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A price model to assess the effects of European Regional Development Fund in Andalusia

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ABSTRACT

Social Accounting Matrices (SAM) are databases that complete the information provided by the input-output tables. They study the intersectoral relationships of an economy, the behaviour of consumers, the government or the foreign sector, while being able to close the income flow of rent. In this work, we deal with the European Regional Development Fund (ERDF) in Andalusia, a Spanish region classified as Objective 1 by the European Regional policy. We apply the Leontief model on the SAM for 1990, 1995 and 1999 to get the gross output fall when we remove these regional funds. Furthermore, we develop a price model to assess the impact of this financial support on aggregate and sectoral prices.

Keywords: social accounting matrix, regional accounting, structural analysis, Structural Fund.

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1. Introduction

Social Accounting Matrices (SAM) are databases that enlarge the information provided by the input-output tables with statistical information coming from the survey of family budgets, or the national or regional accounting, among other sources. The SAM can behave as an instrumental for the impact analysis of certain exogenous shocks. Furthermore, we can derive some analysis where several SAM are involved. Such is the case of the present work, where we evaluate the effects of a public policy as the European funding in the Andalusian economy.

The European Regional Development Fund (ERDF) is a European Structural fund that works on physical capital to promote regional development. It is a very important part of the Community Support Framework (CSF) that deals with the so called European Financial Perspectives where the national government and the European Commission establish priority axes and financial endowments for the economic and social development of poor regions or countries in the EU. The first CSF covered the period 1989-93, the second one, lapses from 1994 to 1999, the third one covered 2000 to 2006, and finally, a new one has been recently approved for 2007-13.

In this paper we work with three different databases: the SAM for 1990, 1995 and 1999 to carry out an impact analysis of the ERDF in terms of ouput fall and prices. Each of our three databases is used for the impact assessment of a representative year of the corresponding CSF. In short, our work applies the Leontief theory on the three SAM by means of a counterfactual analysis that consists on comparing two different scenarios: the initial one where the European transfers are part of the Andalusian final demand, and the hypothetical one where the funds are dropped of the regional economy.

The SAM are databases habitually used in applied general equilibrium models to study the nature of the economic interrelations in an economy, satisfying the optimality conditions in the behavior of the agents, the technological feasibility and the restrictions in terms of productive factors. In this case we present a SAM linear model where we study the effects on prices of the funds removal for every year of the simulation.

As regards the structure of the paper, in the second section we outline the Leontief model applied to our SAM and we calculate the output fall derived from the change in the final demand when funds are removed. The third section presents the price model and the main results in terms of aggregate and sectoral prices and also an approximation to the consumer's welfare. We finish with some conclusions.

2. The Leontief model and the output fall.

As regards the structure of the SAM we are working with, they have been performed for 1990 and 1995. We work with one more matrix, an approach to 1999 by means of an updating technique called *Cross Entropy Method (CEM)* applied on the SAM for 1995. Our three databases have been added to 16 accounts. We define as endogenous accounts the two productive factors (accounts "Labour (11)", and "Capital (12)"), the private sector represented by the "Consumers (13)", and finally ten activity sectors, accounts from (1) to (10). Our exogenous accounts, following the most common approaches in the literature are three: the "Savings and investment (14)", the "Government (15)" and the "Foreign sector (16)".

The formulation of the Leontief linear model is based on the equation:

$$y_n = \left(I - A_n\right) \cdot x \tag{1}$$

where y_n is the vector of final demand, I is an identity matrix of order n x n, An is the input-output average tendency matrix of expenditure between the different endogenous accounts and x is the vector of sectoral output. A generic element of An as a_{ij} is interpreted as the expense carried out in i per each unit of expense of the sector j.

