THE EFFECT OF STRUCTURAL FUND SPENDING ON THE GALICIAN REGION: AN ASSESSMENT OF THE 1994-1999 AND 2000-2006 GALICIAN CSFS

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The effect of Structural Fund spending on the Galician region: an assessment of the 1994-1999 and 2000-2006 Galician CSFs

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ABSTRACT

This paper focuses on the evaluation, for the Galician economy, of medium and long term effects of European Union Structural Funds through the impact of investments financed by the 1994-1999 and 2000-2006 Galician Community Support Frameworks (CSFs). To carry out our analysis we use a supply-side model estimated with a panel of regional data. In our approach we simulate the evolution of the Galician economy under two scenarios: Without and with the investments financed by the CSFs, so comparison of simulated actions for these two scenarios allow us to quantify the intensity of the incentive effects in the growth of income, employment and stock of capital.

Key words: Development Policy, Objective 1, Community Support Framework, European Union, Galicia

J.E.L classification: F35, F47, R58

1. Introduction

The European Union Regional Policy as far as objective 1 regions concerns (regions whose GDPph is less than 75% of the Community average) has become an economic development policy to which a high percentage of the resources of the Structural Funds are devoted. Structural Funds are allocated to the recipient regions through the multi-annual planning of assistance. For Objective 1 regions, five to seven year Community Support Frameworks (CSFs), which are supplemented by Operations Programmes (OPs) are approved by the Commission in consultation with the relevant Member State- and whenever relevant, with the involvement of regional tiers of the government in the process- on the bases of regional development plans previously submitted by the nation States. An important issue related to Structural Funds has been the evaluation of its contribution to economic cohesion in Europe, see Bradley et al., (1995a), (1995b), Christodoulakis and Kalyvitis (1994), (1995), (1998a), (1998b), (2000), De la Fuente (2003a), Herce (1994), Herce and Sosvilla–Rivero, (1995a), (1995b), (1996), Roeger (1996), Modesto and Neves, (1995), Murillo Garcia and Sosvilla-Rivero (2003), Sosvilla-Rivero (2003), Sosvilla-Rivero et al. (2003). Recently some scholars have questioned the capacity of Structural Funds to deliver their objective of reducing regional inequalities across Europe, Martin (1999), Hurst et al. (2000), Midelfart et al. (2002), Puga (2002), Rodriguez-Pose, (2004) and some others have even claimed that in its current form, EU regional development policy is more of an income support policy than a policy capable of setting the bases for a long-run sustainable development, Rodriguez-Pose, (2000), p. 112, Boldrin and Canova, (2001), p.211. However in an specific analysis of the Spanish economy, De la Fuente (2003b) remarks the important role of the Structural Funds both in the growth of objective 1 regions and for the whole of the Spanish economy, although he also remarks the high opportunity costs of these aids.

There is not a well established methodology to quantify the global effect of Structural Funds, but there is some consensus that studying long term effects or supply-side effects is the most adequate. Most previous attempts have relied on conventional country-level macroeconometric models (HERMIN and QUEST II models). These models are probably the best available tool for the analysis of the short and medium term effects of Community policies through their impact on aggregate demand. In general, they can not be used to produce regional-level estimates and are not especially well suited for the analysis of the supply-side effects that are sought by structural interventions because their production blocks are not designed to capture such effects.

In this paper we produce regional estimates of the impact of the 1994-1999 and 2000-2006 Galician Community Support Frameworks (henceforth CSF) using a multieaquational econometric model that is specifically designed and estimated to capture the relevant supply effects. The model will be estimated using a panel of Spanish regional data and will be used to produce an estimate of the impact of the CSF actions on the growth of output, stock of capital and employment in the Galician region. To capture supply-side effects, the model focuses its attention on the most important variables and in their transmission channels. In this paper we identify the key mechanisms through which co-funding actions by the European Funds exert their influence on capital, production flows and in the remaining macromagnitudes. One shortcoming of this approach is that the model does not take into account demand effects that can be quite important in the short run.

The remaining part of the paper is structured as follows: In section 2 the figures of the 2000-2006 CSF are analyzed focusing our attention in the Galician region, the priority axes of intervention are briefly described and consolidate to three main types of intervention that will facilitate the empirical estimation of their macroeconomic effects. The three categories are those aiming to raise infrastructure, aid to productive investment and finally the group of education and training actions. In this form the financial flows of the CSF are easily represented in the model, while the effects that are likely to generate in positive growth and productivity effects are captured by introducing a number of supply side responses to those interventions. The proposed model for the regional economy without the CSF interventions, the estimation of that basic model and the modelling of the CSF externalities are outlined respectively in the subsections 3.1, 3.2 and 3.3 of section 3. In section 4, the model is simulated to quantify the impact of the CSF actions on the Galician economy. After the analysis of results, conclusions and directions of future research are discussed in section 5. Section 6 contains the references.

2. The third CSF for Galicia

2.1 An overview

The Spanish Community Support Framework for 2000-2006 has been approved in October 2000 (Marco Comunitario de Apoyo (2000-2006) para las Regiones Españolas del Objetivo 1, Ministerio de Hacienda), successfully concluding the negotiations between the European Commission, the Spanish Central Government and the Regional Governments on the basis of a revised Regional Development Plan that has been submitted by the end of 1999. In the new programming period 2000-2006 the Community funding for Spanish objective 1 regions reached the amount of 40.887 millions of euros[1]. Out of these amounts a total of 5.408 millions of euros will be assigned to Galicia for 2000-2006. Tables 1 and 2 represent the distribution of the

[1] These figures will increase to 41.193 millions of euros if we take into account the phasing out regime for the region of Cantabria.

Community funds among the different Spanish objective 1 regions. Table 1 gives us the figures of the total Community funding, percentage of total funding allocated to each region, total Community funding per inhabitant and percentage variation for each region with respect to the average Community funding per inhabitant while table 2 gives us the same figures but with respect to the regionalized Community funding. The figures of tables 1 and 2 allow us to check the good relative position of Galicia. It is not only the second autonomous community with the highest volume of Community funding but also has the highest percentage or regionalized Community funding 0.75% (jointly with Asturias and Castilla León). This means that Community funding for Galicia represents 13.80% of the total Community funding and 14.34% of the regionalized Community funding. Galicia is also above the average with respect to the average Community funding per inhabitant. The average Community funding per inhabitant for the total of Spanish objective 1 regions is 1.761 Euros, this figure is increased to 2.067 Euros in the case of Galicia, a 17.5% above the average. With respect to the regionalized Community funding, Galicia is also above the average. The average regionalized total Community funding per inhabitant is 1.274 Euros while this figure for the case of Galicia reach the amount of 1.556 Euros, a 22.2% above the average.

Table 1: Regional Distribution of the foreseen funds for the 2000-2006 Objective 1 Spanish Community Support Framework

OBJECTIVE 1 AUTONOMOUS COMMUNITIES	Foreseen Aid (Performance Reserve Included)			
	Total Funding		Funding/Inhabitant	
	M. Euros 00-06	%	Euros 00-06	Difference to the average
Andalucia	12470	30,50%	1723	-2,16%
Asturias	1921	4,70%	1776	0,85%
Canarias	2862	7,00%	1755	-0,31%
Castilla y Leon	4906	12,00%	1974	12,11%
Castilla la Mancha	3271	8,00%	1906	8,23%
Comunidad Valenciana	4579	11,20%	1138	-35,39%
Extremadura	3230	7,90%	3020	71,50%
Galicia	5642	13,80%	2071	17,59%
Murcia	1758	4,30%	1576	-10,48%
Ceuta y Melilla	244	0,60%	1851	5,12%
TOTAL	40887	100,00%	1761	0,00%

Source: Faina et al. (2000)

Table 2: Regional Distribution of the foreseen funds for the 2000-2006 Objective 1 Spanish Community Support Framework					
OBJECTIVE 1 AUTONOMOUS COMMUNITIES	Regionalized Aid (Performance Reserve Included)				
	Total Funding		Regionalized Funding/Inhabitant		% Regionalizad funding
	M. Euros 00-06	%	Euros/Inhabitant 00-06	Difference to the average	
Andalucia	8750	29,57%	1209	-5,14%	70,17%
Asturias	1478	5,00%	1366	7,19%	76,92%
Canarias	2111	7,14%	1295	1,64%	73,79%
Castilla y Leon	3711	12,54%	1493	17,20%	75,65%
Castilla la Mancha	2407	8,14%	1403	10,07%	73,60%
Comunidad Valenciana	3080	10,41%	765	-39,94%	67,27%
Extremadura	2375	8,03%	2221	74,25%	73,54%
Galicia	4244	14,34%	1557	22,20%	75,21%
Murcia	1289	4,36%	1156	-9,57%	73,35%
Ceuta y Melilla	141	0,48%	1069	-16,12%	57,75%
TOTAL	29590	100,00%	1274	0,00%	72,37%

Source: (Faiña et al. 2000)

According to the agreements between the European Commission and the Spanish Authorities, the priority axes that will be co funding by the Structural Funds are the nine represented in tables 3 and 4.

