Encuentro Economía Aplicada 2007

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 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.

JEL: C67, D57, R15.

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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 structural 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 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, from 1994 to 1999, the third one covered 2000 to 2006. 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 European Regional Development Fund (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 the price model. The third section presents the main results, analysing the behaviour of total output, sectoral prices and an approximation to the consumer's welfare. We finish with some conclusions.

2. The model.

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)".

Following the formulation of the Leontief linear model we get

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

where y_n is the vector of final demand, I is an identity matrix of order n x n, An is the 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. Ma is the so called Accounting Multipliers Matrix and an element ma_{ij} indicates 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.

Suppose an averse shock experienced by the exogenous accounts like the drop of the ERDF. From:

$$x = Ma \cdot x + y \qquad (2)$$

solving by x:

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

This way, a change in final demand will cause an immediate change on total output:

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

From the previous expression 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 effects on regional output and prices explained by this funds, we must have information about ERDF received in Andalusia and their distribution among the different activity sectors. The allotment rules that we have design containing this information are presented in the Annex at the end of the work.

2.1Price formation

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

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

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:

$$\sum_{i=1}^{10} \qquad \sum_{j=1}^{16}$$

$$cpi = P_i * (SAM(i, "13") / SAM(j, "13")) \quad (11)$$

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:

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

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:

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

3. 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 1: 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		
	X fall	P' (IP)	P' (IP')	X fall	P' (IP)	P' (IP')	X fall	P' (IP)	P' (IP')
1 Agriculture, cattle & forestry..	-0,80%	0,970	0,997	-0,48%	0,992	0,994	-0,85%	0,996	0,996
2 Extractives	-0,63%	1,130	1,006	-0,85%	1,006	1,006	-1,47%	1,014	1,012
3 Electricity and natural gas	-0,88%	1,079	1,001	-0,90%	1,010	1,004	-3,35%	1,059	1,039
4 Manufacturing industry	-0,81%	0,990	1,001	-0,73%	1,003	1,003	-0,58%	1,004	1,004
5 Construction	-3,39%	0,934	1,013	-3,29%	1,022	1,022	-0,35%	0,973	0,962
6 Commerce	-1,02%	0,914	0,989	-0,91%	0,994	0,994	-2,47%	1,002	1,005
7 Transport and Comunications	-1,04%	0,928	0,987	-0,80%	0,995	0,994	-0,86%	0,994	0,989
8 Other services	-1,05%	0,757	0,958	-1,17%	0,977	0,978	-1,81%	0,953	0,964
9 Commercial Services	-0,97%	0,957	0,998	-0,86%	0,996	0,998	-1,35%	0,994	0,998
10 Non-commercial services	-0,25%	0,678	0,935	-0,58%	0,965	0,970	-2,53%	0,949	0,964
Average Fall	-1,08%	0,93	0,99	-1,05%	1,00	1,00	-1,36%	0,99	0,99

Source: Own elaboration.

As we can see in Table 1, the account that experiences a bigger reduction as a consequence of the elimination of the funds for this first year, is the one of "Construction (5)", with a percentage that triplicates the half behavior 1.08%. Most of the accounts are around the half value of reference, although it is necessary to highlight the case of "Non-commercial services (10)" for its scarce reaction when the funds are dropped. This fact could be explained because many public services (education, health or social assistance) are covered by our welfare state, so that the elimination of the European funds does not affect these figures.

In 1995 the "Construction (5)" with 3.29% is again the account with a highest value, clearly over the average behaviour that stands at 1.05%. The rest of accounts are close to the half fall but remain slightly below this figure with the exception of "Other services (8)", that is above the reference value. The "Non-commercial services (10)" have increased their sensibility with respect to the funds. The lowest value, 0.48%, is now for the primary sector (1); this could be caused because of the huge community financing that this account receives through the Agricultural Common Policy.

To conclude we analyze the last year of study, 1999, representative of the situation in the third CSF. We observe that for this last year, there are several values above the 1%. The most important falls are reached in "Electricity and natural gas (3)" with a percentage of 3.35%, "Non-commercial services" (10) with 2.53% and "Commerce (6)" with a very similar value to the public activities. For the small values, the most inelastic behaviors are registered in "Manufacturer industry (4)" and the "Construction (5)". These figures clearly show a tendency change with regard to the previous periods since the main investments in infrastructures have already been covered in these years.

