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Department of Economics

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ABSTRACT

Social Accounting Matrices (SAM) are databases that complete the information provided by the input-output tables. They study the intersectorial 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 SAMs 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 sectorial prices.

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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 household budgets, or from the national or regional accounting, among other sources. The SAM can behave as an instrument for the impact analysis of certain exogenous shocks. Furthermore, we can undertake analyses 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 supports 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 1989-1993, the second one extended from 1994 to 1999, the third one covered 2000 to 2006, and finally, a new one has recently been approved for 2007-2013.

In this paper we work on three different databases, the SAMs for 1990, 1995 and 1999, to carry out an impact analysis of the ERDF in terms of output fall and prices. Each of the three databases is used for the impact assessment of a representative year in the corresponding CSF. In short, our work applies the Leontief theory on the three SAMs 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 from the regional economy.

SAMs are databases habitually used in applied general equilibrium models to study the nature of the economic interrelations in an economy, satisfying optimality conditions in the agents' behaviour, technological feasibility and restrictions in terms of productive factors.

SAM type models, defined as extensions of the input-output models, have been commonly used for their simplicity and their utility in short-run policy evaluation. Some well-known references on this methodology are Pyatt and Round (1979, 1985), Defourny and Thorbecke (1984), Pyatt (1988) or Stone (1978). In this case we present a SAM linear model that allows us to study the effects on prices of the removal of funds for every year of the simulation. Some examples of price models that have been addressed for Spanish regional economies are the ones of Llop and Manresa (2004) for Catalonia, or Cardenete and Sancho (2002), which assesses the indirect taxation effects in Andalusia, among others.

Regarding the structure of the paper, in the second section we outline the Leontief model applied to our SAMs and 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 sectorial prices as well as an approach to the consumer's welfare. We finish with some conclusions.

2. The Leontief model and the output fall.

The SAMs we are working with were performed for 1990 (Cardenete (1998)) and 1995 (Cardenete and Sancho (2003)). We also work with one other matrix, an approach to 1999 by means of an updating technique called *Cross Entropy Method (CEM)* applied on the SAM for 1995 (Cardenete and Sancho (2004)). These three databases were published in pesetas and we have done an aggregation work on 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 ten activity sectors, accounts (1) to (10). Our exogenous accounts, according to the most common approaches used in specialized literature, are three: "Savings and investment (14)", "Government (15)" and "Foreign sector (16)".

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

$$y_n = \left(I - A_n\right) \cdot x \qquad (1)$$

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

Since we are working with SAMs, we use Ma instead of An $-Ma$ being the so-called Accounting Multipliers Matrix-. An element ma_{ij} shows the effect an exogenous income unit

of an endogenous account *j* generates on the income of the endogenous account *i*. In other words, the interpretation would be how many monetary income units are generated in sector *i* because of the circular flow of income when sector *j* receives a unitary shock. If we sum up these *Ma* values 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:*

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

Let's suppose an adverse shock experienced by the exogenous accounts, like the drop of the ERDF from the economy. Considering expression (3), a change in the final demand will cause an immediate change in the total output[1]:

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

Therefore, we can perform a simulation on which European funds are dropped from the Andalusian economy by decreasing the final demand in the amount of funds previously distributed into the different accounts of the SAM. We work with the financing priorities approved in the three CSFs designed as part of the European Union regional policy. CSFs are pluriannual documents for the economic promotion of a region which define priorities in the

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

region and establish financial endowments for the different actions. In the paper we work on the following CSFs: 1989-1993, 1994-1999 and 2000-2006. We are going to perform three simulations and each of the matrices in this exercise (SAM-1990, SAM-1995 and SAM-1999) will help us to approach one of these frameworks.

If we want to discern the regional output explained by the granting of this fund, we must have information about the ERDFs received in Andalusia and their distribution among the different activity sectors. The allocation rules that we have designed and 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 in which we drop the ERDF from the Andalusian economy. In Table 1 we can see the figures for 1990. The two first columns deal with the final demand (FD) and the sectorial output (SO) for the ten productive sectors before the 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 this financing is worth 55.294, 81.499 and 145.779 million pesetas respectively, figures that result from the annualization of the CSF for each of our reference years. (Consejería de Economía y Hacienda (1994, 2000) and Ministerio de Economía y Hacienda (1995)).

