4,30	0,89	Base
5	*Oil refining and treatment of nuclear waste*	0,73	0,94	Promoting
6	*Electrical generation and distribution*	0,69	1,05	Promoting
7	*Generation and distribution of gas, steam and hot water.*	0,35	1,18	Promoting
8	*Water capture, tratment and distribution*	0,35	0,97	Promoting
9	*Food*	0,91	0,97	Key
10	*Fabric and leather*	0,37	0,79	Independent
11	*Wood made goods*	0,60	0,70	Independent
12	*Chemistry*	0,70	0,60	Independent
13	*Mining and foundry*	0,53	0,78	Independent
14	*Metallic made goods*	0,44	0,96	Promoting
15	*Maquinaria*	1,10	0,54	Base
16	*Vehicles*	0,39	0,42	Independent
17	*Building Materials*	0,55	0,94	Promoting
18	*Transport*	0,47	1,01	Promoting
19	*Other goods*	0,46	0,90	Promoting
20	*Building*	0,51	1,14	Promoting
21	*Commerce*	1,04	1,15	Key
22	*Transport of passenger by road*	0,27	1,22	Promoting
23	*Transport of goods by road*	0,47	1,03	Promoting
24	*Transport of goods by train*	0,23	1,14	Promoting
25	*Treansport of passenger by train (excluding high speed)*	0,23	2,12	Promoting
26	*Transport of passenger by high speed train (AVE)*	0,23	1,06	Promoting
27	*Transport of passenger by air*	0,23	0,88	Independent
28	*Transport of passenger by sea*	0,23	1,09	Promoting
29	*Transport of goods by sea*	0,23	0,97	Promoting
30	*Activities Annexed to transport, mail and telegraph*	0,79	1,09	Promoting
31	*Other Services*	1,72	1,07	Key
32	*Sale Services*	1,55	1,07	Key
33	*No Sale Services*	0,23	1,25	Promoting

Source: Own elaboration

From previous studies of the Andalusian economy (Cardenete Mainar and Delgado, 2010), the sector of Transportation is classified as backward oriented sector (promoting sector), with a backward linkage over 0,9 and forward linkage of less than 0,9. According to the results of this study, the different means of transportation are kept also as backward oriented (promoting sector) with the exemption of the air transport that is classified as an isolated sector. In this case the due to the organization of the operations of the airlines, the air transport is linked with their related sectors in the economy of

those places where the aircraft are based, and in Spain the main bases are in the airports of Madrid, Barcelona & Palma. In the Andalusian region there are based a few aircraft in Malaga and in Seville in some seasons.

4.2. Multipliers Breakdown

In this paragraph the multipliers are being breaking down in the different effects that are identified in the economy: direct, indirect and induced effects. This methodology is developed from the work of Defourny and Thorbecke (1984) y Pyatt y Round (1985), and from the works of Polo, Roland-Host and Sancho (1991) for the Spanish economy. The use of this methodology allows adding to the links among sectors, the direct and indirect effects, the links between the rents of the primary factors and the final demand from the institutions.

Find here after the different effect in which the multipliers are split off:[10]:

- Direct or own effect effects = (I+A), It weights up the effect on the output of a sector to meet the changes in the final demand.
- Indirect or derived effects = (Ml-I-A), It weights the effect on the output of the rest of the sectors to meet the changes in the final demand of a sector.
- Induced effects = (Ma – Ml), It weights up the effect on the output of the economy due to the increase in the final demand as a consequence of the increase on rents.
- Total Effects= Direct Effects + Derived Effects + Induced Effects. It is the whole effect of a shook of one monetary unit in the sector *j*, and can be written in the following way:

$$\sum_{i=1}^{n} Ma_{ij} = Ma_{1j} + Ma_{2j} + ... + Ma_{nj} \qquad (3)$$

This procedure for breaking down the economy multipliers in the additive sum of three effects, each of one representing one effect in the economy, was stablished by Pyatt and Round (1979). This breaking down of multiplayers has been already used in studies of some sectors in the Andalusian economy, as the one for the petrochemical sector in

[10] I is the identity matrix, A is the matrix of coefficients of expenditure of the institutions (a_{ij}), Ma is the square generalized multiplier matrix and Ml denotes the Leontief inverse matrix.