As regards the total output fall, we can conclude that the behaviour is very similar for the first two frameworks while for the third one the data show more than a 25% of additional fall.

The previous result for 1995, is consistent with those obtained by De la Fuente (2002), where he works with an econometric model to assess the impact of the European Structural Funds for several Objective 1 regions in Spain including Andalusia. His paper deals with the second CSF for 1994-99 and he calculates a 1% the influence of the funds on the total output for the Andalusian economy.

Our results of fall of the productive output are bigger than those obtained by Morillas et alia (2004) for Andalusia during the CSF 1994-99. Reading their paper, an annual 0.7% is explained by their input-output model, since we obtain a 1% fall. This is a reasonable difference keeping in mind that we work with SAM that capture a wider volume of impacts, derived from the feedback effects or circular effects.

The second and third columns for every year show 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.

The fall of annual productive output as consequence of the elimination of the ERDF funds, reaches 1.08% for each of the years between 1989 and 1993; that is to say, 5.4% for the first CSF. This figure is a 1.05% for the years between 1994 and 1999, what supposes a 6.3% for the second period. Lastly, 1.36% would be the percentage of output reduction for every year of those that lapse between 2000 and 2006, what means a reduction of a 9.52% for this last 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.

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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.

Table A.2: Allotment rule for ERDF in Andalusia, CSF 1989-93. (in millions of pesetas).

1989-93 (ANUALIZADO)	*Eje1 Integrac. y Articulac. Territ.*		*Eje 2 Industria, artes y Sº empresas*		*Eje 3 Turismo*		*Eje 4 Agricultura, Des.Rural*		*Eje 5 Infraest. activ. económica*		*Eje 6 Valor. RRHH*		Eje 7 Asist. Técnica, acomp.,..		*Suma Fondos por Sector*
Cuentas sectores productivos MCS 1990	Reparto	%	Reparto	%	Reparto	%	Reparto	%	Reparto	%	Reparto	%	Reparto	%	
1 Agricultura, ganadería,...	-	0	-	0	-	0	1,671.38	100	-	0	-	0	-	0	**1,671**
2 Extractivas	-	0	-	0	-	0	-	0	-	0	-	0	-	0	**0**
3 Producción y distrib.energía..	-	0	-	0	-	0	-	0	-	0	-	0	-	0	**0**
4 Industria manufacturera	-	0	3,321.74	57.5	-	0	-	0	-	0	-	0	-	0	**3,322**
5 Construcción	36,241.30	100	990.17	17.1	-	0	-	0	3,684.73	38.7	-	0	-	0	**40,916**
6 Comercio y Reparación	-	0	-	0	1,084.02	100	-	0	576.19	6.05	-	0	-	0	**1,660**
7 Transporte y Comunicaciones	-	0	-	0	-	0	-	0	-	0	-	0	-	0	**0**
8 Otros Servicios	-	0	1,465.03	25.4	-	0	-	0	5,262.81	55.3	-	0	150.64	100	**6,878**
9 Servicios Destinados Venta	-	0	-	0	-	0	-	0	-	0	-	0	-	0	**0**
10 Servicios no Destinados Venta	-	0	-	0	-	0	-	0	-	0	846.22	100	-	0	**846**
	Total		Total		Total		Total		Total		Total		Total		
	36241.3	100	**5776.94**	100	**1084.02**	100	**1671.38**	100	**9523.72**	100	**846.22**	100	**150.64**	100	55,294
TOTAL FEDER-ANDALUCÍA 1989-93 (sin cofinanciación nacional)															***276,471***

Source: Own elaboration based on Morillas et alia (2004).

Table A.3: Allotment rule for ERDF in Andalusia, CSF 1994-99. (in millions of pesetas).