Table 1

As we can see in Table 1, the removal of the ERDFs means a final demand percentage fall of about 4% in "Construction (5)", 1.27 % in "Commerce (6)" and 1.06% in "Other services

(8)". Regarding the output behaviour, we can see how some sectors that did not initially receive an adverse shock because of the funds, show a decreasing value as the circular flow of income works. Examples of this behaviour are the cases of "Extractives (2)", "Electricity and natural gas (3)", "Transports and Communications (7)" and "Commercial services (9)". Sectors with an elastic behaviour when the final demand changes are "Manufacturing industry (4)" and "Agriculture, cattle and forestry (1)". These two sectors are the ones that reflect a higher incidence of the European funding on the Andalusian economy. Sectors "Other services (8)" and "Commercial services (10)" are close to a 1% output fall. In aggregate terms, the ERDFs received in 1990 represent the 1.22% of the Andalusian final demand and the 1.08% of the total output.

Table 2

We repeat the simulation for 1995; the results for this year are shown in Table 2. The sectors that concentrate the biggest amounts of funds are again "Construction (5)" and some services branches as "Commerce (6)", "Other services (8)" and "Non-commercial services (10)". Again, the circular flow of income makes the whole output vector change even though some sectors do not initially receive any exogenous shock on their final demand. In this case, there are four sectors that react with an output fall close to 1% when this financial help is dropped from the Andalusian economy. These sectors are "Extractives (2)", "Electricity and natural gas (3)", "Transports and Communications (7)" and "Commercial services (9)". The sectors with an output elasticity in relation to the final demand above one are "Manufacturing industry (4)" and "Agriculture, cattle and forestry (1)", just as in 1990. "Construction (5)"

and “Non-commercial services (10)” behave around one. As we can see, there is a common pattern of reaction of the activity sectors for 1990 and 1995. In this second period, the aggregate fall is around one both for the final demand and the total output, and the final demand fall is very similar to that of 1990 and very close to 1%.

Table 3

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)”. In this third period the main infrastructures have already been addressed and these amounts are derived to energy investments and, again, services. Furthermore, those sectors with an output elasticity in relation to final demand changes above one are “Agriculture, cattle and forestry (1)”, “Manufacturing industry (4)” and “Construction (5)”. “Transports and Communications (7)”, “Commercial services (9)”, “Non-Commercial services (10)” and even “Extractives (2)” react to the final demand shock even though they did not receive any initial support from the European Union grants. In aggregate terms, this year registers a 1.04% of final demand fall and a 1.19% total output fall.

3. Price formation.

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

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

The notation for the previous equation follows:

PP_j : production price of sector *j*.

IP_j : Ad Valorem Tax on 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*.

rwp : rest of the world price of good *j*.

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

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

$$L_j = SAM("11",j)/X_j; \qquad (7)$$

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

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

We calculate indirect taxation as an effective tax rate including the information registered in the SAM:

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

Production prices or unitary costs, final prices and wages are endogenous. We also work with a Consumer Price Index (*cpi*), 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 of 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:

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

p and *p'* being vectors that stand respectively 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 considering the fact that the nominal income stays constant throughout the process, -that is $P' *C' - P *C = 0$-, we can show that we are close to the concept of the Compensating Variation welfare measure:

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

3.1 Price effects of the ERDFs on the Andalusian economy.

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

Table 4

Table 4 shows the sectorial prices fall under two different scenarios, one with constant production taxes after the output fall (Simulation 1) and the other with a new vector of indirect taxes once the funds are removed (Simulation 2). In this second simulation we suppose that the indirect taxes vector works as an endogenous variable and changes as a consequence of the adjustment of the Andalusian economy to the new final demand vector. Hence, the IP vector is recalculated in order to find the new equilibrium of the price model under the new scenario.

Let us start with Simulation 1. Sectorial prices were initially fixed with a unitary value to make easy comparisons, so figures above one show a price increase and figures below one show a price fall. For the first year, there are four sectors that see their prices increase: "Extractives (2)", "Electricity and natural gas (3)", "Manufacturing industry (4)" and "Construction (5)", the later with the most significant increase. On the other side, we have some services that register a big prices fall, like "Other services (8)", experiencing a reduction close to a 4% fall, and "Non-commercial services (10)" with over a 6% prices fall.

In Simulation 1 for 1995, sectors (2), (3), (4) and (5) behave as in 1990, showing a moderate increase of the prices, while there is a slight fall in all the services accounts, again a bit more significant for sectors (8) and (10). A similar behaviour is seen in 1999 prices. Secondary sectors still show a moderate increase in their prices but there is one sector that changes its behaviour: "Construction (5)", which reflects a fall in its prices, probably as a consequence of the decreasing investment of the CSF on it. Services in general display more competitive prices when the European funding is removed from the Andalusian economy.

