Department of Economics

The Distribution of Public Expenditure in Europe

Juan González Alegre

Thesis submitted for assessment with a view to obtaining the degree of
Doctor of Economics of the European University Institute

Florence, February 2008

EUROPEAN UNIVERSITY INSTITUTE
Department of Economics

The Distribution of Public Expenditure in Europe

Juan González Alegre

Thesis submitted for assessment with a view to obtaining the degree of
Doctor of Economics of the European University Institute

Jury Members:

Prof. António Afonso, Technical University of Lisbon
Prof. Anindya Banerjee, EUI, Supervisor
Prof. Angel de la Fuente, IAE Universitat Autònoma de Barcelona
Prof. Rick van der Ploeg, EUI

GONZÁLEZ ALEGRE, Juan (2008), The Distribution of Public Expenditure in Europe
European University Institute
10.2870/2238

The distribution of Public Expenditure in Europe.

Juan González Alegre
European University Institute

February 2008

10.2870/2238

DEDICATION

A mis padres.

ACKNOWLEDGMENTS

This thesis would not have been possible without the support of my supervisor, Anindya Banerjee. I would like to thank him for his guidance, suggestions, discussions and patience, without which I would not have written this thesis.

I am also very grateful to the second reader Prof. Rick Van der Ploeg for his comments on the parts of the thesis and for his advice.

I have benefitted from discussions with and comments by Dejan Krusec, Peter Claeys, Sebastian Watzka, Antonio Navas, Steven Poelhekke, Vilen Lipatov, Alain Gabler and seminar participants at the European University Institute, Eidgenössische Technische Hochschule Zürich, Deutsches Institut für Wirtschaftsforschung and LABSI Experimental Economics Laboratory.

I thank Jessica Spataro, Lucia Vigna and the staff at the Department of Economics of the European University Institute for their invaluable advice and assistance.

Finally, I would like to thank my family and friends for their enormous moral support in these four years.

I would also like to acknowledge financial support from the Spanish government.

CONTENTS

Part I

Introduction

"*We assume that the government consumption variable measures expenditures that do not directly affect productivity but that entail distortions of private decisions. These distortions can reflect the government activities themselves and also involve the adverse effects from the associated public finance.*" Robert J. Barro and Xavier Sala i Martín (1995). Economic Growth. MIT press.

"*Theoretical analyses of the impact of intergovernmental grants on public expenditures have run either implicitly or explicitly in terms of the familiar theory of individual choice [...] it is clear that one can concoct particular instances in which a process of collective decision making will lead to results which are at variance with the conclusions which follow from the model of individual choice.*" David F. Bradford and Wallance E. Oates, (1971). Towards a Predictive Theory of Intergovernmental Grants. The American Economic Review, volume 61, number 2.

This thesis has the title "The distribution of Public Expenditure in Europe". It is composed of three chapters and focuses on the reaction of the economy to changes in the pattern of public spending. Our baseline is to investigate the two related principles introduced above: namely the distortions introduced by public expenditure decisions and the contributory role in these distortions of the differences in the decision making processes of different levels of public administration.

In the first chapter we explore the validity of the statement by Barro and Sala i Martin. It aims to fill the gap between the empirical and theoretical literatures by considering the distortions on private decisions induced by the distribution of public expenditure, ignored in most of previous empirical studies about the allocation of public expenditure. Usually, the analyses have looked at the alterations provoked by the distribution of public expenditure on growth or labor productivity, regardless of the mechanism through which these alterations were produced. We discriminate between the impact of the distribution of public expenditure on factor productivity and that on the markets for productive factors.

A broader interpretation of the assumption of Barro and Sala i Martin will lead us to the second and third chapters. Decisions about public expenditure made by certain levels of government affect not only private decisions but also the behavior of other levels of the public administration. Traditionally this phenomenon has been considered in a descending direction, i.e., decisions made by a more general level of public administration affect those made by another level closer to the citizen.

It is here where the differences in the decision making processes among levels of administrations described by Bradford and Oates play a key role. Bradford and Oates use their statement to justify the differences between allocating grants to private households or public bodies, but it can be easily extended to analyze the heterogeneous behavior of different levels of the public administration regarding public spending. We investigate in the second and third chapters how transfers of funds and fiscal autonomy to lower levels of the public administration may have an impact on the distribution of public expenditure and, therefore, also indirectly on the distortions of private decisions described previously.

The thesis has a focus on the allocation of public expenditure in European countries. The common denominator of all three papers is that they use models for panel data. In this framework panel data models have many advantages in comparison to time series modelling, since it allows for the inclusion of more observations for a shorter period of time taking into account relatively well the heterogeneity of the different countries.

More specifically, the first chapter constructs and estimates a panel data model to analyze the effects that the distribution of public expenditure among several categories may have on economic growth. We propose the use of three alternative dependent variables as a way to discriminate effects on growth through productivity from those that come through alterations in the markets of production factors. We consider two alternative classifications of public expenditure and we also introduce a dynamic ARDL model, instead of the static framework traditional in this literature. Using data for 15 European countries from 1971 to 1998 we find that Education, Health, Social Security and public Capital significantly affect economic growth through different channels. While public capital can be seen to distort the markets of production factors, the other three categories of expenditure seem to alter the productivity of factors. In particular, Education produces a positive impact while in the categories Health and Social Security seems to induce a certain level of over-spending.

The second paper analyzes the effects that fiscal decentralization may have on the economic distribution of public expenditures. Economic theory has traditionally explained fiscal decentralization by arguing that heterogeneous individuals get more utility from public goods provided by a closer level of government since it can tailor public spending to local tastes. In this paper we check to what extent decentralization may produce also alterations to the economic distribution of public expenditure. The estimations are based on a model in which the utility of the representative agent from current public expenditure depends on the distance to the level of the administration that provides it, in contrast to public expenditure

on capital. Spain after the Constitution of 1978 is a good example of fiscal decentralization from central to regional governments, with the particular feature that this decentralization process has not been homogeneous among regions, since some regions have made use of some historical rights reinstituted with the Constitution. Using data from the seventeen Spanish regions (1984-2003) we test the hypothesis that decentralized economies could experience a higher share of current expenditure in the budget of the public administrations, in contrast to public investment. We show that fiscal decentralization is a crucial determinant of the share of the public budget devoted to capital. This result may have important policy implications, especially regarding the relationship that public investment might have with economic growth.

The third chapter assesses the effects of European Union cohesion policy in the behavior of public expenditure of member countries. One third of the European Union budget is devoted to Structural Actions, with the aim of enhancing economic growth in less developed areas. The EU distributes Cohesion and Structural funds through the mechanism of "matching grants", that are paid conditional on a certain level of expenditure by local authorities on certain projects to which the European Commission gives priority. Existing studies with US data are reasonably sceptical about this kind of policies, since very often the grants received crowd-out part of the local public expenditure on the areas in which the grants are allocated. This is the first study that tries to measure the so-called "flypaper effect" of the European Cohesion policy, through looking at the response on public investment to the introduction of the EU Structural Funds, more precisely to the European Regional Development Fund and the Cohesion Fund, which are those devoted to financing strategic public infrastructure. Our results are reasonably optimistic. Using annual data from fifteen member countries, from 1993 to 2005, we conclude that there is no evidence of total crowding-out and that public investment in the member countries makes up around 60% of the increase in EU funds. In a sensitivity analysis with data from Spanish regions the results reveal that the implementation of the Cohesion Policy might also encourage investment at other levels of public administration .

In summary, comparing the results obtained in the three chapters with those in the related literature, some general conclusions emerge: first, the distribution of public expenditure matters for growth. The functional allocation is important, but also the proportion of public investment to public consumption as well as the allocation among levels of the public administration. We have identified some categories in which there may exist situations of over-spending or under-spending that could retard economic growth in Europe. In addition,

the processes of fiscal decentralization and distribution of grants are a good example of the impact of the decision-making processes in public expenditure distribution. The grants system introduced with the European Cohesion Policy seems to be designed to enhance public investment in certain regions, and works reasonably well. In contrast, the process of fiscal decentralization analyzed was a political transmission of fiscal autonomy with no economic objective. In this case, the proportion of public investment decreases dramatically, probably as a consequence of a better fit of sub-national levels of government to population's tastes. These results may give new insights in the fields of economic theory and political economy as well as guiding the relevant policy debates.

Part II

Chapters

CHAPTER 1

THE COMPOSITION OF PUBLIC EXPENDITURE AND PRODUCTIVITY GROWTH IN EUROPE

1.1 Introduction

The European Union agenda for growth as set out in the Council of Lisbon in 2000 puts emphasis on the need to enhance economic growth through policies that affect labor productivity.[1] Almost none of the objectives set with this purpose are related to the composition of the public budget.[2] Nearing the deadline of 2010, the economy does not seem to be behaving as well as expected[3] and the question arises of what else should be done in the area of fiscal regulation that could stimulate growth. We argue that the absence of regulation concerning the expenditure of expenditure of the member states may have played an important role in this lack of success.

The difficulties that previous fiscal rules had introduced in the relationship between the Commission and the member states[4] may have motivated the absence of measures concerning public expenditure in the Lisbon Agenda. Moreover, no clear indication about the optimal policies to be taken has been given by the economic literature either. Although several studies have revealed the important role played by the allocation of public expenditure on productivity growth, their many empirical drawbacks have led researchers to be sceptical about the results.

Growth regressions have been used to evaluate the impact of the distribution of public expenditure on growth. Since the first attempts in the late eighties, the estimations have

[1] This is a goal developed as a response to the decline in productivity growth in EU countries relative to the US since the mid-ninetees.

[2] The only measures related to the budget distribution concern taxation and a control over the expenditure on R&D activities, which are monitored by the European Commission. See Sapir (2003) for a detailed description of the Agenda.

[3] For example, the target of 3% of GDP devoted to Research and Development seems already unreachable. See Criscuolo (2007)

[4] As described by Alesina and Perotti (2004) in their analysis of the evolution of the Stability and Growth Pact (SGP).

been reasonably refined. The existence of a large number of studies has allowed the finding of some consensus on the control variables that should be included in these regressions. The availability of better data has motivated the change from the linear regressions to the use of panels that also exploit the time dimension. The findings of Kneller et al (1999) has revealed the importance of taking into account the budget constraint of the government when regressing growth on fiscal variables to make a correct interpretation of the results obtained. The possible endogeneity of fiscal variables with growth has also been addressed from several perspectives.

But there remain some doubts about the correct specification of a panel data model that describes the effect of fiscal variables on growth. Traditionally, with the aim of accounting for long-term impact and to concentrate the business cycle effects, the dependent variable, GDP growth, has been included as a forward-looking moving-average.[5] Levine and Renelt (1992) and more recently Bleaney et al (2001) have revealed the volatility of the results to the process of averaging and evidence the necessity of finding another methodology that make results more stable. Since them several attempts have tried to establish such a new framework: Basanini and Scarpetta (2001) and Romero de Avila and Strauch (2003) consider the possibility that the poor precision in the results is due to the necessity of discriminating between short-term and long-term effects of fiscal variables on growth. For their purpose they propose two different frameworks: Basanini and Scarpetta (2001) rely on the use of the Pooled Mean Group Estimator proposed by Pesaran et al. (1999) while Romero de Avila and Strauch (2003) base their analysis on the cointegration relations among the variables in levels in the framework proposed by Jones (1995).

However, the volatility of the results, criticised strongly by Levine and Renelt (1992), does not imply that the problem necessarily lies with not discriminating between the short term and the long term effects. As proposed by Gupta et al (2005), the problem could lie in the fact that the moving-average process for the dependent variable does not take properly into account the dynamic nature of growth regressions. The omission of dynamic relations among the variables could thus lead to biased estimations.