Table 3: Objective 1 Spanish Community Support Framework: Foreseen aid by priority axes (millions of euros at current prices, Performance Reserve Included)						
PRIORITY AXES		COMMUNITY AID				
		Total	ERDF	ESF	EAGGF-G	FIFG
Code	Denomination	3=4 to 7	4	5	6	7
1	Competitiveness and aid to the productive base of the economy	5125	3450	485	961	228
2	Knowledge-based society (Innovation, R&D, Information society)	3254	2810	444	0	0
3	Environment, natural landscape and water resources	6528	5503	0	1025	0
4	Development of the human resources, employment and equality of opportunities	7638	852	6785	0	0
5	Urban and local development	4232	2882	1349	0	0
6	Transport and energy networks	9454	9454	0	0	0
7	Agriculture and rural development	3148	0	0	3148	0
8	Fishing and acuiculture	1292	0	0	0	1292
9	Technical assistance	213	68	76	36	32
TOTAL		40887	2502	9140	5171	1553

Source: (Faiña et al. 2000)

Table 4: Objective 1 Spanish Community Support Framework: Foreseen aid by priority axes (millions of euros at current prices, Performance Reserve Included)						
PRIORITY AXES		COMMUNITY AID				
		Regionalized aid			Pluriregional Central Ad. funding	Total
Code	Denomination	AA.CC	Central Ad. funding	Subtotal		
1	Competitiveness and aid to the productive base of the economy	451	64	515	208	723
2	Knowledge-based society (Innovation, R&D, Information society)	129	4	133	257	391
3	Environment, natural landscape and water resources	299	301	601	16	617
4	Development of the human resources, employment and equality of opportunities	374	0	404	490	894
5	Urban and local development	178	27	206	289	495
6	Transport and energy networks	440	1039	1479	0	1479
7	Agriculture and rural development	276	225	501	0	502
8	Fishing and acuiculture	387	0	387	127	514
9	Technical assistance	14	0	14	9	23
TOTAL		2582	1661	4244	1398	5642

Source: (Faiña et al. 2000)

The total amount of community funding contained in tables 3 and 4 support the regional development policy established by the Spanish authorities, both with respect to the priority axes and with respect to the Community funding allocated to them, representing around 25.75% of the foreseen investments (160.541 millions of Euros).

With respect to Galicia, the total community funding managed by the different Spanish administrations with competences in the Galician territory, reaches the amount of 5.642 millions of Euros, which represents 27% of the foreseen investments (20.795 millions of Euros). Out of these amounts, 1.661 millions of Euros are expenses of the Central Administration in Galicia. To this figure we have to add 1.398 millions of Euros corresponding to the participation of Galicia in pluriregion programmes.

With respect to the funding managed by the Regional Administration, its amount reaches 2.582 millions of Euros, which represent 24% of the total expenses of the Regional Administration in the framework of the Galician Regional Development Plan (RDP) 1.783.896 millones de pesetas.

2.2 Consolidating the Galician CSF actions

In the form that the CSF has been described in the preceding subsection, it is very difficult to obtain an assessment of its likely macroeconomic impact because several actions with similar expected outcomes on the economy are included in different interventions. To enable de modelling of CSF, the actions entering the 9 development axes are grouped in three categories as follows:

Type 1: Investment in infrastructure, transport, and environment

Type 2: Support to agriculture, rural promotion, business and tourism

Type 3: Investment in education, re-qualification and all measures targeting the human capital of the region

3. A macroeconometric Model for the Galician region and the analysis of the CSF

3.1. The model without CSF

In this section we outline the structure of the regional economy model that is used later for the evaluation of the CSF effects. The structure of the model is basically similar to the HERMIN type models that have been estimated for Ireland by Bradley et al. (1995a), for the European Union periphery by Bradley et al.(1995b), Portugal by Modesto and Neves (1995), Spain by Herce and Sosvilla–Rivero (1995) and for Greece by Christodoulakis and Kalyvitis (1994, 1995, 1998a, 1998b, 2000).

Given that the objective of this paper is to estimate, for the Galician economy, the medium and long term effects of the 2000-2006 Galician Community Support

Framework, the model for the regional economy herein proposed is made up of the following equations:

1) The production function

$$\ln Y_t = \alpha_0 + \alpha_1 \ln L_t + \alpha_2 \ln K_t + \alpha_3 \ln G_t \qquad (1)$$

where Y is the level of production or income, L represents labour, K the stock of private capital and G the stock of public capital, all of which refer to the year t. It is assumed that the production function is of the Cobb-Douglas type augmented with public capital. At this stage no restriction is placed on the returns to scale. This production function leads to the joint demand system for investment and labour that depend positively on output as we can see in the expressions below.

2) The labour demand function:

$$\ln L_t = \beta_0 + \beta_1 \ln Y_t + \beta_2 \ln HC_t \qquad (2)$$

It is assumed that the quantity of labour depends on production levels, while the effect of human capital is also taken into consideration. The sign for the parameter β_2 is initially uncertain: a positive coefficient indicates that, for a given level of activity, the more human capital that this activity involves, the more labour will be needed for it to be carried out. This may be explained by stating that for a constant level of production there is a substitution process, which takes place between physical capital and labour, a process that is positively correlated to the amount of human capital involved in the labour.

It will be observed that there is no reference made to the relative remuneration of labour. This is due in part, to the difficulty involved in estimating its effect using regional data. A further difficulty lies in the fact that it is not possible to evaluate the contribution of this variable to the simulated paths, since that there is no part of the model that explains wages and interest rates. This may be justified by taking into consideration the fact that the relative payment of labour remains constant, and is reflected in the term β_0. This assumption is not particularly restrictive given that each region has its own β_0 parameter.

3) The Equation for the accumulation of private capital: The general expression is as follows:

$$K_t = I_t + (1-\delta^I)\, K_{t-1} \qquad (3)$$

Where "I" represents gross private investment and δ^I is the consumption rate of private capital, which is initially considered to be constant with respect to time. Gross private investment is a function of income, which may be expressed as

$$\ln I_t = \eta_0 + \eta_1 \ln Y_t \qquad (4)$$

and the rate of private capital accumulation is given by:

$$\frac{K_t - K_{t-1}}{K_{t-1}} = \frac{I_{t-1}}{K_{t-1}} - \delta^I + \left(\frac{I_t - I_{t-1}}{I_{t-1}} \right) \frac{I_{t-1}}{K_{t-1}} \qquad (5)$$

If an approximation of the relative growth rate is obtained by calculating the logarithmic difference, then from (4) and (5) we find that the variation in the stock of capital depends on the dynamic of the investment process in the private sector via the quotient I_{t-1}/K_{t-1}, and on the growth in income and the rate of capital depreciation:

$$\Delta \ln K_t = \frac{I_{t-1}}{K_{t-1}} - \delta^I + \eta_1 \Delta \ln Y_t \left(\frac{I_{t-1}}{K_{t-1}} \right) \qquad (6)$$

4) The equation for public capital accumulation: it is assumed that investment and public capital are exogenous.

5) The equation for human capital accumulation: human capital is also assumed to be exogenous.

On utilizing the above expressions it becomes simple to solve the model and obtain the difinitive equation for income which may be understood by referring to the dynamic that exists between the endogenous and exogenous variables. The following expresion is obtained by substituting (2) into (1):

$$\Delta \ln Y_t = \frac{\frac{\alpha_2}{(1-\alpha_1\beta_1)}\left(\frac{I_{t-1}}{K_{t-1}} - \delta^I\right)}{1-\left(\frac{\alpha_2}{1-\alpha_1\beta_1}\right)\eta_1\left(\frac{I_{t-1}}{K_{t-1}}\right)} + \frac{\frac{\alpha_1\beta_2}{(1-\alpha_1\beta_1)}}{1-\left(\frac{\alpha_2}{1-\alpha_1\beta_1}\right)\eta_1\left(\frac{I_{t-1}}{K_{t-1}}\right)}\Delta \ln CH_t + \frac{\frac{\alpha_3}{(1-\alpha_1\beta_1)}}{1-\left(\frac{\alpha_2}{1-\alpha_1\beta_1}\right)\eta_1\left(\frac{I_{t-1}}{K_{t-1}}\right)}\Delta \ln G_t \qquad (7)$$

By taking the differences that exist in expression (7) we obtain the production growth:

$$\Delta \ln Y_t = \left(\frac{\alpha_1 \beta_2}{1-\alpha_1\beta_1}\right)\Delta \ln CH_t + \left(\frac{\alpha_2}{1-\alpha_1\beta_1}\right)\Delta \ln K_t + \left(\frac{\alpha_3}{1-\alpha_1\beta_1}\right)\Delta \ln G_t \tag{8}$$

and by substituting the variation in private capital for the expression given in (6) we arrive at:

$$\Delta \ln Y_t = \frac{\frac{\alpha_2}{(1-\alpha_1\beta_1)}\left(\frac{I_{t-1}}{K_{t-1}} - \delta^I\right)}{1-\left(\frac{\alpha_2}{1-\alpha_1\beta_1}\right)\eta_1\left(\frac{I_{t-1}}{K_{t-1}}\right)} + \frac{\frac{\alpha_1\beta_2}{(1-\alpha_1\beta_1)}}{1-\left(\frac{\alpha_2}{1-\alpha_1\beta_1}\right)\eta_1\left(\frac{I_{t-1}}{K_{t-1}}\right)}\Delta \ln CH_t + \frac{\frac{\alpha_3}{(1-\alpha_1\beta_1)}}{1-\left(\frac{\alpha_2}{1-\alpha_1\beta_1}\right)\eta_1\left(\frac{I_{t-1}}{K_{t-1}}\right)}\Delta \ln G_t \tag{9}$$

By using the expression given in (9) the growth of income in t can be calculated, when the intensity of the private investment process in the period t-1, and the rates of variation in t with respect to the stocks of both human and public capital are known. It should be observed that, the greater the weight of private investment in the stock of capital in t-1, the greater will be the effect of the growth of the stocks of human and private capital on the growth of income.