In Simulation 2, no significant changes of behaviour are perceived so that it seems changes in indirect taxation are not relevant when funds are removed. We can again distinguish two clear and different behaviours: that of the secondary sector accounts, where prices tend to increase, and that of the primary sector and some services accounts, where there is a common pattern of fall, specially stressed for "Other services (8)" and "Non-commercial services (10)", in all the three years.

Table 5

In Table 5 we can see the effects of eliminating ERDFs on the consumer price index. The simulation shows a reduction of nearly 1% for each of the three years, especially marked for 1990. Regarding wages, the figures show important falls that become even greater on the third year. The compensating variation has a negative sign for the whole simulation, which means there is a welfare loss in nominal terms when funds are removed.

4. Conclusions

Along this work we have used a Leontief model applied on the SAM databases, and we have carried out a counterfactual analysis on the region of Andalusia, consisting in valuating the impact of the ERDF on sectorial output and prices. The idea was to detect those sectors that would be most affected by the elimination of the European grants as well as the degree of dependence of the Andalusian region on these funds.

From the point of view of the output, the two sectors that show a greater reaction when funds are removed are the primary and secondary sectors. This is due to an adjustment behaviour to these grants in activities such as the manufacturing industry that should be keysectors in our regional development. There are sectors that have directly received huge amounts of money from the European regional policy: "Construction (5)" for the first and second periods, "Electricity and natural gas (3)" for the third period and "Commerce (6)" and "Other services (8)"for all the three years of our study.

We have also presented a price model that has allowed us to analyze the behaviour of this variable in two different scenarios: one where indirect taxation is exogenous and a second one where it is considered as endogenous. The results do not differ significantly in the short-run and show that the effects on prices follow some general patterns. While services accounts seem to behave even better without funds, registering only a smooth fall in their prices and an improvement in their competitivity, the rest of the accounts experience some increase. For the first two years of the study, removing the investment on infrastructures would entail a

sectorial price increase between one and more than two percentage points. Nevertheless, for the third year, the results completely change and that sector is affected by an important prices fall of about 4%. The competition gains captured by our simulations could compensate the progressive elimination of the European help in order to attend the poorer members of the recently enlarged Europe.

We consider that those methodologies that try to model the behaviour of the receptive regions can be useful to capture their weaknesses or to detect those sectors with a broader multiplying effect. The possibility of designing this type of simulations can help to assume or to discard certain investment projects. The potential of these models in the evaluation of public policies, and also as an alternative to econometric techniques, must be pointed out.

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Tables:

Table 1: Final demand (FD) and sectorial output (SO) falls for 1990 when funds are removed.

(in millions of 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 Communications	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%
Total Fall					-1,22%	-1,08%

Source: Own elaboration.

Table 2: Final demand (FD) and sectorial output (SO) falls for 1995 when funds are removed.

(in millions of 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 Communications	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%
Total Fall					-1,07%	-1,05%

Source: Own elaboration.

Table 3: Final demand (FD) and sectorial output (SO) falls for 1999 when funds are removed.

(in millions of 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 Communications	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%
Total Fall					-1,04%	-1,19%

Source: Own elaboration.

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

Productive Sectors	1990		1995		1999	
	P' (IP)	P' (IP')	P' (IP)	P' (IP')	P' (IP)	P' (IP')
1 Agriculture, cattle & forestry	0,9980	0,9971	0,9940	0,9939	0,9965	0,9963
2 Extractives	1,0043	1,0062	1,0061	1,0061	1,0041	1,0039
3 Electricity and natural gas	1,0008	1,0013	1,0041	1,0043	1,0067	1,0069
4 Manufacturing industry	1,0008	1,0006	1,0027	1,0027	1,0044	1,0042
5 Construction	1,0100	1,0129	1,0219	1,0224	0,9626	0,9614
6 Commerce	0,9896	0,9890	0,9940	0,9942	1,0029	1,0049
7 Transport and Communications	0,9875	0,9872	0,9936	0,9937	0,9888	0,9887
8 Other services	0,9611	0,9581	0,9777	0,9779	0,9616	0,9623
9 Commercial services	0,9982	0,9980	0,9976	0,9976	0,9975	0,9977
10 Non-commercial services	0,9388	0,9345	0,9704	0,9703	0,9377	0,9347

Source: Own elaboration.

Table 5: Consumer Price Index and Wage Index under Simulation 1 and 2. Compensating Variation in millions of pesetas.

	1990		1995		1999	
	IP	IP'	IP	IP'	IP	IP'
CPI	0,9929	0,9925	0,9957	0,9958	0,9905	0,9913
W	0,9178	0,9116	0,9384	0,9381	0,8828	0,8762
CV	-130.084		-214.527		-428.036	

Source: Own elaboration.