Andalusia (Cardenete and Sancho, 2006) and the one for the Aeronautical sector in Andalusia (Cardenete and Lopez, 2013). The advantage of using SAM instead of IO tables is the possibility to have a measure of the induced effect, which is a consequence of the links in the circular income flow of the economy, gathering the feedback effects from the accounts receiving income to the rest of the accounts. This is an improvement in the process of obtaining a detailed picture of the economy.

In table 4 the results for the Andalusian economy are shown, including the means of transport as separate sectors, in year 2010.

Table 4. Multipliers break down in the Andalusian economy according to the SAM of Andalusia in year 2010, with the means of transport disaggregated.

	Sectors	Direct Effect	%	Indirect Effect	%	Induced Effect	%	Total Effect
1	*Agriculture*	1,39	45%	0,33	11%	1,40	45%	3,11
2	*Cattle*	1,47	49%	0,42	14%	1,10	37%	3,00
3	*Fishery*	1,49	57%	0,44	17%	0,68	26%	2,61
4	*Extractivas*	1,61	54%	0,83	28%	0,55	18%	2,99
5	*Oil refining and treatment of nuclear waste*	1,73	53%	1,01	31%	0,53	16%	3,27
6	*Electrical generation and distribution*	1,45	48%	0,62	21%	0,94	31%	3,01
7	*Generation and distribution of gas, steam and hot water.*	1,87	49%	1,17	31%	0,81	21%	3,85
8	*Water capture, tratment and distribution*	1,34	52%	0,26	10%	0,97	38%	2,58
9	*Food*	1,57	55%	0,49	17%	0,82	28%	2,89
10	*Fabric and leather*	1,48	60%	0,38	16%	0,59	24%	2,46
11	*Wood made goods*	1,40	63%	0,32	14%	0,51	23%	2,23
12	*Chemistry*	1,35	66%	0,33	16%	0,36	18%	2,04
13	*Mining and foundry*	1,57	58%	0,68	25%	0,45	17%	2,70
14	*Metallic made goods*	1,58	53%	0,63	21%	0,74	25%	2,95
15	*Maquinaria*	1,27	70%	0,19	10%	0,35	19%	1,81
16	*Vehicles*	1,20	78%	0,17	11%	0,18	12%	1,54
17	*Building Materials*	1,54	53%	0,62	21%	0,73	25%	2,89
18	*Transport*	1,60	53%	0,57	19%	0,85	28%	3,02
19	*Other goods*	1,54	57%	0,44	16%	0,73	27%	2,71
20	*Building*	1,62	49%	0,65	20%	1,02	31%	3,29
21	*Commerce*	1,48	50%	0,31	10%	1,20	40%	2,99
22	*Transport of passenger by road*	1,30	44%	0,23	8%	1,40	48%	2,93
23	*Transport of goods by road*	1,31	50%	0,21	8%	1,11	42%	2,63
24	*Transport of goods by train*	1,37	47%	0,32	11%	1,23	42%	2,91
25	*Treansport of passenger by train (excluding high speed)*	1,97	38%	0,83	16%	2,40	46%	5,20
26	*Transport of passenger by high speed train (AVE)*	1,56	52%	0,42	14%	0,99	33%	2,97
27	*Transport of passenger by air*	1,33	56%	0,16	7%	0,88	37%	2,37
28	*Transport of passenger by sea*	1,61	52%	0,50	16%	0,99	32%	3,10
29	*Transport of goods by sea*	1,49	55%	0,30	11%	0,91	34%	2,70
30	*Activities Annexed to transport, mail and telegraph*	1,25	48%	0,12	5%	1,26	48%	2,63
31	*Other Services*	1,24	48%	0,12	5%	1,22	47%	2,58
32	*Sale Services*	1,18	46%	0,13	5%	1,24	49%	2,55
33	*No Sale Services*	1,41	46%	0,23	8%	1,42	46%	3,07

Source: Own elaboration

The multiplayers presented mean how the output of each sector increases when the demand on this sector increases one monetary unit. The results highlight the high values of the transport of passenger by train (excluded the high speed train), making it as the

sector with the highest value, but this is due to the amount of subsidies received. On the other hand the mean of transport with lower values is the air transport, mainly due to the indirect effects, as a consequence of being an isolated sector in the economy, making it as one of the sector with lower values of its multipliers.