3.2. An estimation of the basic model

3.2.1. General Characteristics

The model contains ten structural parameters. Of these, the rate of depreciation of the stock of private capital, δ^I is given, while the rest of the parameters are obtained by estimating the functions which correspond to the following: the production function – equation (1), the labour demand function – equation (2), and the function for private investment – equation (4).

The panel data used corresponds to the seventeen Spanish regional autonomous communities and takes in the years 1980 to 1992. The objective of this paper is to simulate the impact of specific policies on one particular region - Galicia, and since, for each region there are only 13 observations for each variable this would make non-panel data estimations somewhat imprecise. Hence, the data in the form of a panel provides us with a total of 221 observations, which facilitate estimations of the parameters, which are considerably more precise. Implicit in the use of panel data is the assumption that the structural parameters of the model are the same for all of the regions, and these parameters are contrasted a little further on in the paper.

The source for the data for each of the variables is as follows:

1) Y: Gross value added, at non-agricultural private market prices in constant 1986 pesetas. This data was originally calculated by Campo and others in (1996) and subsequently updated by the treasury office's committee for budgetary planning and analysis (Dirección General de Análisis y Programación Presupuestaria del Ministerio de Economía y Hacienda). Private non-agricultural GVA in this case is made up of the sum of GVA for industry (the sum of branches 06 and 30 which correspond to B-6), construction (branch 53) and the retail sector (branch 68 excluding PISB)

2) L: total private employment in the private non-agricultural sector according to the Spanish regional accounts, compiled by INE (The national institute for statistics), and which constitute a homogenous series from 1980 onwards. Total employment in this case therefore does not include those employed in non-market production in the service and primary sectors.

3) K: stock of non-agricultural, non-residential private capital calculated by the Valencian Institute for Economic Research (Instituto Valenciano de Investigaciones Económicas (IVIE)) and published in Mas and others (1996).

4) I: non-agricultural, non-residential gross private investment, using data taken from the above source.

5) G: total net stock of public capital calculated as the sum of stocks of capital, which correspond to the state, to the regional autonomous communities, to local corporations and the rest of stocks, which correspond to public and non-public administration infrastructures. The source of this data was Mas and others (1996). The net stock of productive public capital (which refers to both public and non-public infrastructures) and the net stock of social public capital were also utilised independently. It should be noted that for construction the sum of the productive capital and social capital comes to less than total public capital since it was impossible to assign the capital that corresponded to the rest of public administration.

6) HC: The human capital indicator reflects the weight of the individuals with secondary school or graduate qualifications as a percentage of the total active population. The annual distribution of the active population according to their level of studies was taken from Mas and others (1995). From this starting point various indices are defined wherein those individuals with higher educational levels are grouped together. Specifically three indices are defined:

- A broad index that divides the total number of individuals with high school qualifications[2], pre university and graduate qualifications, by the total number of the active population.
- An intermediate index, whose numerator consists of those individuals with pre-university or graduate studies.

[2]By high "school qualifications" we refer to the three year-course which Spanish children have to pass in order to graduate from high school, usually at the age of seventeen or eighteen. By "pre-university qualifications" we refer to the one-year course that Spanish students must generally complete before gaining access to university. By graduate qualifications we refer to students who successfully gain either a degree or university diploma.

- A narrow index, which is obtained by dividing the active population with graduate studies by the total active population.

The time period analysed was from 1980 up to 1992 and this period was dictated by the availability of the basic statistical data with respect to particular variables. Specifically, the data series for gross value added began in 1980, while the most recent data for capital and investment corresponds to 1992. All the equations to be estimated are in the form of logarithms with the exception of the index for human capital.

All the equations were estimated by means of minimum least squares. Although the nature of the model itself indicates that the explanatory variables are endogenous, and this could produce a bias in terms of simultaneity, in practise the problems associated with the quality of the data mean that, in almost all of the empirical applications, ordinary least squares were used[3].

In each of the equations the corresponding individual effects were included, and these were treated as fixed effects. The purely cyclical effects were treated as auto correlated interference, which was why, instead of trying to take in and reflect these effects using artificial provisional variables, a first order auto correlation correction was introduced which used the same coefficient for all of the autonomous regions. It has been shown that this correction provides an explanation of the economic cycle similar to that, which would be provided using fictitious provisional variables. In most cases it may be observed that the statistic is very close to being non-significant which would appear to suggest that it does not affect the results obtained.

[3] See for example Hermin`s FEDEA model or the various estimations of regional production functions carried out by the IVIE.

3.2.2. An estimation of the production function

Table 5 takes in the estimations that correspond to the various specifications of total stock -capital that corresponds to total public administration together with non-public infrastructures-. In the first two columns a restriction has been imposed which dictates that the production function has constant returns to scale when all inputs, i.e. labour and both private and public capital, are considered. In the following two columns the estimation of the returns to scale is based purely on the data. In columns 1 and 3 it is assumed that the elasticity of the various factors of production is the same for all of the regions. In columns 2 and 4, the seventeen autonomous regions are divided into two groups, the first group (column 2) being made up of the objective 1 regions, and the second consisting of all the remaining regions. The different elasticities were then estimated for each of the groups. In order to simplify the table the estimations of the fixed effects were omitted.

In table 5 the following results are of special interest:

a) The data unambiguously rejects the hypothesis that returns to scale are constant and this rejection is especially unequivocal in the case of the objective 1 regions. Further, the precision of the estimators is prejudiced when constant returns to scale are assumed, and this is verified by the contrasts in heterocedasticity.

However, the fact that the result might be due to the quality of the basic data, rather than the structural characteristics of the Spanish regional economies, should not be discounted. It should be noted how the elasticity of production with respect to private capital in the objective 1 regions is abnormally low when the constant returns to scale constraint is not observed.

Table 5: Estimations of the production function augmented by the addition of Total Public Capital

	Constant returns to scale		Free returns to scale	
	Common elasticities	Specific elasticities	Common elasticities	Specific elasticities
Labour	0’598 (-)	0’508 (-) 0’675 (-)	0’335 (5’3)	0’319 (3’3) 0’368 (4’4)
Private capital	0’301 (4’1)	0’322 (3’1) 0’233 (2’3)	0’216 (3’2)	0’296 (3’1) 0’100 (1’1)
Public capital	0’101 (2’3)	0’170 (2’2) 0’092 (1’7)	0’181 (4’3)	0’202 (2’9) 0’211 (4’1)
Returns to scale	1	1	0’733	0’817 0’678
ρ	0’77 (16’5)	0’75 (15’6)	0’76 (15’9)	0’73 (14’6)
SSE	0’188106	0’182257	0’164579	0’156802
σ	0’0319	0’0316	0’0299	0’0294
R^2	0’942	0’943	0’999	0’999
Dw	1’54	1’56	1’54	1’57
F het.	2’30	2’20	1’68	1’69
F crs	---	---	35’05	7’29 30’80
F com.el	--	2’94	--	2’99

Notes: In the columns that refer to the specific elasticities, the uppermost figure represents the elasticity of the regions that are not considered to be objective 1, while the figure below it corresponds to the elasticity of the objective 1 regions. The figures given for labour and the two types of capital, represent the estimated elasticities (t); the returns to scale are the sum of all the elasticities; ρ is an estimation of the first order auto-regressive coefficient; SSE is the sum of the squares of errors; σ the estimation of the typical deviation of the residuals; R^2 the determination coefficient; dw Durbin-Watson statistic; F het. the statistic that represents the contrast in the residual heterocedasticity, possessing a distribution under the null hypothesis which varies in each case, but which may be approximated by an F statistic with 16 and 180 degrees of freedom; F crs is the statistic which contrasts the hypothesis of constant returns to scale, with a distribution under the null hypothesis that may be approximated by an F of 1 and 180 degrees of freedom; and F the statistic used to contrast the elasticities common to all of the regions with a distribution under the null hypothesis that may be approximated by an F with 2 and 180 degrees with respect to the specifications that impose constant returns, and an F of 3 and 180 with respect to the specifications that estimate the returns to scale from the data.

b) The hypothesis of the common elasticities for the two groups of regions is only just within the bounds of acceptability. When constant returns to scale are imposed the equality in the elasticities does not reject the usual level of significance of 5% since the critical value in this case is 5.5%. However, when the returns to scale are unrestricted the hypothesis of common elasticities is rejected, although only just, since the critical value becomes 3.3%.

Table 6 presents analogous estimations that allow different elasticities for productive public capital -the stock of public capital devoted to public administration investment in roads, hydrological infrastructure, the urban infrastructure corresponding to local corporations, ports, and non-public administration infrastructure- and the public capital of a social nature, that is, education and health. The statistics that refer to the elasticities of public capital are fairly low which might provoke the belief that the true elasticities do not deviate significantly from zero. However, a more detailed study of the structure of the correlation of the data reveals that all the inputs included in the production function are relevant, although the estimations of the elasticities of each of the two types of capital might be excessively imprecise.