As we are working with SAM, we use the Ma instead of An; Ma being the so called Accounting Multipliers Matrix. An element ma_{ij} shows the effect that an exogenous unit of rent of an endogenous account j, generates on the rent of the endogenous account i. In other words, the interpretation would be how many monetary units of rent are generated in sector i because of the circular flow of rent when sector j receives a unitary shock. If we sum up these values of Ma by columns, we get the total effect of an exogenous shock received by one account on the rest of the economic activity.

$$y_n = (I - Ma) \cdot x \tag{2}$$

Solving for x:

$$x = (I - Ma)^{-1} y \tag{3}$$

Suppose an averse shock experienced by the exogenous accounts like the drop of the ERDF. From expression (3), a change in the final demand will cause an immediate change in the total output[1]:

$$\Delta x = (I - Ma)^{-1} \Delta y \qquad (4)$$

Therefore, we can perform a simulation where the European funds are not received by the Andalusian economy, by decreasing the final demand in the amount of the funds that have been previously distributed into the different accounts of the SAM. We work with the financing priorities approved in the three CSF that have been designed from the regional policy of the European Union. The CSF are pluriannual documents for the economic promotion of a region, establishing priorities in the region and financial endowments for the different actions. The first CSF covers the period 1989-93, the second lapses from 1994 to 1999 and the third one has just finished, the one of 2000-06. These are the three simulations we are going to perform and each of the matrices of this exercise (SAM-1990, SAM-1995 and SAM-1999) will help us to approach to one of these frameworks.

If we want to outline the regional output explained by this fund, we must have information about ERDF received in Andalusia and its distribution among the different activity sectors. The allotment rules that we have design containing this information as well as the annualized amounts of funds for 1990, 1995 and 1999, are presented in Lima and Cardenete (2005).

The following tables show the results of the simulation where we drop the ERDF from Andalusian economy. In Table 1 we can see the figures for 1990. The two first columns deal with the final demand (FD) and sectoral output (SO) for the ten productive sectors before the

[1] For further information about the Leontief model, see for example, Pulido and Fontela (1993).

simulation. If we reduce the final demand in the amount of the ERDF sector by sector, we get the new vector FD'. In aggregate terms these financing corresponds with 55.294, 81.499 and 145.779 million pesetas, figures that result from the annualization of the CSF for each of our reference years.

Table 1: Final demand (FD) and sectoral output (SO) fall for 1990 when funds are removed.(in million pesetas and percentage terms)

Productive Sectors	1990					
	With Funds		Funds Removed			
	FD	SO	FD'	SO'	FD % fall	SO % fall
1 Agriculture, cattle & forestry..	280.553	1.038.670	278.882	1.030.343	-0,60%	-0,80%
2 Extractives	258.160	883.368	258.160	877.823	0,00%	-0,63%
3 Electricity and natural gas	16.683	386.396	16.683	383.010	0,00%	-0,88%
4 Manufacturing industry	1.773.252	5.528.349	1.769.930	5.483.585	-0,19%	-0,81%
5 Construction	1.048.600	1.268.003	1.007.684	1.225.025	-3,90%	-3,39%
6 Commerce	130.331	2.214.215	128.671	2.191.691	-1,27%	-1,02%
7 Transport and Comunications	32.429	978.470	32.429	968.333	0,00%	-1,04%
8 Other services	646.861	1.979.708	639.983	1.959.000	-1,06%	-1,05%
9 Commercial Services	0	606.234	0	600.331	0,00%	-0,97%
10 Non-commercial services	346.956	351.192	346.110	350.309	-0,24%	-0,25%

Source: Own elaboration.

As we can see in Table 1, the ERDF means a sectoral percentage fall of about a 4% in final demand of "Construction (5)", a 1.27% fall in "Commerce (6)" and a 1.06% fall in "Other services (8)". As regards the output behaviour, we can see how some sectors that did not initially receive an averse shock because of the funds, show a decreasing value as the circular flow of income works. An example of this behaviour is the case of "Extractives (2)", "Electricity and natural gas (3)", "Transports and Comunications (7)" and "Commercial services (9)". The sectors with an elastic behaviour when the final demand changes, are the "Manufacturing industry (4)" and "Agriculture, cattle and forestry (1)". These two sectors are the ones that reflect a higher incidence of European funding on the Andalusian economy.