4.3. Employment multipliers

The employment multipliers for the Andalusian economy are presented here after. These multipliers take a measure of the effect on the employment when there is a shock in demand.

The employment multiplier for each sector is determined by:

$$E_j = \sum_{i=1}^{n} w_{n+1} b_{ij} \qquad (3)$$

Where $w_{n+1} = Y^{e_i} / X_i$, Y^{e_i} is the employment per sector, X_i is the total output of sector i.

and b_{ij}, is the element in position ij in the matrix of multipliers M which has been got from the SAM.

In table 5 the figures for the Andalusian economy are shown, ordered by total effects, and in table 6 the same data ordered by relative effects: indirect and induced effects per direct effect.

For each sector the employment multiplier means the employment increase when the demand increases in 1000 euro.

The employment multipliers are going to be analyzed from two different points of view. The first one is from it absolute value (see table 5), the second one from the capability of each sector to create indirect and induced employment per each direct employment generated (see table 6), as it is a parameter that sometimes is used to evaluate the quality of the employment created by one activity.

Table 5. Additive break down of employment multipliers in the Andalusian economy in year 2010, with sectors of means of transport disaggregated.

	Sectores	Direct Effect	Relative	%	Indirect Effect	Relative	%	Induced Effect	Relative	%	Total Effect	Relative
1	*Agriculture*	0,0140	1,00	53%	0,0026	0,19	10%	0,0097	0,69	37%	0,0263	1,88
2	*Cattle*	0,0158	1,00	58%	0,0039	0,25	14%	0,0076	0,48	28%	0,0273	1,73
3	*Fishery*	0,0153	1,00	64%	0,0038	0,25	16%	0,0047	0,31	20%	0,0238	1,55
4	*Extractivas*	0,0051	1,00	41%	0,0036	0,70	29%	0,0038	0,74	30%	0,0124	2,44
5	*Oil refining and treatment of nuclear waste*	0,0180	1,00	69%	0,0045	0,25	17%	0,0037	0,21	14%	0,0262	1,46
6	*Electrical generation and distribution*	0,0142	1,00	59%	0,0033	0,23	14%	0,0065	0,46	27%	0,0239	1,69
7	*Generation and distribution of gas, steam and hot water.*	0,0235	1,00	68%	0,0053	0,23	15%	0,0056	0,24	16%	0,0344	1,46
8	*Water capture, tratment and distribution*	0,0108	1,00	55%	0,0021	0,20	11%	0,0067	0,63	34%	0,0196	1,82
9	*Food*	0,0195	1,00	66%	0,0046	0,24	15%	0,0057	0,29	19%	0,0298	1,53
10	*Fabric and leather*	0,0153	1,00	66%	0,0036	0,24	16%	0,0041	0,27	18%	0,0230	1,50
11	*Wood made goods*	0,0131	1,00	67%	0,0029	0,22	15%	0,0035	0,27	18%	0,0195	1,49
12	*Chemistry*	0,0114	1,00	71%	0,0022	0,19	14%	0,0025	0,22	15%	0,0161	1,41
13	*Mining and foundry*	0,0152	1,00	69%	0,0038	0,25	17%	0,0031	0,21	14%	0,0222	1,46
14	*Metallic made goods*	0,0192	1,00	66%	0,0046	0,24	16%	0,0052	0,27	18%	0,0289	1,51
15	*Maquinaria*	0,0077	1,00	66%	0,0015	0,19	13%	0,0024	0,31	21%	0,0116	1,50
16	*Vehicles*	0,0060	1,00	71%	0,0013	0,21	15%	0,0012	0,21	15%	0,0085	1,42
17	*Building Materials*	0,0165	1,00	66%	0,0036	0,22	14%	0,0050	0,30	20%	0,0251	1,52
18	*Transport*	0,0194	1,00	64%	0,0050	0,26	16%	0,0059	0,30	19%	0,0303	1,56
19	*Other goods*	0,0177	1,00	67%	0,0038	0,21	14%	0,0050	0,28	19%	0,0266	1,50
20	*Building*	0,0205	1,00	63%	0,0049	0,24	15%	0,0070	0,34	22%	0,0324	1,58
21	*Commerce*	0,0131	1,00	54%	0,0027	0,21	11%	0,0083	0,63	34%	0,0241	1,84
22	*Transport of passenger by road*	0,0226	1,00	66%	0,0017	0,07	5%	0,0097	0,43	29%	0,0340	1,50
23	*Transport of goods by road*	0,0194	1,00	68%	0,0016	0,08	6%	0,0077	0,39	27%	0,0287	1,48
24	*Transport of goods by train*	0,0157	1,00	59%	0,0026	0,16	10%	0,0085	0,54	32%	0,0268	1,71
25	*Treansport of passenger by train (excluding high speed)*	0,0358	1,00	61%	0,0067	0,19	11%	0,0166	0,46	28%	0,0591	1,65
26	*Transport of passenger by high speed train (AVE)*	0,0082	1,00	44%	0,0037	0,45	20%	0,0069	0,83	36%	0,0188	2,29
27	*Transport of passenger by air*	0,0077	1,00	51%	0,0014	0,18	9%	0,0061	0,79	40%	0,0151	1,98
28	*Transport of passenger by sea*	0,0135	1,00	57%	0,0035	0,26	15%	0,0069	0,51	29%	0,0238	1,77
29	*Transport of goods by sea*	0,0083	1,00	49%	0,0025	0,31	15%	0,0063	0,75	37%	0,0171	2,06
30	*Activities Annexed to transport, mail and telegraph*	0,0103	1,00	52%	0,0010	0,10	5%	0,0087	0,84	43%	0,0200	1,94
31	*Other Services*	0,0085	1,00	48%	0,0010	0,11	5%	0,0085	0,99	47%	0,0180	2,10
32	*Sale Services*	0,0066	1,00	41%	0,0010	0,15	6%	0,0086	1,30	53%	0,0162	2,45
33	*No Sale Services*	0,0099	1,00	46%	0,0020	0,20	9%	0,0098	0,99	45%	0,0216	2,19