Table 6: Estimations of the production function, augmented by with productive public capital and social public capital

	constant returns to scale		Free returns to scales	
	Common elasticities	Specific elasticities	Common elasticities	Specific elasticities
Labour	0’580 (-)	0’449 (-) 0’660 (-)	0’349 (5’4)	0’316 (3’3) 0’382 (4’4)
Private Capital	0’189 (2’5)	0’295 (2’7) 0’072 (0’7)	0’195 (2’8)	0’289 (2’8) 0’113 (1’2)
productive Public Capital	0’087 (1’3)	0’215 (2’’0) 0’042 (0’5)	0’103 (1’7)	0’146 (1’3) 0’158 (1’8)
Social Public Capital	0’144 (2’0)	0’041 (0’4)	0’143 (2’1)	0’103 (1’1)
Returns to scale	1	1	0’789	0’854 0’755
ρ	0’75 (15’3)	0’73 (14’6)	0’74 (14’9)	0’73 (14’2)
SSE	0’178601	0’170958	0’161215	0’156415
σ	0’0312	0’0307	0’0297	0’0296
R^2	0’945	0’947	0’999	0’999
Dw	1’59	1’58	1’56	1’57
F het.	2’52	2’21	1’79	1’76
F crs	--	--	25’00	4’16 19’36
F com el.	--	2’70	--	1’37

Notes: In the columns that refer to the specific elasticities, the uppermost figure represents the elasticity of the regions that are not considered to be objective 1, while the figure below it corresponds to the elasticity of the objective 1 regions. The figures given for labour and the two types of capital, represent the estimated elasticities (t); the returns to scale are the sum of all the elasticities; ρ is an estimation of the first order auto-regressive coefficient; SSE is the sum of the squares of errors; σ the estimation of the typical deviation of the residuals; R^2 the determination coefficient; dw Durbin-Watson statistic; F het. the statistic that represents the contrast in the residual heterocedasticity, possessing a distribution under the null hypothesis which varies in each case, but which may be approximated by an F statistic with 16 and 180 degrees of freedom; F crs is the statistic which contrasts the hypothesis of constant returns to scale, with a distribution under the null hypothesis that may be approximated by an F of 1 and 180 degrees of freedom; and F com.el the statistic used to contrast the elasticities common to all of the regions with a distribution under the null hypothesis that may be approximated by an F with 3 and 180 degrees with respect to the specifications that impose constant returns, and an F of 4 and 180 with respect to the specifications that estimate the returns to scale from the data.

From tables 5 and 6 the following conclusions may be drawn:

1) It is not clear whether the elasticities are the same for all of the regions or whether, there are differences between the objective 1 regions and the rest of the regions.

   In general, production in the objective 1 regions has a higher elasticity of labour, a lower elasticity of private capital, which in some of the estimations is unacceptably low, a lower elasticity of productive public capital, and a higher elasticity for social public capital. Whether the differences are sufficiently important to warrant treating each group separately is not made clear by the data however.

2) The hypothesis of constant returns to scale is rejected in favour of decreasing returns. This may be attributed to certain real features of the regional production functions, the omission of a relevant input, the use of minimum least squares or the basic data used. Given the heterogeneity of the various statistical sources consulted, and the difficulties intrinsic to the elaboration of the regional statistics for the variables utilized, the basic data itself was probably responsible.

3.2.3. An estimation of the demand function for Labour

Table 7 gives the results of some of the specifications that have been tested for the demand function for labour. It should be remembered that total employment and income are in the form of logarithms, which is why the coefficient for income should be interpreted directly as its corresponding elasticity. The index of human capital is always the weight of the population with the highest level of studies as a proportion of the total population, and the coefficient takes the form of a semi elasticity.

Table7: Estimations of the demand function for work

	Intermediate studies + pre university + graduate		pre university + graduate		graduate	
	Common elasticities	Specific elasticities	Common elasticities	Specific elasticities	Common elasticities	Specific elasticities
Income	0’549 (8’3)	0’605 (5’8) 0’509 (6’0)	0’567 (9’7)	0’588 (5’9) 0’538 (7’4)	0’628 (11’1)	0’669 (6’9) 0’593 (8’5)
Human capital	0’001577 (1’8)	0’000174 (0’1) 0’002560 (2’3)	0’006868 (1’8)	0’001864 (0’3) 0’014239 (2’5)	0’002730 (0’4)	-0’000680 (0’7) 0’015959 (1’6)
ρ	0’71 (14’3)	0’72 (14’4)	0’72 (14’7)0	0’72 (14’5)	0’71 (14’3)	0’71 (14’2)
SCE	0’205425	0’204448	0’204732	0’203069	0’207139	0’204966
σ	0’0333	0’0334	0’0333	0’0333	0’0335	0’0335
R^2	0’999	0’999	0’999	0’999	0’999	0’999
Dw	1’51	1’52	1’51	1’53	1’55	1’55
F het.	2’14	2’20	2’38	2’51	2’93	2’90
F com elas	--	0’87	--	1’50	---	1’94

Notes: In the columns that refer to the specific elasticities, the uppermost figure represents the elasticity of the regions that are not considered to be objective 1, while the figure below it corresponds to the elasticity of the objective 1 regions. The figures given for labour and the two types of capital, represent the estimated elasticities (t); the returns to scale are the sum of all the elasticities; ρ is an estimation of the first order auto-regressive coefficient; SSE is the sum of the squares of errors; σ the estimation of the typical deviation of the residuals; R^2 the determination coefficient; dw Durbin-Watson statistic; F het. the statistic that represents the contrast in the residual heterocedasticity, possessing a distribution under the null hypothesis which varies in each case, but which may be approximated by an F statistic with 16 and 180 degrees of freedom; and F com.el the statistic used to contrast the elasticities common to all of the regions with a distribution under the null hypothesis that may be approximated by an F with 2 and 180 degrees.

In columns 1 and 2 a broader version of the human capital index is used. The numerator of this index includes those individuals with intermediate, pre-university, or graduate qualifications. In columns 3 and 4 only individuals with pre university or university studies are included, whilst in columns 5 and 6 the index may be defined as the weight of the active population with university studies. In columns 1, 3 and 5 it is assumed that the coefficients are the same for all of the regions, while in columns 2, 4 and 6 specific coefficients are considered for the objective 1 regions and the rest of the regions.

Broadly speaking, what is evident is that employment within the objective 1 regions is less elastic with respect to income but more sensitive to variations in the stock of human capital. Further, when the effects specific to each region are introduced, human capital is only significant in the objective 1 regions. The most adequate indices for human capital are those that include, at the very least, pre university studies: if only university studies are taken into consideration the effect of human capital on employment is far less clear than when broader indices are used.

In spite of the apparent differences between the estimated coefficients of the explanatory variables in the models that allow distinct elasticities for groups of regions, the hypothesis that states that levels of employment always react to variations in gross value added and in human capital in exactly the same way, is not rejected. It becomes more difficult to sustain the hypothesis however, when more restrictive versions of the index for human capital are considered.

3.2.4. An Estimation of the private investment function

Table 8 gives the results of the estimations of the main specifications of the private investment function. In column 1 the given elasticity of income is the same for all of the regions while in the second column the objective 1 regions and the rest of the regions were allowed to have distinct elasticities.

Table 8: Estimations of the private investment function

	Common elasticities	Specific elasticities
Income	1’899 (11’2)	2’264 (8’8) 1’685 (7’9)
ρ	0’62 (10’7)	0’60 (10’1)
SSE	4’24971	4’5912
σ	0’1512	0’1499
R^2	0’976	0’976
Dw	1’74	1’74
F het	1’95	1’89
F Com el	--	4’03

Notes: In the columns that refer to the specific elasticities, the uppermost figure represents the elasticity of the regions that are not considered to be objective 1, while the figure below it corresponds to the elasticity of the objective 1 regions. The figures given for labour and the two types of capital, represent the estimated elasticities (t); the returns to scale are the sum of all the elasticities; ρ is an estimation of the first order auto-regressive coefficient; SSE is the sum of the squares of errors; σ the estimation of the typical deviation of the residuals; R^2 the determination coefficient; dw Durbin-Watson statistic; F het. the statistic that represents the contrast in the residual heterocedasticity, possessing a distribution under the null hypothesis which varies in each case, but which may be approximated by an F statistic with 16 and 180 degrees of freedom; and F com.el the statistic used to contrast the elasticities common to all of the regions with a distribution under the null hypothesis that may be approximated by an F with 1 and 185 degrees.

It is evident that there is a disproportional variation in private investment when income varies, and elasticity is higher in the non-objective 1 regions. The difference is significant, given that, the data reject, although not emphatically, the common elasticity hypothesis.

3.3. The model augmented with the addition of CSF funds

In the main, CSF funds are channelled via three major programmes:

- Investment in infrastructure, transport, and environment, which affect levels of both, productive and social public capital equally.
- Investment in education, re-qualification and all measures targeting the human capital of the region, aimed at augmenting levels of human capital.

- Support to agriculture, rural promotion, business and tourism, that co-finance private investment which is considered to be a priority and which, as a consequence, is related to levels of private capital.

In this section, the model developed in 3.1 is taken a stage further in order to allow for the incorporation of these three types of exogenous effects.

3.3.1. CSF aid for infrastructures

The introduction of CSF does not modify the exogenous nature of the investment in infrastructures. The determinants of investment levels however, require a more detailed explanation and this dictates that the investment associated with CSF, and the autonomous investment, which is determined using different criteria, should be separated.