In this paper we use a dynamic panel data model, which has not been previously used, to explore the problem of whether reallocating public expenditure in Europe could promote economic growth. More precisely, we estimate an autoregressive distributed lag (ARDL) model, with lags in the dependent and explanatory variables. We judge that ignoring those

[5] Usually averaging over 5 years

dynamics could be an important source of bias. In fact, we show that the use of the same data to estimate the equivalent static model yields significantly different results. We estimate our dynamic model using the GMM estimator proposed by Arellano and Bond (1991). This estimator deals with one of the main shortcomings that may appear in regressions relating growth to public expenditure: the possibility that some of the explanatory variables could be endogenous. After having estimated the coefficients from the ARDL model, we can compute long-run coefficients from them, by assuming that the economy is at its steady state and all the variables grow at a constant rate.

The paper also sheds light on another unexplored issue and introduces a new question to this strand of the literature**.** Our proposal is based on the developments of economic theory. The first attempts to introduce public expenditure in general equilibrium models have traditionally relied on the assumption that public expenditure affects economic growth through productivity. But more recent developments also consider the existence of distortionary public spending, that affect the supply and demand of both production factors, capital and labor. Unlike economic theory, empirical studies have not traditionally paid attention to the way in which public expenditure may have affected economic growth[6]. Previous work tries to explore the question whether reallocation of public expenditure may affect growth, but it does not infer whether it does so by affecting the production factor markets or by altering their productivity.

By using three different alternative dependent variables, we are able to know more about the channel through which each category of public expenditure may affect growth. The comparison between the effects of reallocating public expenditure on GDP growth, labor productivity and multifactor productivity will help us to discriminate whether the effects come from alterations in the labor market, in the private capital goods market or in the productivity of the factors.

We also want to carry our analysis a little further and analyze how the disaggregation of data of public expenditure may affect the results of fiscal policy studies. Following the classification made by the IMF, two ways of disaggregating public spending are generally accepted. The first one is the distinction between public capital expenditure and public current spending. The second one is the so-called ´functional classification', that distinguishes

[6]with the notable exception of some studies based on simultaneous equation models (Mitze (2007), Fan et al. (2000), Alesina et al. (1993)). These studies, however, do not focus their attention in the distribution of public expenditure and, therefore, do not include disaggregated fiscal data.

categories according to their final use (education, health, etc.). Both of them have been used interchangeably to analyze changes in fiscal policy. We check the sensitivity of our results to the two methods of disaggregation.

Using yearly data from 17 European countries for the period 1971-1998, obtained mainly from the Government Financial Statistics Yearbook, edited by the IMF, we find a significant positive impact of education spending on growth. We also find a negative impact of health and social security expenditures, reflecting, probably, that the level of public expenditure on these categories may be above its economically optimal level. The functional categories of public expenditure considered affect economic growth mainly by altering multifactor productivity, since we are able to estimate a similar value for the coefficient when we regress either GDP growth, labor productivity growth or TFP growth on those variables. We also find a negative impact of public capital expenditure on growth, but in this case the mechanism is different, since the growth-retarding effect is caused by the crowding-out effect from public to private investment. This is revealed by the significant differences in the estimations when we use TFP growth as the dependent variable instead of GDP growth.

Section 1.2 presents an introduction to the inclusion of policy influences on growth, section 1.3 includes a literature review, section 1.4 describes the variables and data sources, section 1.5 introduces the methodology used and describes the results and finally section 1.6 concludes.

1.2 Overview of policy influences on economic growth

The traditional fully-exogenous growth models have been shown not to replicate stylized macroeconomic facts. Many extensions from the Neoclassical growth model are able to allow for government policy to affect the short-term growth rate, and even the level of growth in the long-term path by letting the efficiency of the economy to be related to institutional settings. Endogenous growth models are also able to replicate the influence of policy on growth, very often linking the contribution of the public sector to the process of productivity growth.

Public policy may intervene, not only via productivity growth but also in the process of accumulation of physical and human capital. A policy which may have positive effects on productivity growth may also at the same time have a negative effect on the supply of physical or human capital, for example. Increases in the rate of accumulation of physical capital may lead in a neoclassical growth model to a transitional period of increased output

growth, while endogeous growth models allow for more permanent effects on the steady state growth rate. Romer (1986) also introduces externalities to capital whereby private returns to scale may be disminishing, social return- relating for example to some externality on labor productivity induced by the new capital- can be increasing. Is this case the government has incentives to influence the rate of investment in physical capital either directly or by affecting incentives to invest in the private sector. The role of human capital can be analogous to that of physical capital. Advances in technological progress often have a strong link with education. Education may contribute not only via increases in the skill of the workforce but may also reinforce innovation processes.

Economic theory has considered several channels through which public policy may affect economic growth rates. Many recent studies examine the way in which the public sector may influence growth via research and development. Technological development is at least partially an endogenous process, that may be monitored by the government either by direct provision and funding but also through indirect measures that affect private sector R&D. An important issue to be considered is whether the relationship between public and private Research and Development expenditure is one of complementarity or substitution. Fagerberg (1987) models technological progress as the outcome of intentional R&D activities pursuing profits, while Jones and Williams (1998) outline several forms of negative spillover, such that social returns to R&D can be lower than private returns.

Several theories have also suggested the benefits that the openness to international trade of a country may have for its economy (Coe and Helpman (1995), Ben-David and Kimhi(2004)), via economies of scale, via exposure to competition and via the diffusion of knowledge. Trade may also be endogenous to the process of growth. Moreover, small countries are by default more exposed to foreign trade. This is the reason why many of the trade indicators used in estimations are usually adjusted for country size.

Monetary policy is also a key framework for the public sector to affect the economy. The main channel of relation is the effect that inflation may have on investment. The effect is direct, because it increases the cost of investment projects[7], and may also be indirect since the increase of uncertainty provoked by high levels of inflation may also affect private investment (Barro (1980))

[7]See De Gregorio (1993) and Jones and Manuelli (1993), although previous results suggest the contrary relation (Tobin (1965))

Finally, fiscal policy, which is the object of this study, has also been suggested as an important determinant of growth. We focus our analysis on public expenditure policy, although taxation and deficits may also affect growth. Taxes could distort incentives and change decisions about the allocation of resources (Barro and Sala i Martin (1992), Mendoza and Tesar (1998)). In fact the possible ways of taxation may be often classified as distortionary and non-distortionary depending on their impact on private decisions. High deficits have also often been linked to slowdowns in growth, with the traditional argument of increasing crowding-out effects on the private sector.

1.2.1 Neoclassical growth with public expenditure

In this subsection we will extend the simplest model of endogenous growth to assess several ways in which public expenditure could affect economic growth. Economic theory has considered several channels through which public expenditure may affect growth. In particular, public expenditure may affect the productivity of the private factors or the process of accumulation of private capital. It may also have an impact on human capital or could be considered a consumption good entering in the utility function. We include all these alternative types of public expenditure in an otherwise standard AK model.

Traditionally, growth regressions have not paid attention to the channel through which public expenditure affects growth. Nevertheless, this information can be extremely useful for the policy maker as well as in understanding the mechanisms of public expenditure. Previous estimations have relied on the assumption of public expenditure as a separate input in the production function.[8] This would imply that the impact of public expenditure on economic growth would be equivalent to that on multifactor productivity.[9] The theoretical framework that we develop here aims to introduce the use of alternative dependent variables (labour productivity and total factor productivity) as a way to identify and discriminate several types of public expenditure.

Let us assume an economy in which there are four types of public expenditure in an extended version of the AK model, which are represented by a productivity-enhancing type of public expenditure, (G_1), a capital-enhancing type of public expenditure, (G_2), a labour-enhancing type of public expenditure (G_3), and a publicly provided consumption good (G_4)

[8] See Devarajan et al. (1996) and Romero de Avila and Strauch (2003), for example.

[9] There is a large literature about the shortcomings and the modifications that should be made to the Solow residual so as it represents productivity more accurately. It is not the aim of this paper to enter this discussion. A good description of state of the art can be found in Hulten (2000).

Since the proposals by Aschauer (1989) and Barro and Sala-i-Martin (1992), public expenditure modelled as a separate input in the production function has been used very often in economic theory. We will assume a Cobb-Douglas technology with constant returns to scale over all inputs. In this framework, considering public expenditure as a separate input in the production function is equivalent to incorporating it as a part of the technological constraint that determines total factor productivity:[10]

$$Y = A_t * K_t^{\gamma} L_t^{\delta} G_{1,t}^{\alpha 1} \tag{1.1}$$

We assume constant returns to scale[11] over the private inputs.[12] If labor and private capital markets were not affected by public expenditure, the equilibrium amounts of both factors of production remain constant to alterations on public expenditure. That means that the effect of G_1 on labor productivity growth and total factor productivity growth is similar to the impact on production growth. The use of these three alternative dependent variables, as proposed in this paper, would make no sense if there were no other effect of public expenditure on growth. The coefficient to be estimated would be α_1 on each case.

The capital-enhancing type of public expenditure (G_2) responds to the cost-function approach of public expenditure proposed by several authors[13] to the problems introduced by the inclusion of public investment as a separate argument in the production function, as in G_1, which may violate the standard marginal productivity theory. Demetriades and Mamuneas (2004) study the reaction of output towards a type of public expenditure that affects the cost function of the private sector . In our case, we will make use of the simplest way of affecting the price of public capital, by considering G_2 to be a subsidy to the purchase of private capital, as proposed by Devarajan et al. (1998). Taking to be s a parameter lying in the interval (0,1) representing the non-subsidized share of private capital, the subsided private capital paid through the capital-enhancing type of public expenditure will be:[14]

[10] We can either consider G_1 as a separate input or as a determinant of A. This last option is more general since it allows for a negative impact of public expenditure on productivity, which seems counterintuitive if public expenditure is considered as an input. However, empirical evidence (De la Fuente (1997)) suggests that public expenditure could also induce negative effects in productivity growth.

[11] Aschauer (1989) also consider the case in which the congestion effects make the assumption of increasing returns inappropiate and alternatively assumes constant returns over all inputs. In fact Devarajan, Swaroop and Zou (1996), use it to claim that there is an optimal share of distributing public expenditure among the different possible categories of expenditure that maximices growth. It would not introduce, however, relevant variations on our analysis here.

[12] $\gamma + \delta = 1, \ \gamma, \delta > 0$.

[13] A complete motivation may be found in Romp and de Haan (2007).

[14] The introduction of this type of public expenditure usually responds to rigidities in the capital markets:

$$G_{2t} = (1 - s_t)K_t$$

G_3 will be the labour-enhancing type of public expenditure that will be able to affect the labor market. Corsetti and Roubini (1996) include a very complete proposal of how the impact of public expenditure on human capital could be modelled, while Van der Ploeg (2006) includes public employment as a determinant of private labor supply. Following Agenor (2007), we assume that the labor supply of the economy[15] depends not only on the level of population of the country and the wage rate, but also on the purchase by the public administration of some goods and services, such as education or health (G_3), that enhances the amount of labor available in the market:

$$L_t = N_t^{\nu} G_{3,t}^{\alpha 3} w_t^{\mu} \tag{1.2}$$

where N_t is the total population of the country at time t and w_t is the level of wages at time t. Wages are determined as in a market equilibrium, as the point in which marginal product and marginal cost of labor are identical. G_3 reflects the direct impact that economic theory admits that public expenditure may have on the behavior of the labor market. Certain types of public expenditure may provide incentives for the entry of additional labor in the economy (for example, appropriate education or health systems). But we could also find some other form of public expenditure that withdraws labor supply from the market,[16] either per se (expenditure in culture or recreation could increase the value of leisure), or by using an important amount of labor supply to provide the public services (as described in Agenor (2007)).