Table 2: Final demand (FD) and sectoral output (SO) fall for 1995 when funds are removed.(in million pesetas and percentage terms)

Productive Sectors	1995					
	With Funds		Funds Removed			
	FD	SO	FD'	SO'	FD % fall	SO % fall
1 Agriculture, cattle & forestry..	491.672	1.434.885	491.597	1.428.005	-0,02%	-0,48%
2 Extractives	28.653	468.086	28.653	464.088	0,00%	-0,85%
3 Electricity and natural gas	465	542.310	465	537.432	0,00%	-0,90%
4 Manufacturing industry	2.987.917	7.792.697	2.985.264	7.736.022	-0,09%	-0,73%
5 Construction	1.521.043	2.025.719	1.467.334	1.959.079	-3,53%	-3,29%
6 Commerce	357.468	3.419.619	353.056	3.388.633	-1,23%	-0,91%
7 Transport and Comunications	235.913	1.259.954	235.913	1.249.898	0,00%	-0,80%
8 Other services	1.148.408	2.873.148	1.132.230	2.839.639	-1,41%	-1,17%
9 Commercial Services	37.610	1.196.951	37.610	1.186.657	0,00%	-0,86%
10 Non-commercial services	779.736	816.062	775.262	811.305	-0,57%	-0,58%

Source: Own elaboration.

We repeat the simulation for 1995, the results for this year are shown in Table 2. The sectors tha concentrate the biggest amounts of funds are again “Construction (5)” and some services branches as “Commerce (6)”, “Other servicies (8)” and “Non-commercial services (10)”. Again, the circular flow of income makes the whole output vector changes even though some sector did not initially receive an exogenous shcok in their final demand. The sector with an elasticity os output with respect to final demand over one are “Manufacturing industry (4)” and “Agriculture, cattle and forestry (1)” as in 1990. The “Construction (5)” and “Non-commercial services (10)”, behave around one.

Table 3: Final demand (FD) and sectoral output (SO) fall for 1999 when funds are removed. (in million pesetas and percentage terms)

Productive Sectors	1999					
	With Funds		Funds Removed			
	FD	SO	FD'	SO'	FD % fall	SO % fall
1 Agriculture, cattle & forestry..	936.362	1.300.079	928.440	1.287.624	-0,85%	-0,96%
2 Extractives	27.697	115.324	27.697	114.433	0,00%	-0,77%
3 Electricity and natural gas	1.120	484.517	970	477.368	-13,45%	-1,48%
4 Manufacturing industry	3.209.741	4.999.769	3.199.914	4.969.198	-0,31%	-0,61%
5 Construction	2.499.019	2.865.800	2.490.055	2.854.535	-0,36%	-0,39%
6 Commerce	551.858	3.339.925	506.614	3.255.514	-8,20%	-2,53%
7 Transport and Comunications	471.605	1.300.845	471.605	1.289.540	0,00%	-0,87%
8 Other services	1.573.621	4.051.016	1.535.003	3.976.758	-2,45%	-1,83%
9 Commercial Services	39.746	1.923.902	39.746	1.897.159	0,00%	-1,39%
10 Non-commercial services	1.309.418	1.455.938	1.309.418	1.454.071	0,00%	-0,13%

Source: Own elaboration.

In Table 3 we can see that the sectors that receive important amounts from the European Commission are “Electricity and natural gas (3)”, “Commerce (6)” and “Other services (8)”. Furthermore, those sectors with a bigger elasticity of output with respect to final demand changes are “Agriculture, cattle and forestry..(!)”, “Manufacturing industry (4)”, “Commercial services (9)” and even “Extractives (2)”.

3. Price formation

Given the production structure of the economy, the production prices behave following a standard average cost rule as follows:

$$PP_j = (1+IP_j) \; *\Big(\sum_{i=1}^{10} *a_{i,j} + w*L_j + r*K_j + M_j *prm \Big) \qquad (5)$$

The notation for the previous equation follows:

PP_j : production price of sector j.