Source: Own elaboration

If the employment multipliers are analyzed from their absolute value point of view, (25) *Transport of passengers by train* is the one among all the sectors with the highest value. This is a consequence of their high output multiplier due to the subventions. Excluding this transport mean, because it is an outsider, the means of transport with highest multipliers are (22) y (23) *Transport by road* (with highest values for the transport of passenger than for the transport of loads) and (24) *Transport of loads by train*. (28) *Transport of passengers by sea* is in an intermediate position and the lower positions with poor values of the multipliers are the (26) *High speed train (AVE)*, (27) *Air transport* and (29) *Load transport by sea*. These have values around half of those for the road transport, (22) and (23). This means that the demand to create employment is higher for (26) *High speed train (AVE)* and *(27) Air transport* than the required for road transport, (22) and (23), for example.

Table 6. Additive break down of employment multipliers in the Andalusian economy in year 2010, with sectors of means of transport disaggregated.

	Sectors	Direct Effect	Relative	%	Indirect Effect	Relative	%	Induced Effect	Relative	%	Total Effect	Relative
32	*Sale Services*	0,0066	1,00	41%	0,0010	0,15	6%	0,0086	1,30	53%	0,0162	2,45
4	*Extractivas*	0,0051	1,00	41%	0,0036	0,70	29%	0,0038	0,74	30%	0,0124	2,44
26	*Transport of passenger by high speed train (AVE)*	0,0082	1,00	44%	0,0037	0,45	20%	0,0069	0,83	36%	0,0188	2,29
33	*No Sale Services*	0,0099	1,00	46%	0,0020	0,20	9%	0,0098	0,99	45%	0,0216	2,19
31	*Other Services*	0,0085	1,00	48%	0,0010	0,11	5%	0,0085	0,99	47%	0,0180	2,10
29	*Transport of goods by sea*	0,0083	1,00	49%	0,0025	0,31	15%	0,0063	0,75	37%	0,0171	2,06
27	*Transport of passenger by air*	0,0077	1,00	51%	0,0014	0,18	9%	0,0061	0,79	40%	0,0151	1,98
30	*Activities Annexed to transport, mail and telegraph*	0,0103	1,00	52%	0,0010	0,10	5%	0,0087	0,84	43%	0,0200	1,94
1	*Agriculture*	0,0140	1,00	53%	0,0026	0,19	10%	0,0097	0,69	37%	0,0263	1,88
21	*Commerce*	0,0131	1,00	54%	0,0027	0,21	11%	0,0083	0,63	34%	0,0241	1,84
8	*Water capture, tratment and distribution*	0,0108	1,00	55%	0,0021	0,20	11%	0,0067	0,63	34%	0,0196	1,82
28	*Transport of passenger by sea*	0,0135	1,00	57%	0,0035	0,26	15%	0,0069	0,51	29%	0,0238	1,77
2	*Cattle*	0,0158	1,00	58%	0,0039	0,25	14%	0,0076	0,48	28%	0,0273	1,73