We finally assume that part of the public budget may be devoted to a fourth type of public expenditure represented by a consumption good, that does not enter in the production function but instead augments the utility of the population. An infinitely-lived representative

Demetriadis and Mamuneas (2004) consider adjustment costs; Moreno et al. (2003) assume short term rigidities; and Devarajan et al. (1998) instead introduce it as a response to the existence of a positive externality attached to the subsidized capital. Our model assumes that public expenditure on G_2 incentives private investment, although the situation could also be the opposite.

[15] Our view is slightly different, since Agenor (2007) considers also that only a constant portion of the population is educated and a separate labor market for the teachers that provide this education (equivalent to our G_2).

[16] Alesina et al. (2002) presents evidence of the negative impact of public wages expenditure on private investment and profits, that could support the existence of a negative impact on labor supply of some types of public expenditures.

household in this economy would therefore maximize the discounted stream of future utility represented by the equation:

$$U_s = \Sigma_{t=s}^{\infty} \beta^t C_t^{\theta} G_{4,t}^{(1-\theta)} \tag{1.3}$$

where C_t represents the amount of the private consumption good purchased by the representative consumer in period t, while $G_{4,t}$ is the publicly provided consumption good, decided by the government.[17] The inclusion of public expenditure in the utility function of the representative consumer will have consequences on the savings rate and, therefore, in the growth path of private capital. As long as a certain level of complementarity exists, an increase in public consumption enhances the marginal utility of the private consumption goods, which would lead consumers to increase their consumption and, therefore, alter also their pattern of investment. On the other hand, if we assume that both consumption goods, private and public consumption, are perfect substitutes, an increase in public consumption could lead to a decrease on the demand for the private consumption good, enhancing private investment. In either of these cases, the outcome of our model about the long-term neutrality of publicly provided consumtion goods would remain unaltered.

The public administration decides on $G_{1,}$ G_2, G_3 and G_4 and finances public expenditure levying a tax on production with a constant tax rate τ. It is not the purpose of this paper to solve the optimal fiscal policy to be run by the government since our estimations do not assume that governments set taxes and expenditures optimally.[18] We introduce a tax on consumption, **a**ware that in this framework it does not introduce any distortion on the results, with the purpose of setting up a model in which public expenditure is, at least partially, financed by tax revenues.[19]

[17] We have chosen the inclusion of the publicly provided consumption good directly in the household's utility based on Turnovsky (1999), and Baier and Glomm (2001) since certain degree of complementariry is desired.Other authors prefer to assume public consumption to be additively separable from private consumption (Cassou and Lansing (2004)) as in fact we do for simplicity in the second and third chapter of this thesis. For the sake of our analysis here, however, the inclusion of G_4 only makes sense under a more general framework in which there is complementarity between the private consumption good and the public good.

[18] Complete theoretical predictions about optimal fiscal policy may be consulted in Corsetti and Roubini (1996) for a general framework, Werning (2007) for a model with heterogeneous agents, and Glomm and Ravikumar (1997) for an overlaping generations model.

[19] An income tax or a tax on corporate profit would introduce alterations on the propensity of the representative agent to save and consume. Afonso and Gonzalez Alegre (2007) includes in addition an analysis of the effects of several types of taxation in which it is shown how in this framework a consumption-tax do not affect production in the long-term in contrast to labor-income and profits taxation.

$$\tau C_t = G_{1,t} + G_{2,t} + G_{3,t} + G_{4,t} + H_t$$

where H_t is the budget surplus (deficit) in period t. We have to take into account the behavior of the representative agent towards fiscal policy in order to work out the impact of the fiscal variables on production and productivity growth. The representative household, takes the decision of the government as exogenous, owns the technology, and distributes its income between private consumption and purchase of private capital for the next period. We also assume, for simplicity, total depreciation of private capital and the publicly provided input. That yields the following budget constraint:

$$Y_t = (1+\tau)C_t + s_{t+1}K_{t+1} \tag{1.4}$$

The Euler equation that results from the representative household maximizing the utility function (1.3), subject to its budget constraint (1.4) has the form:

$$\frac{C_t}{C_{t-1}} = \frac{G_{4,t}}{G_{4,t-1}}\left[\frac{\beta\gamma}{s_t}\frac{Y_t}{K_t}\right]^{\frac{1}{1-\theta}} \tag{1.5}$$

We are going to see now how the relationship of production, labor productivity and multifactor productivity with our four types of public expenditure is not identical among them. From equations (1.1), (1.2) and (1.5) we can derive the impact of all three types of public expenditure in economic growth. Substituting out and log-linearizing we obtain:[20]

$$\frac{\partial y_t}{\partial g_{1,t}} = \frac{\alpha_1(1+\mu)}{\Psi} \tag{1.6}$$

$$\frac{\partial y_t}{\partial g_{2,t}} = \frac{\gamma(1+\mu)(1-s_t)}{\Psi s_t} \tag{1.7}$$

$$\frac{\partial y_t}{\partial g_{3,t}} = \frac{\alpha_3\delta}{\Psi} \tag{1.8}$$

[20] Capital letters denote variables in levels while small letters are growth rates, following the standard notation.

$$\frac{\partial y_t}{\partial g_{4,t}} = \frac{\gamma(1-\theta)(1+\mu)}{\Psi} \tag{1.9}$$

where $\Psi = (1+\mu)(1-\gamma) - \delta\mu$. The derivative $\frac{\partial y_t}{\partial g_{4,t-1}}$ has identical value to $\frac{\partial y_t}{\partial g_{4,t}}$ but with opposite sign. This means that public consumption, unlike expenditure on G_1, G_2 or G_3,can only provoke a sustainable impact on growth when the change is permanent. Otherwise it will produce a current impact of growth that will be counterbalanced in the next period when the level of public consumption returns to its previous level.

However if we consider labor productivity instead of production, the coefficients would differ:

$$\frac{\partial(lab_t)}{\partial g_{1,t}} = \frac{\alpha_1}{\Psi} \tag{1.10}$$

$$\frac{\partial(lab_t)}{\partial g_{2,t}} = \frac{\gamma(1-s_t)}{\Psi s_t} \tag{1.11}$$

$$\frac{\partial(lab_t)}{\partial g_{3,t}} = \frac{\alpha_3}{(1+\mu)}\frac{\delta-\Psi}{\Psi} \tag{1.12}$$

$$\frac{\partial(lab_t)}{\partial g_{4,t}} = \frac{\gamma(1-\theta)}{\Psi} \tag{1.13}$$

Where $lab_t = \frac{\Delta\frac{Y_t}{L_t}}{\frac{Y_t}{L_t}}$ is the growth rate of labor productivity. The coefficients for G_1, G_2 and G_4 are almost identical to those derived in the equations for production. They are only slightly smaller because of the decrease in the numerator induced by the indirect effect that those types of public expenditure have on labor supply via wages. But the coefficient attached to the labor-enhancing type of expenditure, G_3, has opposite sign. This happens because if G_3 is able to increment production by increasing the labor supply available in the economy, decreasing returns to scale of a single factor on the production function will impose this productivity loss. Therefore we could identify a labor-enhancing public expenditure if we estimate opposite signs when regressing production and labor productivity growth on this variable.

Finally, the regression of TFP on G_2, G_3 and G_4 should yield insignificant coefficients, while the effect of G_1 is still α_1. The productivity enhancing type of public expenditure may

be thus easily identified since it is the only one that have a significative impact on TFP. The value of the coefficient that the describes the effect of G_1 on TFP should also be very close to the coefficients relative to production and labor productivity. There are small differences among them depending on the value of the elasticities of substitutions of capital and labor. The reason for this is the indirect impact that G_1 has on factor markets because of the changes on the marginal productivities of capital and labor induced by a larger production. The following table summarizes the set up of our model:

	Productivity-enhancing (G_1)	Capital-enhancing (G_2)	Labour-enhancing (G_3)	Public Consumption (G_4)
Production	+	+	+	only short time eff.
Labour Prod.	+	+	-	only short time eff.
TFP	+	no effect	no effect	no effect

Those relations assume values for the parameters that ensure a positive impact on current production of current expenditure, namely, $\alpha 1>0$, $0 > s_t > 1$ $\alpha 3>0$ and $0 > \theta > 1$.

Table1: Types of public expenditure and their relation with alternative measures of growth

This brief analysis will serve us to give a better interpretation of the coefficients estimated in section 1.5, and help us to infer which types of public expenditure are more related to the G_1, G_2, G_3 and G_4 described here. A good example of such inference are the positive coefficients associated to education in table 6. One may expect that education increases the productivity of the population. But we could also be concerned about the fact that public education could also withdraw an important amount of population from the labor market -acting like G_3 with a negative sign-, which could imply a growth-retarding effect. Our results reject that last possibility and confirm that public instruction has a significant positive impact on growth through enhancing productivity.

1.3 Literature review: Estimating the impact of public expenditures

The effects of government spending on growth have been the subject of many empirical studies. Although some of these studies (Ram (1986)) are based on time series studies, the

most used approach has been use the analysis of cross country data. Two pioneering studies in this vein are those by Barro (1991) and Easterly and Rebelo (1993). They highlight the relation of fiscal structure with growth as well as try to identify which of the ways of spending public funds encourages growth They also look at other economic variables that indirectly affects growth. Barro (1991) uses a static equation on 98 countries and introduces a great variety of variables. He estimates 23 possible equations using White's heteroskedasticity-consistent covariance matrix. Easterly and Rebelo (1993) replicate the work by Barro (1991) introducing a broader variety of fiscal variables. They also introduce the use of cross-country time series data to estimate a panel data model.

The results concerning fiscal variables are still quite variable among the different studies. Levine and Renelt (1992) in fact present evidence on the non-robustness of the results presented by the empirical growth literature, and the sensitivity of the results to changes in the conditioning set of variables. Miller and Russek (1997), using a panel of annual data for 39 countries, show that the effect on growth of changes in expenditure depends significantly on the way this change on expenditure is financed.

A first attempt to answer the critics was made by Devarajan et al. (1996), making use of economic theory to claim that the effect on growth induced by some kinds of public expenditure may depend on the initial level of expenditure. That is probably one of the reasons why subsequent work did not include developed and developing countries in the same panel, which had been quite a common practice in previous studies. Indeed, the use of a more homogeneous panel country sample seems to be a more adequate approach.

Kneller et al. (1999) showed that most of the previous research had ignored the government budget constraint thereby introducing a significant bias into the regression of the coefficients. The government budget constraint implies that the estimated coefficient of each fiscal element within a growth regression will depend on how it is financed. The omission of elements of the budget of the government introduces implicit assumptions about the financing of the variables included (it will be necessary to omit one variable to avoid perfect collinearity). They compare the results from their fixed-effects linear model estimated by OLS, with those from an instrumental variable estimation to conclude that the results of the OLS estimation were not caused by the endogeneity of the variables. But they also find that the results are sensitive to the 5-year averaging that they apply to the data to control for the business cycle. This result is reinforced in Bleaney et al (2001), while Odedokun

(2001) uses 5-year moving averages for estimating a panel data model for 103 countries classified in four groups, arguing that it is also an effective way to control for the endogeneity of the explanatory variables. He also sets up a fixed-effects model estimated using White's heteroskedasticity-consistent technique.

The findings in Kneller et al. (1999) will be taken into account in the subsequent studies. Bose et al (2003) in a panel of thirty developing countries use decade-averaged data for the seventies and the eighties. They estimate their linear equation using seemingly-unrelated regression, that allows for autocorrelation and heteroskedasticity of the error term. They also compare their results to those obtained using three-stage least squares to check for endogeneity as well as to expand the set of regressors to control for the effect of monetary policy or degree of openness. Robustness checks are performed, but the main weakness of their results is the small amount of data used to run the estimations, as well as, again, the year averaging technique.