Let $CSFI_t$ be the EU funds assigned for this objective, let r^I be the co-financing ratio for the national public sector, defined as the contribution of the internal public sector for each unit of money provided by the EU. The total investment in infrastructures provided by the CSF is

$$TIICSF_t = (1 + r^I)\ CSFI_t \qquad (10)$$

Where AII_t represents autonomous investment, and the total investment in infrastructures may be expressed as

$$TII_t = TIICSF_t + AII_t \qquad (11)$$

Assuming a constant rate of public capital consumption that is equal to δ^G, the stock of public capital for year "t" may be calculated in the following way

$$G_t = TII_t + (1-\delta^G)\ G_{t-1} \qquad (12)$$

3.3.2. CSF aid for education and re-qualifacation of human capital

The impact of this CSF programme is particularly difficult to evaluate. The overriding problem resides in establishing a nexus among specific actions connected to human resources, the levels of human capital, and income.

In previous sections, the level of human capital was approximated by defining it to be; the members of the active population with intermediate, pre-intermediate, or graduate studies. The question that this definition raises therefore, is; How would using EU funds to provide secondary education studies for those members of the active population with only primary studies, modify the human capital indicator. In other words, taking the average annual cost of secondary education, how many individuals with only primary studies would be able to achieve secondary-school qualifications using CSF funds for human resources? How would this change the index for human capital? And, what would the effects of this change in terms of income be?

Obviously, in practise, a proportion of the funds goes towards the education of individuals who already possess intermediate studies, which implies that the programme will not necessarily increase the index of human capital as it is defined in section 3.2.1. Further, some of the recipients of EU funds will already be working and, will leave work, or reduce the hours in which they work in order to further their education, whilst others who are unemployed will cease searching for employment in order to further their education. The real cost of elevating the educational status of this latter group therefore, is higher than that of an individual who does not constitute a member of the active population. This is true because the “real” cost is made up of the teaching costs together with the opportunity cost related to the loss of labour hours or a prolonged period of unemployment. However, since the relationship between CSF funds for training and education and regional income is difficult to establish, the approach taken in this analysis would seem to be reasonable.

It should also be noted that, as in the case of public capital, the incorporation of CSF funds within the model, does not affect the exogenous nature of levels of human capital. It does mean however, that it is essential to separate the intrinsic, independent evolution of human capital from the growth in human capital stimulated by the provision of European funding.

Let CSFHRt be the CSF funds for human resources provided by the EU, r^{HR} the ratio of co-financing for the national public sector, and $HRICSF_t$ the total investment that the programme generates, where,

$$HRICSF_t = (1 + r^{HR})\ CSFHR_t \qquad (13)$$

ACSSE represents the annual cost per student of secondary school education, where the secondary school teaching cycle lasts for “T” years. The number of individuals with primary studies able to obtain intermediate, secondary school qualifications, after a total expenditure of $HRICSF_{t,}$ is given by:

$$NSCSF_t=1/T(HRICSF_t/ACSSE) \qquad (14)$$

If it is assumed that the constant active population is equal to ACT, the equation for the accumulation of human capital will be

$$HC_t = \frac{NSCSF_t}{ACT} + AGHC_t + HC_{t-1} \qquad (15)$$

where the first term constitutes the contribution of the CSF human resources programme, and the second, the autonomous growth of the stock of capital derived from the normal processes of schooling. It should be noted that, because of the way in which the indicator is defined, there is no depreciation in the stock of capital that already existed.

3.3.3. CSF investment aid

As previously stated, CSF funds specifically destined for investment, go to co-finance projects undertaken jointly by both the internal public sector and the private sector. As a consequence, if the quantity of European funds available is equal to $CSFPA_t$, the volume of public resources available for the private sector is

$$CSFPF_t = (1 + r^{PA/PB}) \; CSFPA_t \qquad (16)$$

Where $CSFPF_t$ represents the total amount of public funds designated to the programme, and $r^{PA/PB}$ is the ratio of the co-financing of the internal public sector destined for aiding production.

Total investment depends on the ratio of co-financing for the private sector ($r^{PB/PR}$) and the general expenditure associated with the process (q^{PA}), according to the expression

$$CSFPAI_t = (1 + r^{PA/PR}) (1 - q^{PA}) \; CSFPF_t \qquad (17)$$

In the basic model, that is the model without CSF, private investment is totally endogenous and is determined by income. In the model that includes CSF, on the other hand, total private investment is made up of two elements, one that is endogenous and induced by income and expressed as IY_t, and an exogenous element linked to CSF funds:

$$I_t = IY_t + CSFPAI_t \tag{18}$$

Where the investment induced forms part of the basic model and is given by the equation

$$\ln IY_t = \eta_0 + \eta_1 \ln Y_t \tag{4}$$

and $CSFPAI_t$ has been defined in (17).

3.3.4. Definitive equation for income in the model with CSF

Following the methodology used to obtain equation (6), the growth of the stock of private capital with the aid of CSF funds may be expressed in the following way:

$$\frac{K_t - K_{t-1}}{K_{t-1}} = \frac{IY_{t-1}}{K_{t-1}} - \delta^I + \left(\frac{IY_t - IY_{t-1}}{I_{t-1}} \right) \frac{IY_{t-1}}{K_{t-1}} + \frac{CSFPAI_t}{K_{t-1}} \tag{19}$$

Approximating the rates of relative growth for the difference of the logarithms and then substituting the difference of the logarithm of induced investment for its corresponding expression in terms of the difference in the logarithm for income we obtain

$$\Delta \ln K_t = \frac{IY_{t-1}}{K_{t-1}} - \delta^I + \eta_1 \Delta \ln Y_t \left(\frac{IY_{t-1}}{K_{t-1}} \right) + \frac{CSFPAI_t}{K_{t-1}} \tag{20}$$

$$
\Delta \ln Y_t = \frac{\frac{\alpha_2}{(1-\alpha_1\beta_1)}\left(\frac{IY_{t-1}}{K_{t-1}} - \delta^I\right)}{1-\left(\frac{\alpha_2}{1-\alpha_1\beta_1}\right)\eta_1\left(\frac{IY_{t-1}}{K_{t-1}}\right)} + \frac{\frac{\alpha_2}{(1-\alpha_1\beta_1)}}{1-\left(\frac{\alpha_2}{1-\alpha_1\beta_1}\right)\eta_1\left(\frac{IY_{t-1}}{K_{t-1}}\right)}\left(\frac{CSFPAI_t}{K_{t-1}}\right) +
$$

$$
+ \frac{\frac{\alpha_1\beta_2}{(1-\alpha_1\beta_1)}}{1-\left(\frac{\alpha_2}{1-\alpha_1\beta_1}\right)\eta_1\left(\frac{IY_{t-1}}{K_{t-1}}\right)}\Delta \ln CH_t + \frac{\frac{\alpha_3}{(1-\alpha_1\beta_1)}}{1-\left(\frac{\alpha_2}{1-\alpha_1\beta_1}\right)\eta_1\left(\frac{IY_{t-1}}{K_{t-1}}\right)}\Delta \ln G_t \qquad (21)
$$

The independent component of private investment provides an additional term for the final version of the model, which takes the following form

From this expression it becomes possible to simulate the effect that the various programmes contemplated by the CSF will have on income. According to figure (21), growth in income is determined by four factors:

1) The dynamic of the endogenous private investment process, reflected in the weight of private investment induced in the previous period, in the corresponding stock of capital. This dynamic has a direct effect, via the first term, on the right hand side of the equation, and an indirect effect in that it modifies the coefficients that measure the changes in income, due to changes in the three exogenous variables.

2) CSF investment in private capital, which is made up of funds that come directly from the European Union, internal public funds, and internal private funds. The effect of CSF investment in private capital on the growth in income depends on its magnitude relative to the region’s stock of private capital.

3) The total growth in the stock of human capital, in which there is an autonomous component together with the effect of CSF funds destined for the programme.

4) The total growth of the stock of private capital, in which there are also two components; strictly autonomous investment linked to internal policy decisions and, the growth associated with the CSF infrastructures programme.

4. A quantification of the impact of CSF on the Galician economy

4.1 General approach

In order to measure the effects of the CSF programme, we simulate the evolution of income and the other relevant macroeconomic variables for the period 1993-2020, using the model described in section 3. First the paths for the independent components of the exogenous variables are established and the evolution of the economy is simulated under the hypothesis that the CSF has not existed; this first scenario constitutes what is termed the reference economy. The second scenario considered within this section differs from the first in that it includes all the funding, both public and private linked to the CSF (2000-2006) within the simulation of the economy.

In both cases, 1992 was the most recent year for which data on capital and investment was available. The results of the simulations are measured in real terms at constant 1990 euros. All the figures associated with CSF funds were originally in current pesetas (for the 1994-1999 CSF programme) or in current euros (for the 2000-2006 programme) and were thus deflated with the aid of the corresponding regional retail price index (RPI) before being introduced into the model. The RPI values for the years 1994-2001 are the actual observed values, while the values for the years 2002 to 2006 have been modified according to an assumed inflation rate of 2% per annum.

Besides analysing the evolution of the simulations year by year, the averages were also calculated for five aggregate time periods:

1) The first, which corresponds to the real time-span of the programme 1994-2006, and which measures the effect of the impact.

2) The second, which deals with the period, 1994-1999.

3) The third, which looks at the following period, 2000-2006.

4) The fourth, which gives the medium-term effects reflected in the aggregate 1994-2010.

5) The fifth, which gives the long-term effects measured by the total income generated in the period 1994-2020.

Besides analysing income, the evolution of other important variables, such as the stocks of capital and employment, are also studied.