24	*Transport of goods by train*	0,0157	1,00	59%	0,0026	0,16	10%	0,0085	0,54	32%	0,0268	1,71
6	*Electrical generation and distribution*	0,0142	1,00	59%	0,0033	0,23	14%	0,0065	0,46	27%	0,0239	1,69
25	*Treansport of passenger by train (excluding high speed)*	0,0358	1,00	61%	0,0067	0,19	11%	0,0166	0,46	28%	0,0591	1,65
20	*Building*	0,0205	1,00	63%	0,0049	0,24	15%	0,0070	0,34	22%	0,0324	1,58
18	*Transport*	0,0194	1,00	64%	0,0050	0,26	16%	0,0059	0,30	19%	0,0303	1,56
3	*Fishery*	0,0153	1,00	64%	0,0038	0,25	16%	0,0047	0,31	20%	0,0238	1,55
9	*Food*	0,0195	1,00	66%	0,0046	0,24	15%	0,0057	0,29	19%	0,0298	1,53
17	*Building Materials*	0,0165	1,00	66%	0,0036	0,22	14%	0,0050	0,30	20%	0,0251	1,52
14	*Metallic made goods*	0,0192	1,00	66%	0,0046	0,24	16%	0,0052	0,27	18%	0,0289	1,51
15	*Maquinaria*	0,0077	1,00	66%	0,0015	0,19	13%	0,0024	0,31	21%	0,0116	1,50
22	*Transport of passenger by road*	0,0226	1,00	66%	0,0017	0,07	5%	0,0097	0,43	29%	0,0340	1,50
10	*Fabric and leather*	0,0153	1,00	66%	0,0036	0,24	16%	0,0041	0,27	18%	0,0230	1,50
19	*Other goods*	0,0177	1,00	67%	0,0038	0,21	14%	0,0050	0,28	19%	0,0266	1,50
11	*Wood made goods*	0,0131	1,00	67%	0,0029	0,22	15%	0,0035	0,27	18%	0,0195	1,49
23	*Transport of goods by road*	0,0194	1,00	68%	0,0016	0,08	6%	0,0077	0,39	27%	0,0287	1,48
7	*Generation and distribution of gas, steam and hot water.*	0,0235	1,00	68%	0,0053	0,23	15%	0,0056	0,24	16%	0,0344	1,46
5	*Oil refining and treatment of nuclear waste*	0,0180	1,00	69%	0,0045	0,25	17%	0,0037	0,21	14%	0,0262	1,46
13	*Mining and foundry*	0,0152	1,00	69%	0,0038	0,25	17%	0,0031	0,21	14%	0,0222	1,46
16	*Vehicles*	0,0060	1,00	71%	0,0013	0,21	15%	0,0012	0,21	15%	0,0085	1,42
12	*Chemistry*	0,0114	1,00	71%	0,0022	0,19	14%	0,0025	0,22	15%	0,0161	1,41

Source: Own elaboration

When the employment multipliers are analyzed from the point of view of their capability to create indirect and induced employment, then the results are different (this is a different approach). Then their position change, and the higher positions in the table are occupied by (26) *High speed train (AVE),* (28) *Transport of goods by sea* and (27) *Air transport*, and the means of transport by road (22) and (23) are in the lower positions. (27) *Air transport* and (29) *Sea transport of load* can create one additional employment per direct employment, and (26) *High speed train* even more than one, mainly due to the induced employment. This could be taken as a measure of the quality of the employment.