Bassanini and Scarpetta (2001) instead argue that the use of data averaging implies a loss of information that such studies cannot afford. The lack of synchronicity in country business cycles does not purge five-years average from cyclical influences. They use the Pooled Mean Group Estimator that distinguishes between short and long-run effects. The main shortcoming of the use of this technique is the large number of coefficients to be estimated with a relatively small set of data.

Romero de Avila and Strauch (2003) and Tomljanovich (2004) also estimate short-term and long-term effects of the fiscal variables on growth in the same equation, but using a different approach, which is based on Jones (1995). The method relies on the specification of an equation based on an AK model with non-stationary fiscal variables (in levels) to discriminate the long-term effect on growth from the short term effect attached to the variables in first differences.

Gupta et al. (2005) set up a dynamic equation instead of data averaging to define long-term relationships. This article also contains an interesting study of the different specifications that the equation could take, and a comparison between the results that should be obtained using different estimation methods. They find that the results are quite robust to those changes.

1.3.1 Main Results

Traditionally, the dependent variables chosen to study the effects of fiscal policy on growth has been GDP growth in real and per capita terms. Some studies (see table 1), however, use an indicator of productivity such a total factor productivity or labor productivity (Cellini (1997), Englander and Gurney (1994) among others). The use of alternative dependent variables could affect the results of the estimates corresponding public expenditure, as we have just described in section 1.2. Regarding the control variables, the significance of demographic and labor force variables may also change among our three different specifications.

The first level of disaggregation of public expenditure, on an economic basis, is to break it into just current and capital expenditure. Barro (1998) finds that growth is inversely related to the share of government consumption in GDP, the relation with the share of capital expenditure is insignificant. The first result has been broadly confirmed by posterior studies, however the implications of the share of capital expenditure to economic growth seem to depend on the set of countries in which the regression is run. The excess of expenditure on an a priori productive category of expenditure may make it unproductive. The relation seems to be insignificant or negative for developed countries while there is a positive relation of the share of capital expenditure with growth in developing countries.[21]

When public expenditure is disaggregated according to its function, the results are usually dependent also basically on the level of current expenditure of the set of countries. There seems to exists an excess of expenditure in Health for the high income countries, that would retard growth. The level of expenditure on infrastructure on transport an communication seems to be rather low in developing countries according to Kneller,et al (1999) and Easterly and Rebelo (1993) and negative or insignificant for developed countries (Odedokun (2001), Bose (2003)).

The relation of expenditure on Defense with growth is quite controversial. Devarajan et al. (1996) find a negative relation of defense expenditure and growth for developing countries. However Barro (1991) classifies defense as a productive category of expenditure because it helps to protect property rights (Barro's work includes 98 countries, both developed and developing), and Bose et al. (2003) find a weak positive significant association between defense expenditure and growth. Aschauer (1988), who studies the relation of different

[21] See Devarajan et al. (1996), Odedokun (2001), Bose et al. (2003)

types of public expenditure on productivity, concludes that public expenditure on defense has a weak association with productivity movements.

The financing of public spending, as explained above, becomes a complementary study to the computation of optimal levels of spending. There is a huge literature also trying to define the effects on private behavior of alterations on the levels of taxation (Stokey and Rebelo (1995), Corsetti and Roubini (1996), Jones and Manuelli (1993)). Given optimal levels of taxation, the counterpart to alterations of government spending is the budget balance. There are some recent studies trying to identify the role of the deficit on economic growth. Perotti (1999) shows that consolidations tends to be expansionary when the debt is high. Other studies (Alesina and Perotti (1995), Alesina and Ardagna (1998), Von Hagen and Strauch, (2001)) show how the effect of a fiscal impulse is dependent on public budget composition. So, cuts in transfers and wages for example tend to cause and expansion while cuts in public investment tend to be contractionary. Baldacci et al. (2001) perform an empirical study of the impact of initial conditions on the effectiveness of fiscal policy.

A third issue of interest is the nexus between the composition of fiscal deficit financing and growth. The effect that fiscal consolidations may have in private investment also indirectly affect economic growth, by altering aggregate demand and money variables (Khan and Senhadji (2001), Sarel (1996)). Gupta et al. (2005) show for a group of developing countries the desirability that deficits are financed by external debt. The effects of changes on inflation and public spending are expected however to be quite diverse from developing to developed countries.

Author	Data periods and coverage	Dependent variable (s)	Estimation method	Comment
Aschauer (1988)	U.S. yearly data (1949-1985)	Output per unit of capital	OLS	The regressions include an interesting discrimination of military expenditure. Also identifies the importance of some 'core' infrastructures.
Barro (1991)	98 countries, average for the period 1960-1985	Per capita real GDP average growth rate	OLS (White covariance)	Identifies the positive relation of growth with human capital, a negative with public consumption and a neutral with public investment.
Levine and Renelt (1992)	119 countries, average for the period 1960-1989	Average annual GDP growth rate per capita	OLS (Robust Standard Errors)	They find that previous results are very sensitive to small changes in the conditioning information set. Positive correlation between growth and the share of investment on GDP.
Easterly and Rebelo (1993)	84 to 102 countries, decade averages 1960-1990	Log of real GDP per capita growth rate	OLS	They recognize the difficulty of isolate the effects of taxation. They get strong results on the implications of public investment in transport and communication on growth.
Hansson and Henrekson (1994)	14 OECD countries, average growth 1970-1987	Industry level rate of growth	OLS	Government transfer consumption and total outlays have a negative impact on growth while education expenditure has a positive impact and government expenditure is not significant.
Cashin (1995)	23 developed countries, yearly data 1971-1988	GDP per worker growth rate	Between effects and Fixed-effects	Identified a negative effect associated to tax revenues and a negative to current expenditure.
Devarajan, Swaroop and Zou (1996)	43 developing countries, yearly data 1970-1990	Five-year forward moving average of per-capita real GDP growth rate	Fixed-effects	They claim that there might be an excess of public capital expenditure for their data set.
Agell, Lindh and Ohlsson (1997)	23 OECD countries, growth average period 1970-1990	Real per-capita GDP growth rate	OLS	Includes shares of younger and older cohorts in the population and catch-up. Find very weak relations for revenues and expenditure variables.
Miller and Russek (1997)	39 countries (developed and developing), yearly data, 1975-1984.	Real per-capita GDP growth rate	Fixed-effects and random-effects	For developed countries concludes that debt-financing increases in expenditure have no effects on growth, but tax-financing increases do. Education expenditure is positively linked with growth.
Kneller, Bleaney and Gemmell (1999)	22 OECD countries, yearly data 1970-1995	Five-year moving average of per-capita real GDP growth rate	Fixed-effects, random effects.	They show that the omission of variables of the budget constrain may distort the results. They also identify relations for distortionary taxation and productive expenditure.
Odedokun (2001)	103 countries in 4 groups, yearly data 1970-1998	Five-year moving average of per-capita real GDP growth rate	Fixed-effects.	It is identified the variations of overspending on capital and current expenditure for countries for different groups of countries.
Bose, Haque and Osborn (2003)	30 developing countries, decade averages, 1970-1990	Decade average of per-capita real GDP growth rate	OLS, 3SLS	Identify the importance of education and government spending for economic growth in their set of countries. Also find a significant correlation with capital expenditure.
Gupta, Clements, Baldacci and Mulas-Granados (2005)	39 low income countries, yearly data, 1990-1999	Real per-capita GDP growth rate	Fixed-effects, GMM, A-Bond, IV.	They make an interesting analysis of the variation on the results to different specification of the equation and different estimation methods. They also introduce the importance of discriminating the sources of financing deficits.

Table 2: Selected literature review

10.2870/2238

1.4 Statistical Data and Descriptive Analysis

1.4.1 Data

As described earlier, the main goal of the present study is to analyze the implications on growth of fiscal policy in Europe, in particular regarding expenditure composition and budget balance of the government. Data for the variables where obtained mainly from two sources: the Government Financial Statistics Yearbook (GFSY) published annually by the International Monetary Fund and the World Development Indicators CD-Rom network.

The empirical analysis uses annual data on 17 European countries[22] from 1970 to 1998, with some gaps,[23] depending on the availability of the data. The choice of the countries source of data has been made by trying to include only countries that share structural economic homogeneity in Europe. For this reason we have omitted countries whose economies are or have recently passed through structural changes due to political reasons, like those belonging to the Soviet Union. This is motivated by the results found by Miller and Russek (1997) in which they show that the inclusion of heterogeneous economies with high differences in their level of development in a unique sample may lead to unprecise estimates.

As introduced above, this study uses three alternative dependent variables: per capita GDP growth, labor productivity growth and total factor productivity growth. The measure for GDP has been extracted from the World Development Indicators database elaborated by the World Bank, expressed in constant local currency units at market prices. Labor productivity growth has been computed from the variable real GDP per worker growth in PPP, obtained from the Penn World Table elaborated by the Center for International Comparisons at the University of Pennsylvania (CICUP). Finally the data for TFP have been kindly provided by the International Institute for Applied System Analysis (IIASA).

[22] Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

[23] The econometric methods used here can be easily accomodated to the estimation of unbalanced panel data, under the assumption of lack of serial correlation and the existence of a minimal number of continuous time period observations for each unit.

Variable	label	Units	Source
Per capita GDP (growth rate)	GDPpc	Growth rate (from data in constant LCU)	World Development Indicators Database (World Bank)
Labor Productivity (growth rate)	LabProd	Growth rate (from data in constant LCU)	Penn World Table (University of Pennsylvania)
Total Factor Productivity (growth rate)	TFP	Growth rate (from data in constant LCU)	International Institute for Applied Systems Analysis (IIASA)
Public Expenditure on General Public Services	Public Services	Perc. GDP /public exp.	IMF*
Public Expenditure on Defense plus Public Order and Safety	Defense	Perc. GDP /public exp.	IMF*
Public Expenditure on Education	Education	Perc. GDP /public exp	IMF*
Public Expenditure on Health	Health	Perc. GDP /public exp	IMF*
Public Expenditure on Social Protection	SocSecurity	Perc. GDP /public exp	IMF*
Public Expenditure on Housing and community amenities	Housing	Perc. GDP /public exp	IMF*
Public Expenditure on Recreation, culture and religion	Culture	Perc. GDP /public exp	IMF*
Public Expenditure on Economic affairs	Economic Affairs	Perc. GDP /public exp	IMF*
Public current expenditure	CurrentExp	Perc. GDP /public exp	IMF*
Public capital expenditure	CapitalExp	Perc. GDP /public exp	IMF*
Tax revenues	TaxRevenues	Perc. GDP /public exp	IMF*
Public Surplus (- deficit)	Surplus	Perc. GDP /public exp	IMF*
Terms of Trade	ToT	Constant US dollars	World Development Indicators Database (World Bank)
Labor force growth	LaborFgr	Growth rate	World Development Indicators Database (World Bank)
Private fixed investment	PrivFixedInv	Perc. GDP	Eurostat

* Historical Government Finance Statistics CD-rom (1972-1989 and Government Finance Statistics CD-rom (1990-1998) International Monetary Fund. The data are also available in the Government finance statistics yearbook

Table 3: Description of variables and data sources

Regarding the expenditure side of fiscal variables, we will use the functional classification from our main source of data, which is the Government Financial Statistics Yearbook (GFSY) published annually by the International Monetary Fund. This classification divide the expenditure into fourteen main categories, of which five are treated as an homogeneous group (Economic affairs and services). We have also obtained from the GFSY the data for the variables concerning the government's revenue which are included to take into account the government's budget constraint. Alternatively we also consider the classification that discriminates between capital and current public expenditure. The data in the GFSY are expressed in constant local currency and have been transformed into percentages of the GDP and into percentages of total public expenditure.