4.2 A detailed description of the scenarios

4.2.1 Scenario 1: the reference economy

This scenario presupposes that the CSF programme does not exist. This implies that the evolution of income for the period 1993-2020 is predetermined exclusively by the dynamic of the model, which prolongs the economic momentum generated up until 1992, and by the independent evolution of the exogenous variables. Certain assumptions have been made with respect to these variables:

- The stock of human capital: the index that measures the stock of human capital grows by 1.5 percentage points annually.
- The stock of total public capital: the stock of total public capital grows at an accumulative rate of 6% net, annually, starting from the capital, which already existed in 1992.
- The stock of productive public capital: the stock of productive public capital evolves in a similar way to total public capital, the difference being that the accumulative rate is 5% net annually.
- The stock of social public capital: the social public capital evolves in exactly the same way as total public capital.

These figures constitute an average, lowered slightly in one or two cases, according to what was observed in the period 1980-1992. Further, based on the information available for this period, the following suppositions have been made for the non-estimable parameters:

- The depreciation rate for private capital: the depreciation rate for private capital is assumed to be 8.56% in 1992, and from this value there is an annual increase of 0.06%.
- The depreciation rate for total public capital, productive public capital, and social public capital: a common rate, which was assumed to be constant over time, was fixed at 4.20%.

Finally, for the reasons expressed in section 3.2.2, the specifications of the most suitable production function for the years 1980-1992 might be open to debate. Given that different specifications might lead to important differences in the simulated trajectory of the economy, the following sensitivity analysis was carried out. Four distinct production functions were chosen, and the model was solved using each of them, thus obtaining four distinct paths for the evolution of income. Following this methodology it becomes possible to compare the results and evaluate the extent to which the estimated effects of the CSF programme are robust with respect to the specific production function used. The four production functions are defined as follows:

Exercise 1: The production function incorporates total public capital, returns to scale estimated from the data and elasticities common to all of the regions; the coefficients are those that pertain to table 1, column 3.

Exercise 2: total public capital, constant returns to scale, a priori taxation, and common elasticities for all of the regions; these parameters can be found in table 1, column 1.

Exercise 3: productive public capital and social public capital, which are considered separately, returns to scale estimated from data and elasticities common to all of the regions; see table 2, column 3.

Exercise 4: productive public capital and social public capital, which are again considered separately, constant returns to scale a priori taxation and elasticities specific to the objective 1 regions. These elasticities are given in table 2, column 2.

On quantifying the impact of CSF on income, the results from each of the four exercises are compared. The study of the effects of the macroeconomic variables of stocks of capital and employment is carried out using the results of the assumptions defined in exercise 1.

4.2.2 Scenario 2: the economy with the CSF

In this scenario, CSF funds have been added to the independent evolution given in the first scenario. The funds that come directly from the EU are considered to be consistent with the quantities and schedules allotted to them, as and when each of the two plans was approved. Internal public, co-financing was not treated in the same way, because of the variety of potential interventions and the possibility that there might be imbalances. Accordingly the averages of the estimated co-financing ratios were calculated and applied to the corresponding EU funds. Private internal co-financing was calculated in exactly the same way as for public co-financing. Thus:

- The internal public co-financing ratios for the public capital programme take the following values: total public capital 0.564, productive public capital 0.569, and social public capital 0.493.
- The internal public co-financing ratio for the human resources programme takes the following value: 0.337.
- The internal public co-financing ratio for the investment aid programme takes the following value: 0.359.
- The internal private co-financing ratio for the investment aid programme takes the following value: 0.570

It is assumed that the figure for general expenditure is zero. Finally, based on the education figures of Uriel et al (1997), the average cost of secondary school education for each student has been estimated at 1950 euros (1990), a process which is assumed to last three years.

In order to evaluate the magnitude of the CSF programme with respect to the Galician economy, table 9 offers some of the coefficients for the volume of monetary resources involved in this programme along with the main regional macroeconomic variables. The figures for this table are the annualised impacts in constant euros, and are calculated as the total, in real terms, of CSF funds divided by the number of years in which they were distributed, and expressed as a percentage of the value of the micro-magnitude in 1992.

Focussing on the second programme, which takes in the years 2000 to 2006, the total number of interventions foreseen implies a positive, average, annual shock of 5.36% of regional 1992 GVA, or 30.09% of gross non-residential private investment (1992): These figures are therefore, much higher than those, which are usually considered in economic policy simulations.

In the simulations that have been carried out, the exogenous variables now have two components: one which is the same as that described in the reference economy and is consequently independent, and a CSF component which, constitutes the total amount associated with the CSF programme, that is, European funds plus internal public funds and, should they be available internal private funds. As in the case of the reference economy, a sensitivity analysis was carried out, in order to determine the extent to which certain factors such as the returns to scale of the production function might distort the estimation of the effects of the CSF.

Table 9.- CSF Funds annualised in % of the main Galician macromagnitudes (1992)

	EU Funds		Total Public Funds		Total Funds	
	CSF 94-99	CSF 00-06	CSF 94-99	CSF 00-06	CSF 94-99	CSF 00-06
Total CSF / GVA	2,60	3,05	3,81	4,46	4,61	5,36
CSF infrast / public capital	1,91	2,31	2,98	3,61	2,98	3,61
CSF prod. capital / prod. capital	3,25	3,28	5,09	5,15	5,09	5,15
CSF social cap. / social cap.	0,56	2,54	0,84	3,80	0,84	3,80
CSF prod. aids/ prod. aids	0,76	0,85	1,03	1,16	1,62	1,82
CSF prod. aids/ Private inv.	5,80	6,52	7,88	8,86	12,38	13,91
CSF total / Private inv.	14,58	17,12	21,38	25,04	25,87	30,09

4.3 Shock estimations

The simulations for the scenarios were carried out, while taking into consideration the corresponding sensitivity analysis for the changes in the estimated elasticities for the production function. This made it possible to carry out an initial evaluation of the results using the summary given in table 10. Table 10 was formulated by calculating the aggregate income for each scenario for the years 1994-2020, 1994-2010, 1994-2006, 1994-1999 and 2000-2006. The values for the totals obtained for the CSF programmes were expressed as a percentage of the corresponding aggregate income for the reference economy. Henceforth, it should be noted that non-agricultural private GVA will be considered to be synonymous with income.

Table 10.- Income with CSF in % of the income of the reference economy

Period	Exercise 1	Exercise 2	Exercise 3	Exercise 4
1994-2020	105,5	110,0	106,7	105,4
1994-2010	106,0	109,1	107,3	105,9
1994-2006	105,5	107,9	106,6	105,4
1994-1999	103,4	104,2	103,7	102,7
2000-2006	107,1	110,4	108,7	107,3

From this table it may be ascertained that:

1) The total income for the period 1994-2020 under he auspices of the CSF will be between 5.4% and 10% higher than it would otherwise have been without this community cohesion policy instrument. On looking at the impact for the period 1994-2010 we find that this evaluation varies very little, oscillating between 5.9% and el 9.1%.

2) The specification which gives rise to the greatest impact is that which is defined in exercise 2 and contains total public capital, ignoring the distinction between productive and social, constant returns to scale and common elasticities for all of the regions. The most conservative of the specifications is that which is given in exercise 4 in which productive public capital and social public capital are treated separately, in which there are constant returns to scale, and the elasticities are specific for each of the objective 1 regions. This arrangement however, is not independent of the specific way in which CSF funds are distributed, and this can be by comparing the estimates for exercises 1, 3 and 4 for the years 1994-1999 and 2000-2006.

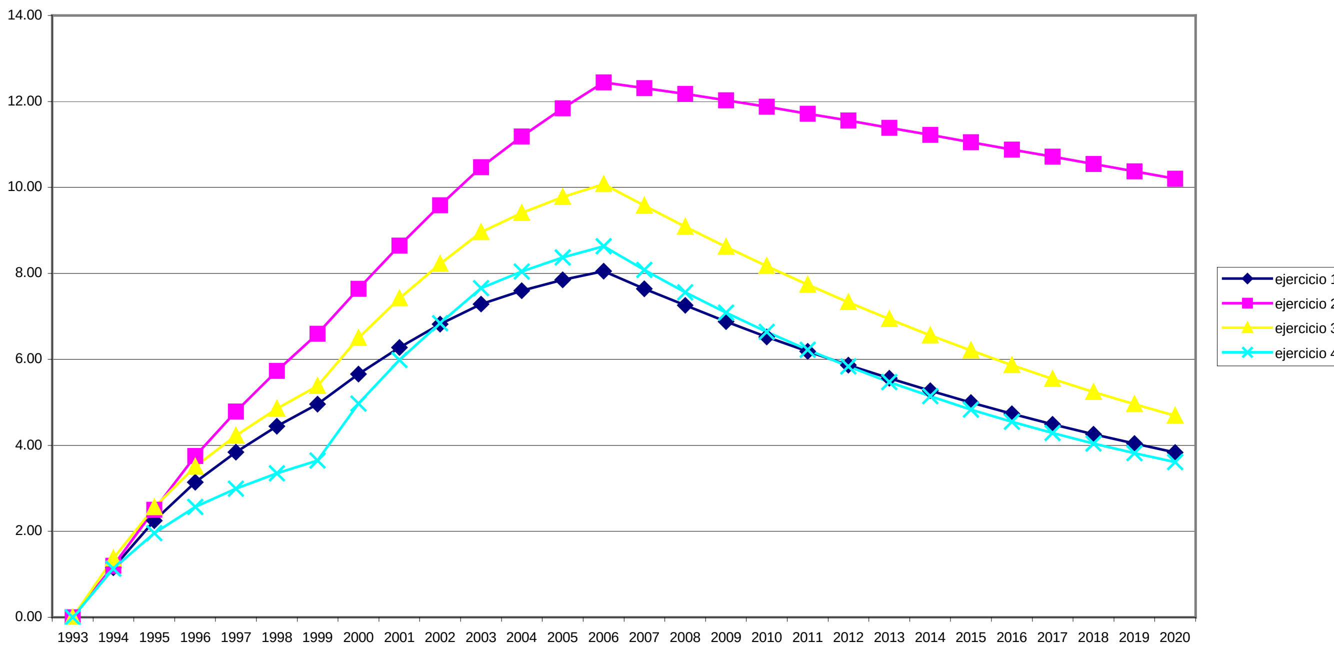
3) If the shocks associated with the period 1994-1999 are compared to those generated in the years 2000-2006, it would seem that the second generates much profounder effects than the first. It should be remembered however, that the starting point for the simulations for the years 1994-1999 is zero, whilst the simulations for the period 2000-

2006 incorporate the boost provided by the first CSF period and as a result the shocks are not directly comparable.