4.4. Salary multipliers

The notion is the same than the employment multipliers, but in this case the multiplier shows the effect of a shock in the end demand in terms of salaries.

The salary multiplier for each sector is determined by:

$$S_j = \sum_{i=1}^{n} s_{n+1} b_{ij} \qquad (4)$$

Where $s_{n+1} = W^{e_i} / X_i$, W^{e_i} is the salary per sector, X_i is total output total of sector i. and b_{ij}, is the element in position ij in the matrix of multipliers M which has been got from the SAM.

In table 7 are shown the figures for the Andalusian economy

For each sector the salary multiplier means the increase on salaries in the whole economy when the demand for the sector increases the amount of one euro.

Table 7. Salary multipliers in the Andalusian economy in year 2010, with sectors of transport means disaggregated.

	Sectors	Total Effect
25	*Treansport of passenger by train (excluding high speed)*	1,51
33	*No Sale Services*	0,74
24	*Transport of goods by train*	0,69
22	*Transport of passenger by road*	0,67
31	*Other Services*	0,62
23	*Transport of goods by road*	0,53
30	*Activities Annexed to transport, mail and telegraph*	0,51
21	*Commerce*	0,49
28	*Transport of passenger by sea*	0,49
27	*Transport of passenger by air*	0,48
1	*Agriculture*	0,44
20	*Building*	0,44
18	*Transport*	0,44
29	*Transport of cargo by sea*	0,42
26	*Transport of passenger by high speed train (AVE)*	0,41
8	*Water capture, tratment and distribution*	0,39
32	*Sale Services*	0,37
2	*Cattle*	0,37
14	*Metallic made goods*	0,35
19	*Other goods*	0,32
9	*Food*	0,31
7	*Generation and distribution of gas, steam and hot water.*	0,30
17	*Building Materials*	0,29
3	*Fishery*	0,29
6	*Electrical generation and distribution*	0,26
10	*Fabric and leather*	0,26
4	*Extractivas*	0,23
11	*Wood made goods*	0,21
5	*Oil refining and treatment of nuclear waste*	0,21
13	*Mining and foundry*	0,19
15	*Maquinaria*	0,17
12	*Chemistry*	0,14
16	*Vehicles*	0,09

Source: Own elaboration

All the different means of transport are relevant when the salary multipliers are compared. All of them are among the most important ones generating salary income. Excluding (25) *Transport of passenger by train (excluding high speed)*, the sectors with higher values are (24) *Transport of goods by train* and (22) *Transport of passenger by road*. The sectors (26) *Transport of passenger by high speed train (AVE)* and (27) *Transport of passenger by air* have lower values, but with better figures for the air transport.

4.5. Global impact of different means of transport

In order to have a measure of the global impact of each mean of transport in the economy of Andalusia, it has been performed a series of simulations. Taking advantage of the linear SAM model, with the SAM of Andalusia of year 2010 with the means of transport disaggregated, it has been performed one simulation per mean of transport taking a contra factual scenario with a shock of minus the total output of the corresponding mean of transport. The result obtained are shown in the table 8

Table 8. Impact of the means of transport in the economy of Andalusia in 2010.

Sector	Mean of transport	Shock	Impact	% GDP
22	Transport of passenger by road	-882.341	-2.586.746	1,80%
23	Transport of cargo by road	-3.826.187	-10.048.013	7,00%
24	Transport of cargo by train	-34.997	-101.937	0,07%
25	Treansport of passenger by train (excluding high speed)	-24.729	-128.637	0,09%
26	Transport of passenger by high speed train (AVE)	-250.411	-744.869	0,52%
27	Transport of passenger by air	-163.768	-388.770	0,27%
28	Transport of passenger by sea	-67.214	-208.407	0,15%
29	Transport of cargo by sea	-68.197	-184.034	0,13%

Source: Own elaboration

As it can be shown (22) *Transport by road* has the highest impact in the economy, much higher for (23) *Transport of goods* than (22) *Transport of passengers*. In fact the impact of the rest of means of transport of cargo is negligible compared with (23) *Transport of cargo by road*.