We have also considered some variables that have often been included in previous studies as conditioning on growth regressions. Levine and Renelt (1992) identify the investment share of GDP , the initial level of GDP per capita, the initial secondary school enrollment rate and the average annual rate of population growth as variables that always need to be included in the regression. Instead of the investment share of GDP, we will consider a measure of private investment (as done by Bose et al. (2003)) to avoid a possible multicollinearity problem with any expenditure variable. We consider the labor force growth rate rather than a population indicator to control for labor supply variations. The terms of trade has been included in some other studies. All these variables have been obtained from the World Development Indicators. (See table 3)

The main shortcoming that may be found in those data is that they only cover the operations of central governments. The volume of expenditure of regional governments may be quite significant in some cases and for some categories of expenditure like health or education that are often run by regional governments. Nevertheless, Devarajan et al. (1996) find that the differences between the coefficients obtained using the data for the general consolidated government and those obtained using only central government expenditure statistically insignificant in a regression quite similar to the one presented in this paper. We explore further the relationship of decentralization with public expenditure distribution in the second chapter of this thesis.

		Fiscal variables as a percentage over total exp.				Fiscal variables as a percentage over GDP			
	N	mean	St. Deviation	minimum	maximum	mean	St. Deviation	minimum	maximum
GDPpc	459	0.0273	0.0254	-0.0728	0.1120				
LabProd	440	0.0192	0.0298	-0.0968	0.1034				
TFP	459	0.0105	0.0231	-0.0894	0.1669				
Public Services	369	0.1023	0.0771	0.0270	0.3922	0.03812	0.0314	0.0080	0.1367
Defense	369	0.0751	0.0344	0.0203	0.2659	0.0263	0.0117	0.0064	0.0633
Education	369	0.0844	0.0405	0.0054	0.1665	0.0316	0.0176	0.0016	0.0775
Health	369	0.0897	0.0593	0.0024	0.2171	0.0317	0.0219	0.0010	0.1002
SocSecurity	369	0.3940	0.0902	0.1519	0.6417	0.1418	0.0430	0.0490	0.2297
Housing	369	0.0213	0.0135	0.0020	0.1137	0.0081	0.0059	0.0005	0.0381
Culture	369	0.0084	0.0049	0.0006	0.0249	0.0030	0.0018	0.0001	0.0094
Economic Affairs	369	0.1252	0.0532	0.0418	0.3086	0.0442	0.0187	0.0152	0.0914
CurrentExp	408	0.9197	0.0377	0.7330	0.9867	0.3376	0.0798	0.1091	0.5142
CapitalExp	408	0.0802	0.0377	0.0132	0.2669	0.0282	0.0124	0.0059	0.0650
TaxRevenues	394	0.8375	0.1075	0.4862	1.1105	0.2931	0.0823	0.1262	0.4430
Surplus	394	-0.0870	0.1067	-0.4424	0.2307	-0.0343	0.0428	-0.2103	0.0912
ToT	442	-2.44E+08	1.49E+10	-2.44E+08	7.82E+10				
LaborFgr	459	0.0089	0.0064	-0.006	0.0582				
PrivFixedInv	459	18.057	3.2266	11.380	29.492				

Table 4: Summary Statistics

1.4.2 Fiscal policy and growth: bivariate analysis

In table 5 we report simple correlations of the variables which are the main objective of interest of the study with the three alternative dependent variables: GDP growth, labor force growth and Total Factor Productivity . Correlation coefficients are calculated using the Spearman rank correlation formula to avoid the effects of outliers.

There is a significant association between deficit, expenditure composition and growth consistent with previous findings. The result that stronger budget balances are positively associated with per capita growth is not new. Regarding the composition of public expenditure, capital spending has traditionally been thought as a source of economic growth, while current expenditure is considered as less favorable for economic development.

Regarding functional categories of expenditure, Defense, Social Security and Economics Affairs and Services are also found to be related to GDP growth.

.

Variables	GDP growth	Labor prod. gr	TFP gr.	Obs
Gen. Public Services	-0.0863 (.116)	-0.0800 (.145)	0.0070 (.898)	369
Defense	-0.1258** (.021)	-0.1174** (.032)	-0.0986* (.072)	369
Education	0.0012 (.982)	-0.0093 (.866)	-0.0608 (.269)	369
Health	-0.0093 (.865)	-0.0251 (.648)	0.0009 (.987)	369
Social security and wel.	-0.1672*** (.002)	-0.1445** (.008)	-0.0721 (.189)	369
Housing and com. am.	0.0272 (.621)	-0.0115 (.834)	0.0480 (.383)	369
Recreation, culture and r.	0.0055 (.920)	0.0343 (.533)	-0.0108 (.843)	369
Economic Affairs and S.	0.1196** (.029)	0.0993* (.070)	0.1172** (.032)	369
Current Expenditure	-0.1425** (.009)	-0.0946* (.085)	-0.0210 (.703)	408
Capital Expenditure	0.0972* (.076)	0.0441 (.423)	0.0083 (.880)	408
Tax revenue	-0.0079 (.885)	-0.0053 (.923)	-0.0567 (.303)	394
Surplus (-deficit)	0.1673** (.002)	0.1275** (.020)	0.0310 (.573)	394

Bilateral correlation * Significant at 10 percent confident interval
** Significant at 5 percent confident interval
*** Significant at 1 percent confident interval

Table 5: Bivariate correlations (variables expresed as percentage of GDP)

These preliminary results are consistent with other consulted in previous literature, that show balanced budgets and investment in transport (included in Economic Affairs and Services) as being consistently correlated with growth. However, for Social Security and Defense there does not exist such unanimity, especially concerning Defense as detailed below.

1.5 Econometric Analysis

1.5.1 The econometric models

The growth equations can be derived from a growth model built around a constant-returns-to-scale technology. If countries were at their steady state, or if deviations from the steady state were random, growth equations would depend on the relationship between steady–state output and its determinants. Under the hypothesis that fiscal variables have an influence on long term growth, we include them in a regression of GDP, labor productivity or TFP growth rates on variables that the literature has identified as determinants for economic growth.

The equation relating disaggregated public expenditure and output growth has been traditionally specified as a static relation. Sometimes it can be thought of a "quasi-dynamic" approach, from the fact that many authors have chosen to substitute the dependent variable for a 5-year forward moving average of GDP growth, with the aim of purging out the business cycle effects.

Growth relationships are dynamic in nature, as growth in a given period is not uncorrelated with past growth trends**.** Parameter estimates based on a static fixed-effects estimator are biased and inconsistent if the true model is not static, even when the error terms are not serially correlated. For that reason we propose a panel data model that includes unobserved country specific effects and allowing for the existence of lagged values of the variables. Only Gupta et al (2005) introduce a lag of the dependent variable in an alternative specification to the specification they propose. However, no lags of explanatory variables are considered. We want to allow for the possibility that the variations of past fiscal variables may still affect current variations in growth. Specially regarding some kinds of public expenditures, it seems plausible to consider that the effects of some policies may take some time to appear.

In addition to the variables that are the object of study, some other variables that may affect output growth must be included in the estimated equation. The dynamic specification of this equation to be estimated from panel data can be expressed as an ARDL model:

$$y_{it} = \mu_i + \Sigma_{j=1}^{p} \lambda_j y_{i,t-j} + \Sigma_{j=0}^{q} \delta_j' fiscal_{i,t-j} + \tau_i other_{it} + \varepsilon_{it} \qquad (1.14)$$

$$for \qquad i = 1, 2, ..., N; \qquad t = 1, 2, ..., T.$$

The estimate of such models is done using the method proposed by Arellano and Bond (1991). The GMM estimate also controls for endogeneity by using the lagged values of the

levels of the endogenous and the predetermined variables as instruments. It is necessary to test for the validity of the instruments as well as the presence of serial correlation in the residuals once the equation has been estimated.

Estimates made by the Arellano and Bond (1991) procedure are made by the one step procedure, since the two step procedure has been found to lead to biased downward standard errors for small samples. They also develop a one step robust procedure for the cases in which heteroskedasticity exists. There is no need to use the robust estimator in this study due to the characteristics of the data (furthermore, the gains in precision of the two steps procedure are more relevant also in the presence of heteroskedasticity). The Sargan test of over identifying restrictions over-rejects in the presence of heteroskedasticity with the one step procedure, which will not be an drawback in our case since our data are not suspected of heteroskedasticity and in any case the Sargan test cannot reject the null hypothesis that the over-identifying restrictions are valid.

Long-run relationships between the variables may be easily derived from the estimation of equation (1.14). An economy on its steady state is assumed to show a constant rate of growth,and therefore identical values for the variables over time. Imposing this condition we can work out long-run coefficients:

$$\Delta = \frac{\Sigma_{j=0}^{q} \delta_j'}{1 - \Sigma_{j=1}^{p} \lambda_j} \tag{1.15}$$

Standard errors for coefficients obtained with this procedure may be easily computed using Stata. They are computed applying a delta method. A general discussion of this method can be found in Wooldridge (2002)

As we have previously justified, we want to discriminate effects on economic growth through changes in production factors markets from effects through changes in productivity by considering three alternative dependent variables: GDP per capita growth, labor productivity growth and total factor productivity growth. Labor productivity is the fraction of production for worker. We shall expect that when a fiscal variable induces an effect on GDP growth through altering the equilibria levels of labor supply, such an effect would dissappear, or even be reversed because of the decreasing returns to a single production factor, when

we regress labor productivity on that fiscal variable. The same reasoning would serve us to unmask simultaneous alterations from the same variable: one variable could for example enhance growth through productivity and simultaneously push down the supply of labor force, which could explain why we find an insignificant coefficient when we regress GDP growth on this variable.

Total factor productivity is a measure that indicates the part of growth in production that has not been induced by the alteration of the levels of both production factors. Initially computed as the Solow residual, there exists an extensive literature about refinements to be made on its computation as well as on its shortcomings.[24] By using TFP as a dependent variable, we estimate the effects that our variables of interest may induce in economic growth independently of the alterations on the production factors, i.e. exclusively through changes on productivity.

Simultaneously, we will consider two different specifications of the models, as suggested in Gupta et al. (2005). Recalling the results by Kneller et al. (1999) described in the literature review, it is necessary to take into account the government budget constraint to make a correct interpretation of the coefficients. In Model A, fiscal variables will be measured as a share of GDP omitting the variable that represents the fiscal balance (surplus). The purpose is to capture the effects of a particular expenditure categories assuming increases or decreases on government deficit as the source of financing . In Model B the fiscal variables are also measured as a percentage of GDP but we exclude from the government budget the variable tax revenues. The assumption in this model is therefore, that any possible change in public expenditure would be financed by altering the level of tax revenues, keeping the level of deficit and the other fiscal variables constant.

The description of each of the two alternative specifications are:

Model A: Public deficit as source of finance:

$$y_{i,t} = \alpha + \Sigma_{j=1}^{p} \lambda_j y_{i,t-j} + \Sigma_{j=0}^{q} \delta_j' fiscal_{i,t-j} + \tau_i other_{it} + \varepsilon_{it} \tag{1.16}$$

where $y_{i,t}$ is the growth rate of real GDP per worker; $other_{it}$ is a vector of nonfiscal variables often included in other similar regressions consulted in the relevant literature; and

[24] We have included data collected from the International Institute for Applied System Analysis (IIASA)

$fiscal_{it}$ is a vector of fiscal variables, the effect of the composition of the budget on GDP is the target of this study. These variables are measured in percentage of GDP and include the main categories of expenditure and revenue considered by the IMF. In order to avoid perfect collinearity among regressors, as explained above, the budget balance, represented by the omitted variable surplus, is not included. The coefficient accompanying expenditure variables will represent then, the effect on the dependent of increasing the amount of spending in the variable, financed by an increase in the deficit, or a decrease in the surplus. The coefficients associated with revenue variables have a similar interpretation, with the only difference that an increase on a revenue variable would imply a decrease of deficit instead.