4) If the aggregate time periods 1994-2020, 1994-2010 and 1994-2006 are compared, the temporal profile is almost always the same: the greatest difference with respect to the reference economy is in the period 1994-2010, which indicates that the momentum provided by the CSF in the medium term, goes beyond the programme's finalization. However, in the long term, the force of the boost to the economy begins to decline and the reference economy begins to catch up in three of the four exercises.

Graph 1 represents the year-by-year contribution of the CSF to regional income up to the year 2020. This contribution is measured by taking the difference between the simulated income with CSF funds and the income for the same year for the reference economy expressed as a percentage of the latter.

Figure 1.- Increasing in income associated with the CSF (in % of the reference economy)



On comparing the estimated shocks for the four exercises, it is clearly observable that the results from exercise 2 are vastly different from the rest. According to this specification for the production function, the income for the economy with the CSF is much higher than that of the reference economy, which in turn is much higher than that of the other reference economy, simulated in exercises 1,3 and 4. This comparison leads us to suspect that the production function used in exercise 2 has led to an overestimation of the potential for growth in the Galician economy, and thus the estimations of the associated shocks should be viewed very cautiously.

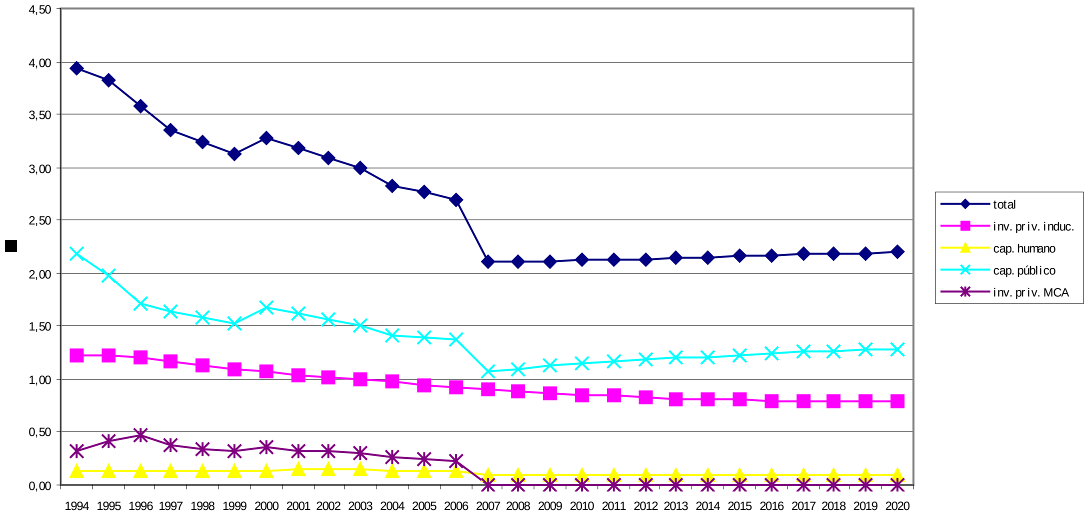
On considering the results obtained in exercises 1,3 and 4, the simulated paths for income indicate that the maximum CSF shock will occur in the year 2006, when income will be between 8% and 10% higher than it would otherwise have been without this community cohesion policy instrument.

From here onwards the gap begins to close rather slowly, although by 2020 it is hoped that income will still be between 3.6% and 4.7% higher than it would otherwise have been without the CSF.

Having finished this initial evaluation of the impact of the CSF, certain specific aspects of the framework are now analysed with the aid of the results obtained in exercise 1.

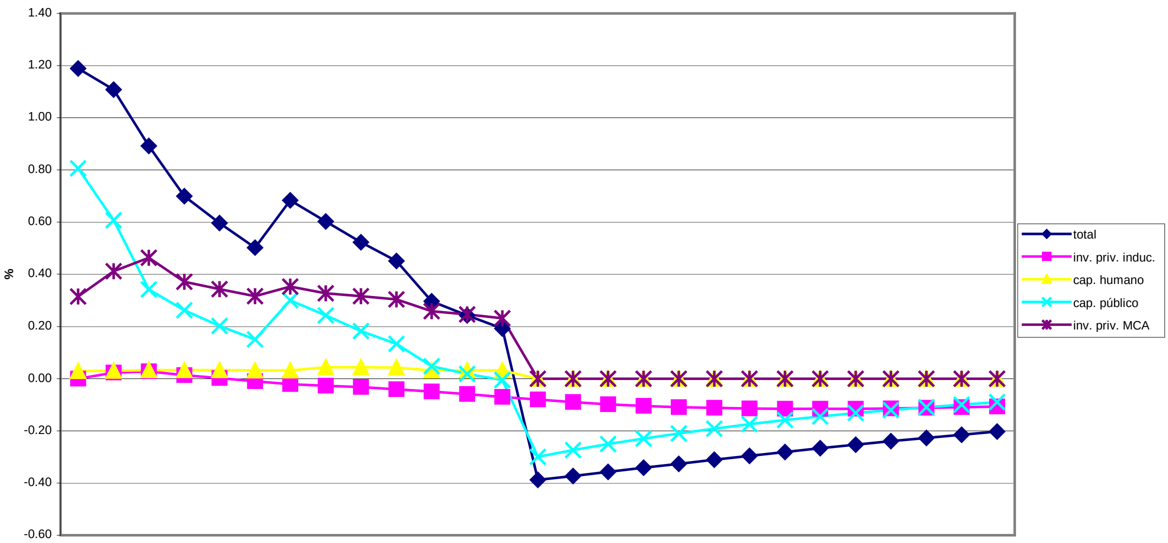
Graph 2 provides a breakdown of the inter-annual growth rate and the factors that explain this growth: the induced private investment or the contribution of the endogenous investment dynamic of the private sector, growth in human capital, growth in public capital, and the provision of total investment associated with the CSF aid programme. Given that the simulations that generate these breakdowns contain certain assumptions as to the independent evolution of the exogenous variables, the absolute figures are not in themselves particularly illuminating. The real kernel of interest lies in the fact that these figures diverge from their former values as a consequence of the impact of CSF funds and the way in which the boost provided by these funds fades out and the various contributions return to the rather gentler paths of evolution linked to the autonomous growth unstimulated by CSF funds.

Figure 2.- Division of the interannual growth rate of income with CSF



An evaluation is now carried out of the extent to which the CSF really has changed the contribution of each of the factors responsible for inter-annual income growth when compared to what would have been observed in the reference economy. To this end each of the factors for each year for the reference economy are compared with their counterparts in the economy with the CSF and the relative differences in growth are given in graph 3.

Figure 3.- Diferencial Evolution of the income growth explaining factors : economy with CSF versus reference economy 1994 to 2020



From the above graph it can be observed that from the year 2007 onwards the growth in income in the economy with the CSF is in fact lower than in the reference economy due to the sharp fall in total investment caused by the finalization of the programme. This result is consistent with some previous findings and in particular with the fact that the difference between the aggregate incomes for the period 1994-2020 with and without the CSF, was lower than the difference for the period 1994-2010. The graph is also quite illustrative in that it shows how augmented income growth changes due to increases in public capital and the dynamic which, shapes endogenous private investment. The graph also reflects the relative weight of the aid to production programme, especially towards the end of the programme.

Lastly, graphs 4 to 7 show the evolution of the differential with respect to the stock of private capital (graph 4), the stock of public capital (graph 5), the stock of human capital (graph 6), and employment (graph 7). As in graph 1, for private capital, public capital and employment the value that appears on the "y" axis for each year and scenario, reflects the difference between the value of the variable in the economy with the CSF and its corresponding value in the economy without CSF expressed as a percentage of the latter. In the case of human capital, the absolute difference in the indices is given.