1994-99 (ANUALIZADO)	*Eje1 Integrac. y Articulac. Territ.*		*Eje 2 Industria, artes y Sº empresas*		*Eje 3 Turismo*		*Eje 4 Agricultura, Des.Rural*		*Eje 5 Infraest. activ. económica*		*Eje 6 Valor. RRHH*		Eje 7 Asist. Técnica, acomp.,..		*Suma Fondos por Sector*
Cuentas sectores productivos MCS 1995	Reparto	%	Reparto	%	Reparto	%	Reparto	%	Reparto	%	Reparto	%	Reparto	%	
1 Agricultura, ganadería,...	-	0	-	0	-	0	74.60	100	-	0	-	0	-	0	**75**
2 Extractivas	-	0	-	0	-	0	-	0	-	0	-	0	-	0	**0**
3 Producción y distrib.energía..	-	0	-	0	-	0	-	0	-	0	-	0	-	0	**0**
4 Industria manufacturera	-	0	2,652.82	57.5	-	0	-	0	-	0	-	0	-	0	**2,653**
5 Construcción	42,663.59	100	790.77	17.1	-	0	-	0	10,254.47	38.7	-	0	-	0	**53,709**
6 Comercio y Reparación	-	0	-	0	2,808.32	100	-	0	1,603.50	6.05	-	0	-	0	**4,412**
7 Transporte y Comunicaciones	-	0	-	0	-	0	-	0	-	0	-	0	-	0	**0**
8 Otros Servicios	-	0	1,170.01	25.4	-	0	-	0	14,646.21	55.3	-	0	361.33	100	**16,178**
9 Servicios Destinados Venta	-	0	-	0	-	0	-	0	-	0	-	0	-	0	**0**
10 Servicios no Destinados Venta	-	0	-	0	-	0	-	0	-	0	4,473.56	100	-	0	**4,474**
	Total		Total		Total		Total		Total		Total		Total		
	42,663.59	100	**4,613.61**	100	**2,808.32**	100	**74.60**	100	**26,504.18**	100	**4,473.56**	100	**361.33**	100	81,499
TOTAL FEDER-ANDALUCÍA 1994-99 (sin cofinanciación nacional)															**488,995**

pesetas).

Source: Own elaboration based on Morillas et alia (2004).

Table A.4: Allotment rule for ERDF in Andalusia, CSF 2000-06. (in millions of pesetas).

2000-06 (ANUALIZADO)	*Eje1: Integrac. y*		*Eje 2:Industria, artes.y S°*		*Eje 3: Turismo*		*Eje 4: Agricultura,*		*Eje 5: Infraest.activ.ec*		*Eje 6: Valor. RRHH*		*Eje 7: Asist. Técnica,*		*Eje 8: Estructuras*		***Suma Fondos por Sector***
Cuentas sectores productivos MCS 1999	Reparto	%	Reparto	%	Reparto	%	Reparto	%	Reparto	%	Reparto	%	Reparto	%	Reparto	%	
1 Agricultura, ganadería, caza y silvicultura; pesca y	-	0	-	0	-	0	4,758.69	100	1,861.18	21.8	-	0	-	0	-	0	**6,619.868**
2 Extractivas	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	**0.000**
3 Producción y distribución de energía eléctrica, gas	3,013.19	20	-	0	-	0	-	0	3,307.72	38.7	-	0	-	0	-	0	**6,320.918**
4 Industria manufacturera	4,519.79	30	3,875.76	74.6	-	0	-	0	-	0	-	0	-	0	-	0	**8,395.555**
5 Construcción	7,532.98	50	-	0	-	0	-	0	-	0	-	0	-	0	-	0	**7,532.984**
6 Comercio y Reparación	-	0	-	0	45,244.55	100	-	0	-	0	-	0	-	0	-	0	**45,244.552**
7 Transporte y Comunicaciones	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	**0.000**
8 Otros Servicios	-	0	406.58	7.83	-	0	-	0	2,863.16	33.5	33,287.31	50	393.15	100	-	0	**36,950.211**
9 Servicios Destinados a la Venta	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	**0.000**
10 Servicios no Destinados a la Venta	-	0	910.26	17.5	-	0	-	0	517.23	6.05	33,287.31	50	-	0	-	0	**34,714.812**
	Total		Total		Total		Total		Total		Total		Total				
	15,065.97	100	5,192.61	100	45,244.55	100	4,758.69	100	8,549.30	100	66,574.63	100	393.15	100		0	**145,779**
TOTAL FEDER-ANDALUCÍA 2000-06 (sin cofinanciaicón nacional)																	**1,020,452.30**

Source: Own elaboration based on Morillas et alia (2004).