Model B: Tax revenues as source of finance:

$$y_{i,t} = \alpha + \Sigma_{j=1}^{p} \lambda_j y_{i,t-j} + \Sigma_{j=0}^{q} \delta_j' fisc_{i,t-j} + \tau_i other_{it} + \varepsilon_{it} \tag{1.17}$$

where $y_{i,t}$ and $other_{lt}$ are defined as before, while $fisc_{i,t-j}$ is a vector of fiscal variables, as well as before, included with the aim of studying the effects of the composition of public expenditure on growth, but taking into account also the effect of the budget balance and omitting tax revenues instead. The interpretation of the coefficient associated with the expenditure variables now changes. These coefficients are now relative to the revenues. This means that they represent the effect on the dependent variable of a change in the public expenditure variable corresponding to the coefficient, financed by an equivalent change in tax revenues. The coefficient accompanying the variable surplus represents the convenience of reducing the deficit, under the implicit assumption that this would be financed by the omitted variable, tax reveneues.

1.5.2 Baseline regressions

Tables 6 and 7 present the results of estimating equations (1.16) and (1.17) with GDP growth, labour productivity growth and TFP growth as the dependent variables. The results shown are the long-term coefficients computed from those obtained applying equation (1.15) after estimating equation (1.14) using the GMM estimator proposed by Arellano and Bond (1991). In practice, we have included two lags of the dependent variable and one lag of the fiscal variables and private investment. The other two explanatory variables, Terms of trade and labor force growth, have only been included in levels.

Table 6 present the results concerning functional categories of public expenditure. Model A, in columns [1] to [3], assumes that the coefficients attached to public expenditure are associated to public deficit as a source of finance, while model B, in columns [4] to [6] assumes that the source of finance of additional public expenditure would come from extra tax-revenues.

The divergence attached to the variable "General Public Services" may reveal precisely that an increase of public expenditure on this category could be harmful for economic growth depending on the alterations that this increase would include in the public budget. Moreover, the fact that the coefficient is not significantly negative in the regression in which TFP is the dependent variable and that the coefficients estimated in columns [1] and [2] are not significantly different from each other, suggest that the growth-retarding effect would come through alterations in the market for private capital. This type of public expenditure has a behavior equivalent to the G_2 described in section 1.2 with a negative coefficient associated to it, representative of the so-called "crowding-out" effect of public expenditure on private capital.

	Model A: Fiscal variables as % over total exp.			Model B: Fiscal variables as % over GDP		
	(1)	(2)	(3)	(4)	(5)	(6)
	GDPpc gr.	LABpr gr.	TFP gr	GDPpc gr.	LABpr gr.	TFP gr
Public Services	-0.1083** (.053)	-0.1910*** (.071)	0.0463 (.057)	-0.0619 (.056)	-0.1238* (.072)	0.0838 (.059)
Defense	0.1445 (.307)	0.1740 (.409)	0.1943 (.351)	0.1400 (.332)	0.0461 (.424)	0.2613 (.349)
Education	0.7330** (.323)	0.8185** (.407)	0.9021*** (.345)	0.8363** (.328)	1.0158** (.414)	1.0004*** (.356)
Health	-0.5403*** (.174)	-0.6697*** (.207)	-0.4776** (.188)	-0.6900*** (.184)	-0.7971*** (.221)	-0.6285*** (.191)
SocSecurity	-0.3656*** (.092)	-0.2956*** (.111)	-0.1827* (.099)	-0.3839*** (.086)	-0.3970*** (.109)	-0.2545*** (.088)
Housing	-0.1459 (.294)	-0.3029 (.378)	0.1525 (.313)	-0.0434 (.342)	-0.0190 (.435)	0.0717 (.369)
Culture	-2.7623* (1.46)	-1.4675 (1.84)	-3.3937** (1.61)	-2.0745 (1.56)	-1.6096 (1.88)	-2.8239* (1.64)
Economic Affairs	-0.1057 (.128)	0.0240 (.167)	0.2113 (.140)	-0.2005 (.141)	0.0512 (.182)	0.1032 (.149)
Tax revenues	-0.1890*** (.070)	-0.2373** (.093)	-0.1905** (.077)			
Surplus (-def)				0.0204 (.059)	0.0925 (.075)	-0.0163 (.063)
ToT	0.1120 (.875)	0.2090* (.126)	0.2350** (.095)	0.0629 (.096)	0.0831 (.129)	0.2330** (.103)
LaborFgr	0.1234 (.231)	-0.1406 (.309)	-0.3222 (.247)	0.1668 (.233)	-0.0147 (.301)	-0.2727 (.025)
PrivFixedInv	0.00006 (.0007)	-0.00001 (.0009)	-0.0020*** (.0007)	0.0002 (.0007)	-0.0009 (.0009)	-0.0024*** (.0007)
Observations	288	269	288	288	269	288
Wald Chi2 (23)	397.91	327.79	228.30	372.53	323.10	204.23
Sargan test	265.59 Prob>chi2=.44	262.16 Prob>chi2=.50	274.95 Prob>chi2=.29	273.68 Prob>chi2=.31	267.83 Prob>chi2=.40	275.33 Prob>chi2=.28
A-B test aut. residuals order 2	-0.23 Prob>z=.81	-0.51 Prob>z=.61	0.19 Prob>z=.84	-0.38 Prob>z=.70	-0.62 Prob>z=.53	0.30 Prob>z=.76

*Significant at 10 percent confident interval
** Significant at 5 percent confident interval
*** Significant at 1 percent confident interval

Table 6: Functional categories of Expenditure. Long-term coefficients.

Nevertheless, we do not find statistically significant differences among the results of columns [1] to [3] for the rest of categories of public expenditure. For "Defense" , "Housing" and "Economic Affairs" we cannot show any significant relation with growth, labor productivity or total factor productivity. As for "Recreation", its negative relation with TFP is unclear.

Regarding education, our results suggest a positive correlation of the variable with growth. The larger absolute value and significance levels of the second and mostly third columns suggest that education could behave slightly as a consumption good (G_4) that retards private investment. But clearly its main role is to increase productivity, behaving like g_1 in section 1.2, and having an overall positive impact on economic growth because of its impact on multifactor productivity.

There seems to exist a situation of overspending in Health and Social Security policies,

for the period and countries considered.[25] Both types of public expenditure affect negatively TFP and therefore, economic growth. They are equivalent to G_1 in section 2 with a negative coefficient attached to it. In the case of "Health" we can see in addition that the coefficients in columns [2] and [5] are larger in absolute value. This could be due to the fact that this kind of expenditure could also behave slightly like G_3, encouraging small changes in labor supply. But this effect would be expected to be much weaker than the negative impact on productivity.

The differences between the estimations of models A and B are not dramatic. The negative coefficients estimated for "tax revenues" in model A together with the one estimated "General Public Services" make us think that financing extra expenditure by enlarging public deficit might be slightly more harmful than using taxes instead.

Table 7 show the results for the estimation of models A and B respectively when public expenditure is disaggregated according to its economic nature, between public capital expenditure and public current expenditure. Again we show the long-term coefficients computed from the dynamic model, in which we have included two lags of the dependent variable and one lag of the fiscal variables and private investment:

[25] This possibility have been addressed by the specific literature about health expenditure (Nixon (2000), Atun and Fitzpatrick (2005), Suhrcke et al (2006)) and have been focus of the attention of the European Commission (Directorate-General for Health and Consumer Protection (2005))

	Model A: Fiscal variables as % over total exp.			Model B: Fiscal variables as % over GDP		
	(1)	(2)	(3)	(4)	(5)	(6)
	GDPpc gr.	LABpr gr.	TFP gr	GDPpc gr.	LABpr gr.	TFP gr
Current expenditure	-0.0548 (.063)	-0.0437 (.072)	0.0053 (.080)	-0.0801 (.071)	-0.0523 (.084)	-0.1702* (.093)
Capital expenditure	-1.1068*** (.343)	-1.2556*** (.400)	-0.1263 (.524)	-1.4211*** (.359)	-1.4616*** (.431)	-0.4393 (.549)
Tax revenues	-0.00051 (.054)	0.0005 (.059)	-0.1768** (.077)			
Surplus (- pub. deficit)				-0.1128 (.070)	-0.0509 (.084)	-0.2253** (.107)
ToT	-0.1200 (.155)	-0.1660 (.191)	-0.2250 (.199)	-0.1130 (.164)	-0.1850 (.216)	-0.1930 (.204)
LaborFgr	0.0986 (.353)	-0.3777 (.425)	-0.7869* (.463)	0.2722 (.349)	-0.2072 (.630)	-0.6199 (.450)
PrivFixedInv	0.0008 (.0009)	0.0013 (.001)	-0.0030** (.001)	0.0014 (.001)	-0.0016 (.001)	-0.0034*** (.001)
Observations	324	305	318	324	305	318
Wald Chi2 (11)	134.02	138.97	57.44	145.84	134.85	61.58
Sargan test	185.61 Prob>chi2=.10	177.68Prob>chi2=.20	175.58 Prob>chi2=.20	161.70 Prob>chi2=.13	157.29 Prob>chi2=.19	152.08 Prob>chi2=.19
A-B test aut. residuals order 2	0.70 Prob>z=.48	0.56Prob>z=.57	0.02 Prob>z=.98	0.25 Prob>z=.79	0.12 Prob>z=.90	-0.16 Prob>z=.87

*Significant at 10 percent confident interval
** Significant at 5 percent confident interval
*** Significant at 1 percent confident interval

Table 7: Economic categories of expenditure. Long-term coefficients.

From table 7 we can infer that actually public expenditure is not completely optimally allocated either if we consider its economic classification. So, decreasing capital spending to finance a higher share in current expenditure or disminishing tax revenues or public deficit seems to represent an incentive to promote economic growth. The level of capital expenditure is above its optimal.

The negative and significant coefficient associated with the share of capital expenditure on GDP may seem against the standard hypothesis, but the comparison of the coefficients estimated in the three columns are informative about what could be the explanation for this effect. According to columns [3] and [6], public capital expenditure does not affect TFP significantly, i.e. the actual level of public capital expenditure is not harmful for the

productivity of the private factors. But the coefficients estimated in columns [1] , [2], [4] and [5] are negative and almost identical. This suggests that public capital expenditure could behave like G_2 with a negative sign, acting as a disincentive to private investment .This crowding-out effect from public to private capital is the origin of the negative impact of public capital expenditure on economic growth.

We find no significant coefficient attached to current expenditure. Tax revenues, according to tables 6 and 7 seems to be slightly growth retarding. The negative coefficient attached to private investment estimated in equation [3] in all tables is a natural consequence of the way in which TFP is computed.

We also include in our tables the outcome of some tests on the validity of the model estimated. The wald test of joint significance for all the variables entered in x (i.e. a test of the null hypothesis that their estimated coefficients are all zero. In all cases, we can easily reject the null.[26] The Sargant test cannot reject the null hypothesis that the over-identifying restrictions are valid. The Arellano and Bond (1991) test of second order autocorrelation cannot reject the null of no autocorrelation in all cases for reasonable confidence intervals. For simplicity we do not report here the equivalent test for autocorrelation of order one since first-order autocorrelation does not represent a problem for the validity of this GMM estimator.