Figure 4.- Increasing of the private capital stock associated with CSF (in % of the reference economy)

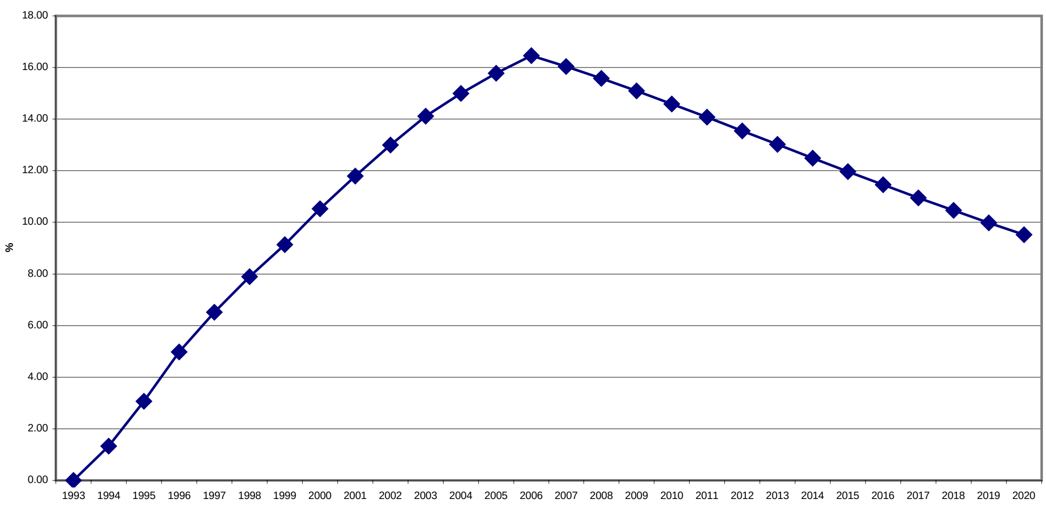


Figure 5.- Increasing stock of Public Capital associated with CSF (in % of the reference economy)

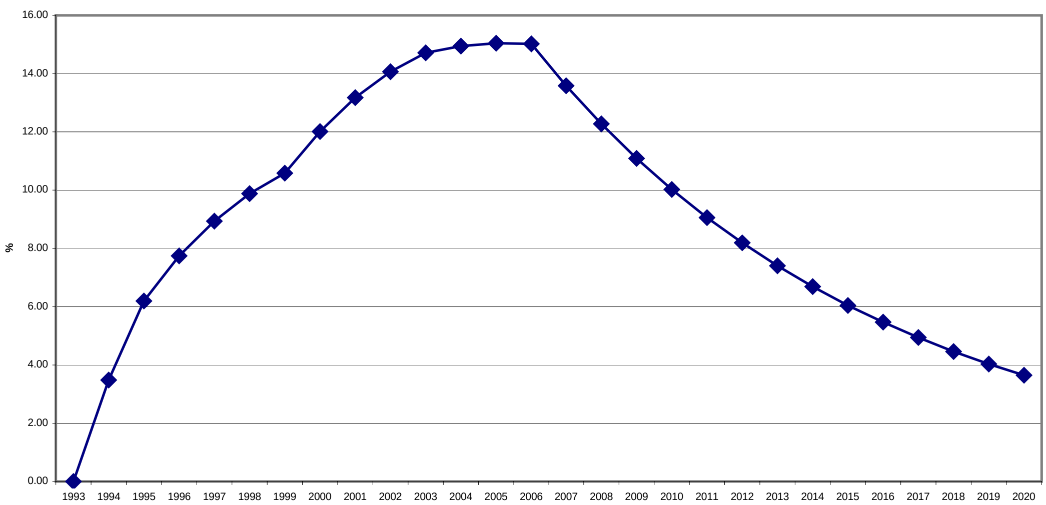


Figure 6.- Increasing stock of Human Capital associated with CSF (diference with respect to the reference economy)

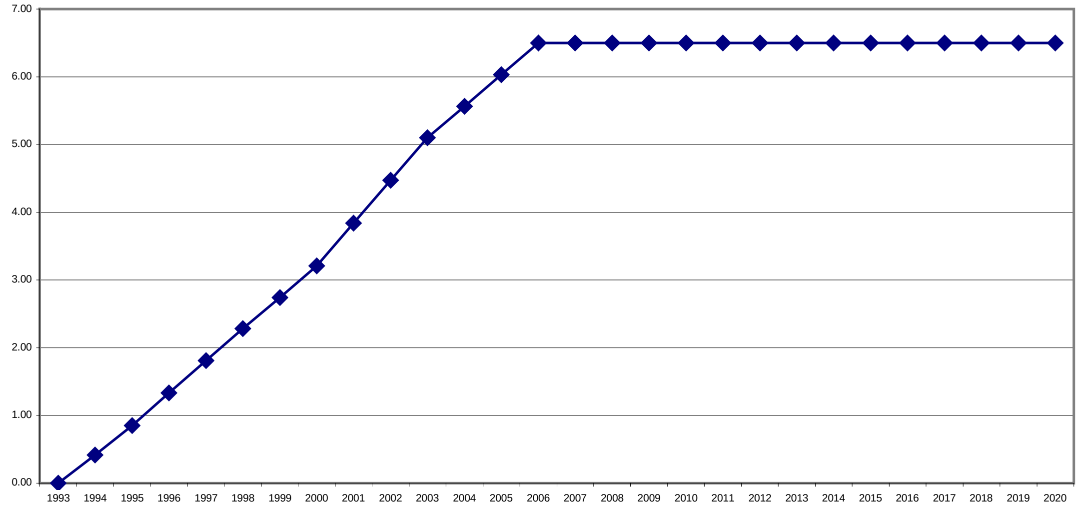
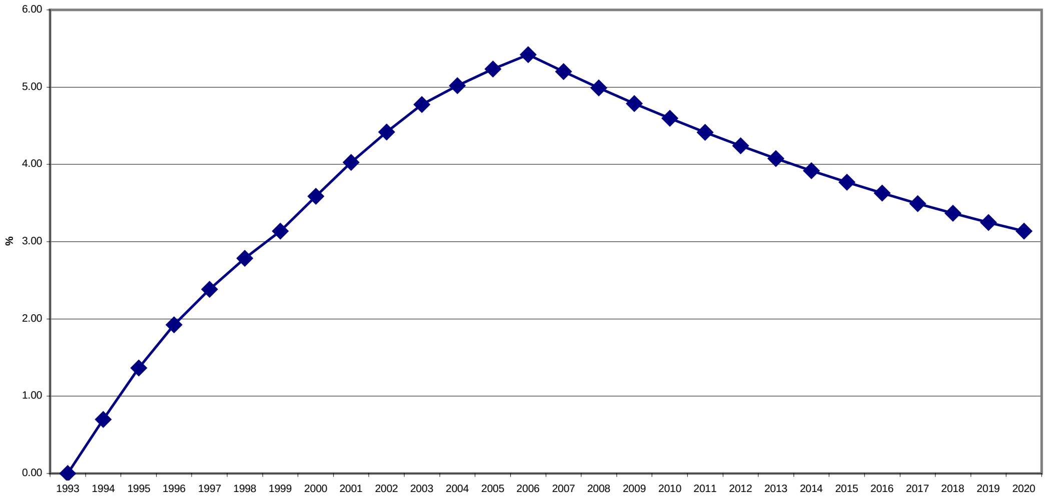


Figure 7.- Increasing employment associated with CSF (in % of the reference economy)



It may be observed that in the year 2006 the stock of private capital is 16.5% greater than the figure would be without the CSF funding package. The differences subsequently diminish, but in 2020 this figure is still approximately 9.5%. The stock of public capital does not grow quite so much. The peak of this growth is 15.1% in 2006. Subsequently, and after the finalization of the CSF, this difference also begins to diminish, falling to a figure of 3.6% in 2020. Human capital also fails to exhibit important variations between the scenarios. Given the assumed absence of depreciation, once the difference reaches its maximum, it then stabilises at an estimated figure of around 6.5%. Finally, employment at the point of maximum deviation is actually a little over 5.4% greater than in the case of the economy with the CSF, which constitutes a figure of 38,700 jobs in real terms, 6.8% of private non-agricultural employment in 1992. The difference with respect to the reference economy does not diminish quite so fast as with the other variables, given that at the end of the time-span analysed it is still about 3.1% higher than in the case of the economy with CSF.

5. Conclusions

In this paper we have present an evaluation of the EU regional policy for the case of an Spanish objective 1 region, Galicia, traditionally lagged behind but that has experienced in recent years a special dynamism. The analysis has been performed from data for 1994-1999 and 2000-2006 Galician CSFs by using a regional production function, a labour demand function and a private investment function estimated with Spanish regional data. An special feature of our analysis is that allows us to compare the effective evolution of the Galician economy with the one that would likely have taken place if Galicia would not have received the Community funds.

Our results suggest that the contribution of the Structural Funds to the growth of Galician output and employment has been considerable. Summarizing the main results of our simulations, in the long run (year 2020), the contribution to the growth of output of the 1994-1999 and 2000-2006 Galician CSFs varies between 5.4% and 10%. These results hardly change for the short run (year 2010) in which the percentages oscillate between 5.9% and el 9.1%[4]. In the medium run the accumulated impact on employment exceeds 38,000 new jobs, which in percentage terms means a deviation of over 5.4% with respect to the case of the economy without the CSFs. This deviation does not

[4] The two percentages we give are based on those specifications of the production function that give the minimum and maximum values in our simulation of the impact of Structural Funds

diminish quite so fast in the long run, given that at the end of the time-span analysed it is still about 3.1% higher than in the case of the economy without CSF.

On the other hand, in the short run, the accumulated impact of CSFs on the stock of private capital (public capital) exceeds sixteen percentage points (fifteen percentage points) with respect the scenario without CSFs. This percentage subsequently diminish, but in the long run it is still over nine percentage points (three percentage points) higher than in the reference economy. Human capital fails to exhibit important variations between the scenarios. Given the assumed absence of depreciation, once the difference reaches its maximum, it then stabilises at an estimated figure of around 6.5%.

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