IP_j : Ad Valorem Tax of sector j.

P_i : final price of sector j.

$a_{i,j}$: input-output technical coefficients.

w : wage rate.

L_j : labour technical coefficients of sector j.

r : capital services rate.

K_j : capital technical coefficients of sector j.

M_j : technical coefficients for foreign good j.

prm : price of imported good j.

The calibration of the technical coefficients $a_{i,j}$,$L_{j,}$, K_j ,and M_j is a calculation using the information contained in the three Social Accounting Matrices as follows:

$$a_{i,j} = SAM(i, j)/X_j; \quad (6)$$

$$L_{j,} = SAM("11",j)/X_j; \quad (7)$$

$$K_j = SAM("12",j)/X_j \quad (8)$$

$$Mj = SAM("16",j)/X_j \quad (9)$$

We use a calculation of the indirect taxation as an effective tax rate, that is, including the information registers in the SAM:

$$IP_j = SAM("15", j)/(X_j - SAM("15", j)); \quad (10)$$

The production prices or unitary costs, final prices and wages are endogenous. We also work with a Consumer Price Index (cpi) as a basket of goods defined as follows:

$$cpi = \sum_{i=1}^{10} P_i * (SAM(i, "13")/ \sum_{j=1}^{16} SAM(j,"13")) \quad (11)$$

We consider that capital and foreign prices are exogenous in our model and fixed at unitary levels.

Although we do not have a utility function for the consumers, we can obtain an approximation to the influence of the funds on individual welfare for a representative consumer. We compute the expenditure change ΔE associated to the cost of a typical basket of consumption goods:

$$\Delta E = (P-P')*C \qquad (12)$$

p and *p'* being vectors that stand for the original and after simulation final prices and C the typical basket of consumption goods. A positive result means an increase of welfare for the consumer and a negative result means a worsening. With some algebraic manipulation, and the fact that nominal income stays constant throughout, that is $P' *C' - P *C = 0;$ we can show that we are close to the concept of Compensating Variation welfare measure:

$$CV = P' * (C'-C) = P' * (C'-C) + P *C - P *C = (P-P')*C + P' *C' - P *C = (P-P')*C = \Delta E \qquad (13)$$

3.1 Price effects of the ERDF on the Andalusian economy.

In the following tables, we present the change on sectoral output and final prices if we assume the fall of output when funds are removed from Andalusian economy:

Table 4: Sectoral output fall and sectoral prices changes when IP is considered as a constant, P'(IP), and when IP changes, P'(IP'), for the three simulation periods 1990, 1995 and 1999.

Productive Sectors	1990		1995		1999	
	P' con IP cont	P' con IP var	P' con IP cont	P' con IP var	P' con IP cont	P' con IP var
1 Agriculture, cattle & forestry..	0,970	0,997	0,998	0,994	0,996	0,996
2 Extractives	1,130	1,006	1,004	1,006	1,004	1,004
3 Electricity and natural gas	1,079	1,001	1,001	1,004	1,007	1,007
4 Manufacturing industry	0,990	1,001	1,001	1,003	1,004	1,004
5 Construction	0,934	1,013	1,010	1,022	0,963	0,961
6 Commerce	0,914	0,989	0,990	0,994	1,003	1,005
7 Transport and Comunications	0,928	0,987	0,988	0,994	0,989	0,989
8 Other services	0,757	0,958	0,961	0,978	0,962	0,962
9 Commercial Services	0,957	0,998	0,998	0,998	0,998	0,998
10 Non-commercial services	0,678	0,935	0,939	0,970	0,938	0,935

Source: Own elaboration.