Regarding the transport of passengers, (22) *Transport by road* has the higher value, reaching 1,8%, followed by (26) *AVE*, that reaches 0,52% doubling the impact of (27) *Air transport*, 0,27%, and almost four times (28) *Transport by sea*, 0,15%.

5. Conclusions

As a result of this work it is highlighted how the importance of the different means of transport in the economy of Andalusia is very different from one to the others, therefore how interesting is to have data with the means of transport disaggregated. It is necessary to be aware about this qualitative and quantitative data in order to measure the impact of any shock that could affect to the demand of these means of transport as the impact will be different depending on the mean of transport. The policy makers should be aware about the different effects of promoting one mean instead of others, or if there is no alternative, at least to evaluate the impact in the economy in order to have more data to evaluate the efficiency of investing in infrastructures of transport or policies to favor the demand.

Table 9. Summary of multipliers of the means of transport in the economy of Andalusia in 2010.

		Multipliers			
		TotalOutput	Total Employment	Relative Total to Direct Employment	Labor Income
22	Transport of passenger by road	2,93	0,034	1,5	0,67
23	Transport of cargo by road	2,63	0,0287	1,48	0,53
24	Transport of cargo by train	2,91	0,0268	1,71	0,69
26	Transport of passenger by high speed train (AVE)	2,97	0,0188	2,29	0,41
27	Transport of passenger by air	2,37	0,0151	1,98	0,48
28	Transport of passenger by sea	3,1	0,0238	1,77	0,49
29	Transport of cargo by sea	2,7	0,0171	2,06	0,42

upper third of the multipliers amplitude
lower third of the multipliers amplitude
middle third of the multipliers amplitude
Maximun /Minimum values

(25) Transport of passenger by train (excluding high speed) not being considered

Source: Own elaboration

Regarding the transport of loads, when comparing transport for load by train and by road, because they both are two means of transport that can compete in some cases, it can be highlighted how it would be preferred the transport by train over the transport by road, in terms of total and salaries multipliers, only being preferable the transport by road in terms of employment multipliers due to the fact that is a sector more intensive in labor. Transport of goods by sea, cannot always compete with train and road, anyway it has better performance in terms of induced employment and lower performance in terms of salaries and labor multipliers.

When focusing on the transport of passengers, if it is preferred to favor an increase of the total output of the economy it should be interesting to invest in policies which increase the demand of transport of passenger by sea, if not AVE or by road, and in any case the air transport should not be favored. In case that the aim is to favor the creation of employment, then the transport by road is the mean that offers better results, but the air transport is the one that offers the poorest results, but it has also to be taken into account that once direct employment has been created, then air transport capability to generate indirect and induced employment is higher than the road transport, but still lower than the AVE. Finally, if the labor income is favored then the road transport demand should be improved.

Also in the transport of passengers, it has to be taken into account that in some cases the means of transport are not substitutive, so it cannot be favored one mean in detriment of another: transport of passenger by road cannot be compared with AVE or air transport due to time of the trip. Sea transport cannot compete with road transport as not all destines have a port. But sometimes the means of transport enters into competition, is when they also compete for the investment on infrastructures that allow an increase in the demand or even the creation of this one. One typical case is the competition between AVE and air transport. In the case of Andalusia, in the routes where the two means of transports enter into competition, AVE has better impact in the economy in terms of the total output of the economy (multiplier is 25% higher) and the creation of employment (multiplier is also 25% higher), also in the creation of indirect and induced employment per direct employment generated (0,31 employments more per direct employment, what means 32% more). Only the Air transport offers a better component in creating labor income (air transport multiplier is 17% higher that AVE). It seems that in the case of Andalusia in 2010 in the case of routes where the transport of passengers by air and by AVE are competing, the impact of AVE in the economy is better that the impact of the air transport

As has been already pointed out at the beginning of this paragraph, the results of this exercise are potentially useful for extending the, sometimes deficient, information about the impact of favoring the demand of the different means of transport, mainly when they are competing for the investment in the required infrastructures to do it.

In this respect, an interesting extension of this research could be to make an approach by using other models such as AGEM (Applied General Equilibrium Models) which are much more elaborated and could provide with more accurate information. Additionally, these analyses can also be improved when the information available would allow updated data for the MAS.

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