The following table links the results reported in tables with the theoretical framework introduced in section 2. According to the comparison of the estimates in columns (1) to (3) and (4) to (5) for each variable, we can attach the behavior of our fiscal variables to the types of public expenditure described in section 2 and summarized in table 1:

	Productivity -enhancing (G_1)	Capital-enhancing (G_2)	Labour-enhancing (G_3)	Public Consumption (G_4)
Functional categories	Education (+) Health (-)	Social Security (-) Public Services (-)	Public Services (-)	Public order and defence Social Security
Economic Categories		Capital Exp. (-)		Current expenditure

Note: This table considers 5 percent significance level of the estimates.

Table 8: The theoretical interpretation of the estimates.

[26] The critical values for a 99 percent confidence interval are 10.20 and 41.64 for the Chi-Square distribution with 23 degrees of freedom, and 3.05 and 24.72 for the distribution with 11 degrees of freedom. See Bond and Windmeijer (2002) for more about the accuracy of the one-step Wald tests for GMM estimators in panel data models.

Health, for example, presents a negative estimator in all cases. Therefore, according to table 1, its behavior is more similar to the productivity-enhancing type of public expenditure. For some categories it is not possible to match the estimates with only one of the types of public expenditure described in section 2, but they could replicate the behavior of more of one of them simultaneously. It is the case of public services, whose negative estimates in the regressions for GDP and labour productivity suggest the behavior of the capital enhancing type of public expenditure. But the estimates are not identical in columns (1) and (2). This difference could mean that this variable is simultaneously behaving as the labour enhancing type of public expenditure, although the effect seems weaker.

The relationships that identify some public expenditure variables with the comsumption type of public expenditure (G_4) are only visible in the short-run. Therefore, we can only observe them in the dynamic model estimated according to equation (1.14) but not in the long-run coefficients estimated according to equation (1.15) and reported in tables [6] and [7]. We observe significant coefficient in the current period and in the lagged period with similar absolute value but oposite sign for the three categories included in table [8]: "Public Order and Defence", "Social Security" and "Current expenditure".

1.5.2.1 The importance of the dynamics and comparison with previous results

Tables A3 and A4 in Appendix III show the results of the equivalent estimations if we had considered the variables only in levels. Their conclusions are significantly different from the dynamic specification that we propose. Education would be an obstacle for growth in the static counterpart of model A, while we have estimated a positive coefficient, the coefficients associated to Health and Social Security are insignificant instead of negative, and they estimate a negative correlation of growth with current expenditure, and not with capital.

These divergences could partly explain the differences between our analysis and previous studies. If there exist dynamic relations between the dependent an explanatory variables, we should expect biased estimations from the static specifications modelled in previous studies.

The differences in the data sources and time periods, apart from the use of quite heterogeneous models and methodology to estimate the effects of public expenditure on economic growth, may also be the origin of heterogeneous conclusions. Out of the six studies that

we describe in the following table to compare with our results, only three of them include a dataset of developed countries that could be easily compared to our 17 European countries (Cashin (1995), Kneller, Bleaney and Gemmel (1999) and the subsection devoted to developed countries in Devarajan, Swaroop and Zou (1996)). The other three include a dataset of developing countries from which we might expect different relations between fiscal variables and growth. However these three studies use the more recent techniques that have been applied to our particular problem, and the comparison with our results here might be quite illustrative:[27]

	Our Estimation	**Cashin (1995)**	**Devarajan, Swaroop and Zou (1996) (21 OECD countries)**	**Kneller, Bleaney and Gemmell (1999)**	**Odedokun (2001)**	**Bose, Haque and Osborn (2003)**	**Gupta, Clements, Baldacci and Mulas-Granados (2005)**
Capital Expenditure	*-1.4*	*0.011* (log of 5 year moving average)	*0.072* (Defined over total expenditure)	not reported (n.r)	*-0.076*	*0.151*	*0.567*
Current Expenditure	no significative coefficient	n.r.	*-0.074* (over t.e.)	n.r.	*-0.09*	no significative coefficient	n.r.
General Public Services	*-0.1*	n.r.	n.r.	0.28 (vble " productive Expenditure" that includes in addition Defense and Transport and Communication, 5 y.m.a.)	*-0.15*	n.r.	n.r.
Education	*0.8*	n.r.	-0.029 (over t.e.)		*0.30*	1.582 (current exp. on educ.) 0.65 (cap. exp.)	n.r.
Health	*-0.6*	n.r.	0.019 (over t.e.)		*-0.34*	n.r.	n.r.
Social Security and Services	*-0.3*	0.0083 (log 5yma)	n.r.		n.r.	n.r.	n.r.
Tax revenues	*-0.2*	*-0.0190* (log 5 y.m.a.)	n.r.	*-0.41* (vble 'distortionary taxation' (on income, soc. sec., property and payroll, 5yma)	*-0.083*	*-0.209*	*-0.056*
Main differences with our model / estimation		Static model estimated using Between Effects estimator.	They use OLS/F-E Includes total exp. as explanatory	Static model estimates 2-way fixed effects	Fixed-effects Developing Countries	OLS 10 year averages variables. Low income countries	Fixed effects Developing countries
Dependent Variable		GDPpc growth 5 year moving average.	GDP growth 5 year moving average	GDPpc growth 5 year moving average.	GDPpc growth 5 year moving average.	10 year average GDPpc growth	Per capita real GDP growth

Table 9: Summary of previous comparable results.

The coefficients estimated for Education are smaller than the value "1.582" estimated by Bose et al. (2003) for a set of developing countries and higher than "0.305" estimated by Odedokun (2001) for developed countries. Devarajan et al. (1996) report a negative coefficient for education in the application of their model to a subset of 21 developed countries.

[27] Table [9] includes a summary of the main results on these studies that could be compared to our coefficients estimates in tables [6] and [7]. Explanatory variables are expresed on share over GDP unless specified.

They go further and identify University education as the main responsible for this negative coefficient. In general, the results in Devarajan et al (1996) contradict most of the literature and our results here. We suspect that the reason for this may be the mispecification of the model because of the omission on variables included in the budget constraint, as suggested by Kneller et al. (1999). We also consider that their Fixed-Effects and OLS estimation methods ignore the dynamic behavior of the variables that we introduce in this study.

The negative relationship between health expenditure and economic growth in developed countries has been previously found by Odedokun (2001). Devarajan et al (1996) are not able to find a negative coefficient attached to Health in their subset of developed countries. On the contrary, they find in a more disaggregated analysis that public expenditure devoted to hospitals have a positive impact on growth in contrast to the rest of health expenditure.

In contrast with the negative relationship of "Health" and "Social Security and Welfare" with growth, there is no coincidence of our results with some of the literature on the effects of "Economic Affairs and Services". This category could be included in what Kneller, Bleaney and Gemmell (1999) grouped with the denomination of 'productive expenditure', for which them they also find a positive correlation with growth. Easterly and Rebelo (1993) find a significant positive effect for expenditure on Transport and Communication on growth. The category Transport and Communications is one of the subcategories into which "Economic Affairs" is divided and it usually represents around half the amount of the whole category. On the contrary, we agree with some other studies (Devarajan et al. (1996), Bose et al. (2003)) who also find an insignificant coefficient attached to this category of expenditure.

The relation of expenditure to "Defense" with growth is quite weak. Devarajan, Swaroop and Zou (1996) find a negative relation of defense expenditure and growth for developing countries. We have described in the literature review the controversy that exists in the literature about the nature of this kind of expenditure.

The negative coefficient attached to public capital expenditure contradicts every previous estimation apart from the results of Odedokun (2001).[28] In any case, our estimated coefficient is larger in absolute value. This is the main difference obtained with our dynamic specification of the model in contrast to all previous studies, based on static relations. We

[28] also Devarajan et al. (1996) find a negative and significant coefficient associated to the share of capital expenditure on total public expenditure, for their sample of developing countries. They estimate the coefficient '-0.045 ', although their unit of measure is capital expenditure over total expenditure. Ours instead is the share of capital expenditure over GDP.

claim there might exists a bias from ignoring dynamics that could lead to underestimate the "crowding-out" effect introduced by public capital expenditure, and thus we identify as the main factor explaining this result.

1.6 Conclusions

This paper sought to shed light on the relationship between public expenditure composition, and economic growth in a set of European countries and put into discussion the necessity of reallocating composition of public expenditure as it may be important for increasing economic growth and productivity.

The lack of coincidence between previous results is one of the main shortcomings of this literature. We claim the reason of that disagreement maybe that most previous studies ignore the dynamic nature of growth relations while setting their economic models, and that may lead them to arrow biased conclusions. We show that, for our dataset, dynamics are a crucial determinant of the results.

We have also tried to include a new topic of discussion in the literature. So far, empirical studies have not compared the effects of their regressions on different dependent variables related to growth. We claim that by doing so, we may be able to identify the source of the distortion that the different categories of public expenditure may induce. In particular, the discrimination of the effects on GDP, labor productivity and total factor productivity will help us to understand whether public expenditure induces changes on the agents interacting in the factor markets that will translate to a different growth rate, or whether it affects the productivity of those factors.

Fiscal adjustment by cutting expenditure in selected categories, mainly "Health" and "Social Security", in favor of other categories more productive or for a reduction of tax revenues would affect positively economic growth. Regarding the economic classification of public spending, capital expenditure should be affected by some fiscal policy. Rather than simply disminishing the share of public expenditure devoted to capital, efforts should focus on eliminating the crowding-out effects that public capital may induce in the private capital markets.

The inclusion of sub-national levels of public expenditure, as well as a better specification of the origin of tax revenues would be an interesting extension to be done in the future.

1.7 Appendix I. The strategy of the EU to enhance growth

On 23 and 24 March 2000, an Extraordinary European Council in Lisbon set up a new strategic objective for the European Union. The goal to be reached in ten years is defined as: "making the Union the most dynamic, competitive sustainable knowledge-based economy, enjoying full employment and strengthened economic and social cohesion". After an initial phase of defining policy objectives and drafting policy reforms, some quantitative targets were decided subsequently at the 2002 Barcelona European Council (Commission of the European Communities (2002)).

The Lisbon process is the response of the policy makers to the fact that the EU was placed for the first time in decades, on a trend productivity growth path which is lower than that of the US, with the cross-over point occurring in the mid-1990's. The situation some years before was that of a productivity growth rate one point over that of the US (2.5 and 1.5 per cent respectively for the beginning of the 1990's, approximately), and has turned around in five years to situate the US one per cent over the EU.[29]

The European Commission developed a package of more than 100 highly varied indicators covering economic, social and evironmental indicators. The Commission has also agreed on a shortlist of 14 indicators.[30] Public spending is around 40% GDP in average in the European Union. Curiously, the measures taken by member states to reach the Lisbon objectives rarely affect the way in which the public finances of the members should evolve over time. Some policies to harmonize certain types of taxation,[31] the target of reaching the minimum level R&D expenditure (public and private) to 3% of GDP and the inclusion of specific goals to improve the efficiency of the Education system, constitute probably the closest influence that the Lisbon directives may have on Public Expenditure policies.

The lack of directives that affect the rest of the composition of the public expenditure of the member countries as well as its financing could be a response to the recent weakness of the surveillance system of the Stability Growth Pact, confirmed on 2003 with the decision of the Council to include a modification that would avoid to France and Germany of facing

[29] See Hishow (2005) for further details on the productivity gap between the US and Europe

[30] The 14 structural indicators on the list include: GDP per capita, labor productivity, employment rate, employment rate of older workers, education attainment, R&D spending, business investment, comparative price levels, poverty rate, long-term unemployment, dispersion of regional employment rates, greenhouse gas emissions, energy intensity and volume of transport.

[31] "Lisbon" Directives number 4, 5, 25, 43, 46 and 71.

sanctions for excess of deficit. Alesina and Perotti (2004), also identify other bureaucratic sources of inefficiencies in the decision making of the EU that could explain this situation.