Table 4 shows the sectoral prices fall under two different scenarios, the one with constant production taxes after the output fall (Simulation 1)and the one with a new vector of indirect taxes as a consequence of the new output (Simulation 2). Lets start with Simulation 1. The sectoral prices were initially fixed with a value of 1 to make easy comparisons, so the figures over 1 show a price growth and the figures below 1 show a price fall. For the first year, our model show a 7% of total price fall. There are only two sectors that increase their prices: "Extractives (2)" and "Electricity and natural gas (3)". There is a group of accounts that change very little their prices while some services register a big fall. For 1995, the prices behave as in the initial case in aggregate terms but if we look figure by figure, we find that accounts "2" to "5" have values bigger than 1 while there is a slight fall in all the services accounts. A similar behaviour is shown in 1999 prices.

In Simulation 2, there are not important falls in aggregate terms but we can distinguish two clear and different behaviours: the one of second sector accounts where prices tend to increase and the one of primary sectors and services accounts where there is a common pattern of fall.

4. Conclusions

Along this work we have used a Leontief model applied on SAM, and we have carried out a counterfactual analysis on the region of Andalusia, consisting in valuating the impact of the ERDF funds on sectoral output and prices. Hence, we can extract conclusions on the degree of dependence of the Andalusian region with regard to these funds.

From the output point of view, the two sectors that show an important reaction when funds are removed are "Agriculture, cattle and forestry.. (1)" and "Manufacturing industry (4)". The sectors that have directly received the most important amounts of money from the European regional policy have been "Commerce (6)" and "Other services (8)", together with "Construction (%) for the first and second periods, and "Electricity and natural gas (3)" for the third period.

We can deduce a quite stable behavior of the funds in nominal terms for the first two frameworks. However, it is necessary to highlight the turnaround registered for the last period that evidences a growing accommodation of the Andalusian economy to the community financing. Nevertheless, the accommodation effect could also be interpreted as a learning effect for the regional government as the number of years of receiving the funds goes by. Anyway, this result should put in alert to those responsible for the economic policy since the future years present a scenario, where there are important cuttings as consequence of the enlargement of countries in the European Union.

We have also presented a price model where we have analysed the behaviour of this variable under two different scenarios: one where the indirect taxation is endogenous and another one

where it is considered as exogenous. The results show that the effects on prices are much more relevant for the first CSF, that is 1989-93 while there is some accommodation effect for the second and third ones. We can point out some general patterns because while services account seen to behave even better without funds registering an smooth fall in their prices, the rest of accounts, register some growth.

The possibility of designing simulations in advance, to assume or to discard certain investment projects, indicates the potential of these models in the evaluation of public policy in terms of efficiency evaluation, as an alternative to econometric techniques.

There are very few works of quantitative character to the object of determining the degree of effectiveness of the European funds on regional level. We consider that those papers that try to model the behavior of the receptor regional economies to detect their weaknesses or to capture the sectors where bigger multipliers effects can be generated, can be very useful for the policymakers.

5. References

Bosch, J., García Montalvo, J., García Villar, J., Sancho, F. and Serra de la Figuera, D. (1997): *Evaluación del Impacto Económico de la Construcción de la Red de Cable de Banda Ancha en Cataluña*, Institut D'Estudis Territorials, Barcelona.

Cardenete, M.A. (1998): "A social accounting matrix for the Andalusian economy: 1990", Revista de Estudios Regionales nº 52, pp.137-153.

Cardenete, M.A. and Moniche, L. (2001): "El nuevo marco input-output y la SAM de Andalucía para 1995", *Cuadernos Ciencias Económicas y Empresariales* nº 41, pp. 13-32.

Cardenete, M.A. and Sancho, F. (2002): "Sensitivity of simulation results to competing SAM updates", *The Review of Regional Studie*s, 34 (1), pp. 37-56, 2004.

Cardenete, M.A. and Sancho, F. (2002): "The price effects of indirect taxation in the regional economy of Andalusia", Journal of Applied Input-Output analysis, Vol. 8.

Cardenete, M.A. and Sancho, F. (2003): "Evaluación de multiplicadores contables en el marco de una matriz de contabilidad social regional", *Investigaciones Regionales*, nº 2, pp. 121-139.

European Commission, General Direction XVI of Regional Politics and Cohesion (1999): "Elaboration of regional policy. New period of programming 2000-2006", Working Paper nº 5, Luxemburg.

Consejería de Economía y Hacienda. Dirección General de Planificación. Dirección General de Políticas Regionales FEDER (1994): *FEDER Andalucía 1989-93*, Junta de Andalucía y Comisión de las Comunidades Europeas.

Consejería de Economía y Hacienda de la Junta de Andalucía. Dirección General de Fondos Europeos y Comisión Europea (2000): *Plan de Desarrollo Regional de Andalucía 2000-06.*

Consejería de Economía y Hacienda de la Junta de Andalucía. Dirección General de Fondos Europeos y Comisión Europea (2000): *Programa Operativo Integrado de Andalucía (2000-2006).*

Consejería de Economía y Hacienda de la Junta de Andalucía. Dirección General de Fondos Europeos y Comisión Europea (2000): *Marco Comunitario de Apoyo (2000-06) para las regiones españolas del Objetivo nº 1.*

De la Fuente, A. (1999): *The effect of Structural Fund spending on the Spanish regions: a preliminary assessment of the 1994-99 objetive 1 CSF*, Instituto de Análisis Económico, CSIC.

De la Fuente, A. (2002): *Fondos Estructurales, inversión en infraestructuras y crecimiento regional*, Centro de Investigación Económica y Financiera, Fundación Caixa-Galicia.

De la Fuente, A.and Doménech, R. (1999): " The redistributive effects of the EU budget: an analysis and some reflections on the Agenda 2000 negociations", Discussions Papers Series on International Macroeconomics nº 2113, Centre for Economic Policy Research, (CEPR).

Lima, M.C. and Cardenete, M.A. (2005): "Análisis de impacto de los fondos FEDER recibidos por una economía regional: un enfoque a través de Matrices de Contabilidad Social", *Presupuesto y Gasto Público-Instituto de Estudios Fiscales*, n. 40, pp. 113-131.

Ministerio de Economía y Hacienda. Dirección General de Planificación (1995): *La planificación regional y sus instrumentos. Informe anual 1994*. Madrid.

Morillas, A., Moniche, L. and Castro, J.M. (1999): "Evaluación de los efectos de los fondos estructurales en la economía andaluza", Revista de *Estudios Regionales* nº 54, pp. 225-249.

Morillas, A., Moniche, L. and Castro, J.M. (2004): "Evaluación y efectos ultrafrontera del Marco Comunitario de Apoyo 1994-1999 en Andalucía", Mimeo.

Murillo, E. and Sosvilla-Rivero, S. (2003): "Efectos a largo plazo sobre la economía andaluza de las ayudas procedentes de los Fondos Estructurales: el Marco de Apoyo Comunitario 1994-99", Working Paper Serie de Economía E/2003/34, Fundación Centro de Estudios Andaluces (centrA).

Pyatt, G. and Round, J. (1979): "Accounting and fixed price multipliers in to Social Accounting Matrix framework", The Economic Journal, Vol. 89.

Pyatt, G. and Round, J. (1985): Social Accounting Matrices: a basis for Planning, The World Bank, Washington.

Pulido, A. and Fontela, E. (1993): *Análisis input-output: modelos, datos y aplicaciones,* Pirámide.

Sosvilla, S. and Herce, J.A.(1994): "HERMIN- S4: A four-sector structural model of the Spanish economy for the analysis of Community Support Frameworks", Documento de Trabajo 94-08, FEDEA.

Stone, R. (1978): The Disagreggation of the Household Sector in the National Accounts, World Bank Conference Social on Accounting Methods in Development Planning, Cambridge.

6. Annex

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	Agriculture, cattle & forestry and fishing
2	Extractives
3	Electricity and natural gas
4	Manufacturing industry
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.