In an analysis of the performance of the objectives of the Lisbon process (Deniset al. (2005)), the EU Commission put in evidence that those objectives are still far to be reached in terms of growth. Labor productivity growth rates continue to decline in the EU, despite having relatively high investment rates. This situation may suggest that the marginal productivity of capital is declining, possibly because of overinvestment in certain traditional sectors and in areas yielding less returns, while the levels of investment may be still too low in a range of the newer, high productivity growth industries. Simultaneously, the same study underlines the great share of public to private R&D investment in the EU, in comparison to the same share for the US economy. They suggest that the returns from private R&D investment is higher than those from the public one, and may reinforce the idea that the objectives regarding public investment (on R&D) included in the Lisbon process could be refined.

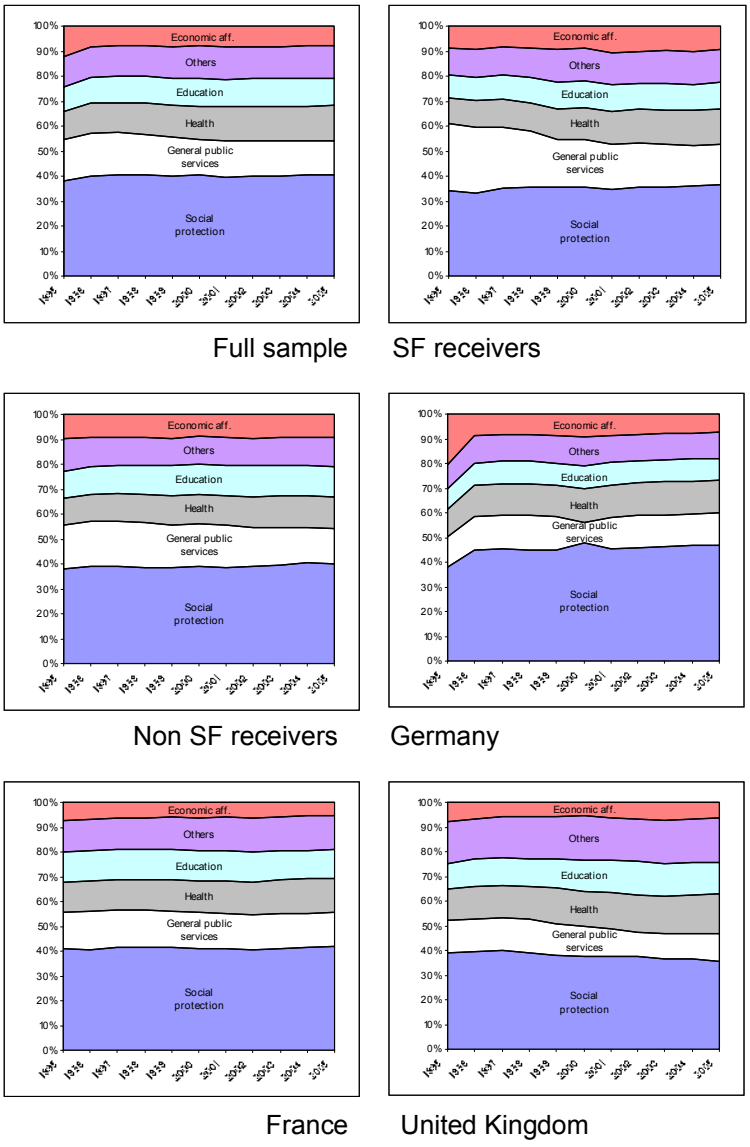
But this is not the only pessimistic evaluation on the performance of the Lisbon indicators. As at 2005, it was already widely accepted that the objectives fixed in 2000 were no longer available (Angermann et al. (2005)), the Commission decided then to propose some changes to the Lisbon strategy, in order to focus the efforts on growth and jobs. These changes also implied that Member States should produce and implement a national reform programme. Despite the concern of the European Commission about the quality and sustainability of public finances as a means to increasing their contribution to growth potential,[32] again no specific measures about the composition of the public budget of the Member States were included in the reform of the Lisbon process.

In figures 1.7 and 1.7 we show the evolution, immediately before and after the implementation of the Lisbon Strategy, of the main categories of public expenditure for selected groups of countries in our sample. Those are expressed as percentages of total expenditure and GDP respectively. The data have been obtained from Eurostat.[33] The data have been grouped into five groups: firstly, we consider the three larger countries in the sample, Germany, France and the UK, and secondly, we group the 13 remaining countries in two categories: a group of five Structural Funds' receivers, with lower per capita income and

[32] Reflected in the document Directorate-General for Economic and Financial Affairs (2004).

[33] These data are not exactly comparable to the data used for the regressions in this paper, since the functional classification of public expenditure made by Eurostat differs slightly from the one considered by the IMF in the Government Financial Statistics used as the datasource in this paper.

a the remaining 8 non Structural Funds' receivers, with slightly higher income. We have chosen this criteria in the basis of the similar behavior of public expenditure.



Data include subnational levels of public administration. Structural Funds (SF) receivers are Greece Ireland, Italy, Portugal and Spain while non Structural Funds receivers are the remaining: Austria, Belgium, Denmark, Finland, Luxembourg, Netherlands, Norway and Sweden. Source: Eurostat.

Figure A.1: The composition of public expenditure as % of total expenditure.

We do not observe dramatic changes in the pattern of public expenditure with the introduction of the Lisbon Strategy. However some changes may be mentioned, although

with the suspicion that some of the movements may have been induced by the business cycle. Firstly we could mention the general decrease that public expenditure as a percentage of GDP has suffered for all groups. This decrease may have been induced by the loss of importance in the public budget of the categories "General Public Services", "Economic Affairs", and partially "Social Protection", which is one of the main components of the budget and has seen its share of GDP declining softly, except if France and Germany.

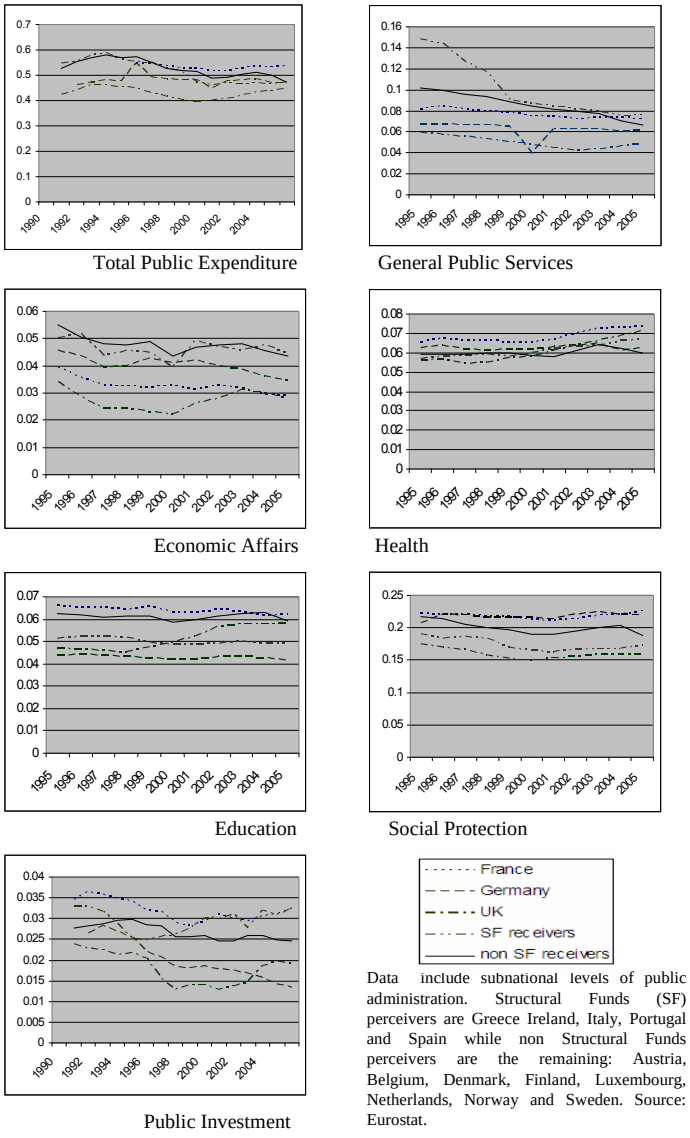


Figure A.2: The composition of Public Expenditure as % of GDP

The decrease in the importance of public expenditure in Social Security is the only "positive" measure if we take into account the results shown in section 1.5. Public expenditure

in "Health" has increased except for the group of non SF perceivers. "Education" has experienced a significant increase only for the group of SF perceivers, while the rest of countries have maintained it at stable levels despite the recommendation of previous studies mentioned in section 1.3 of increasing public expenditure in education to enhance growth.

Finally, regarding the economic classification of public expenditure, public investment, represented by gross fixed capital formation, has decreased its share on GDP significantly for all countries from the year 1998 onwards. Around 2003 this decrease has stopped, and even been reversed, but only the group of SF receivers has been able to reach stheir previous levels.

To sum up, it seems that public bodies in member countries have not taken very much into account the role of the composition of public expenditure in the group of measures established to enhance productivity growth in the framework of the Lisbon process. The results shown in some studies suggested a positive correlation of Education and public investment with economic growth and a negative influence of public expenditure in social security. We have refined the estimation of those relationships by including a dynamic model in this paper. Given that the Lisbon Strategy did not include specific measures regarding the allocation of public expenditure, there has been no reaction of the public budget in European countries to accommodate these finding.

1.8 Appendix II. Variable description

	Public Services	Defense	Education	Health	Soc. Security	Housing	Culture	Economic Aff.	CurrentExp	CapitalExp	Total Exp.
Austria	7.36%	6.41%	10.20%	10.11%	49.94%	3.87%	0.91%	11.21%	89.67%	10.33%	100%
	2.10%	*1.83%*	*2.91%*	*2.88%*	*14.23%*	*1.10%*	*0.26%*	*3.19%*	*25.55%*	*2.94%*	*28.50%*
Belgium	15.66%	6.68%	15.53%	1.47%	39.54%	1.45%	0.76%	18.91%	87.97%	12.03%	100%
	6.18%	*2.63%*	*6.12%*	*0.58%*	*15.58%*	*0.57%*	*0.30%*	*7.45%*	*34.67%*	*4.74%*	*39.42%*
Denmark	8.58%	7.25%	16.04%	10.04%	40.11%	1.51%	2.40%	11.34%	93.27%	6.73%	100%
	2.70%	*2.29%*	*5.06%*	*3.17%*	*12.65%*	*0.48%*	*0.76%*	*3.57%*	*29.40%*	*2.12%*	*31.53%*
Finland	7.94%	6.07%	15.35%	10.63%	27.28%	1.16%	0.97%	27.88%	84.00%	16.00%	100%
	1.88%	*1.43%*	*3.63%*	*2.51%*	*6.44%*	*0.27%*	*0.23%*	*6.58%*	*19.84%*	*3.78%*	*23.62%*
France	6.91%	7.58%	9.89%	14.99%	40.83%	3.17%	0.67%	9.50%	93.63%	6.37%	100%
	2.46%	*2.69%*	*3.52%*	*5.33%*	*14.51%*	*1.13%*	*0.24%*	*3.38%*	*33.28%*	*2.26%*	*35.55%*
Germany	5.06%	12.43%	1.47%	17.47%	46.62%	0.26%	0.39%	11.31%	90.44%	9.56%	100%
	1.12%	*2.74%*	*0.32%*	*3.86%*	*10.29%*	*0.06%*	*0.09%*	*2.50%*	*20.41%*	*2.16%*	*22.07%*
Greece	5.67%	14.86%	9.07%	7.38%	27.20%	3.39%	1.90%	25.50%	73.31%	26.69%	100%
	1.39%	*3.64%*	*2.22%*	*1.81%*	*6.66%*	*0.83%*	*0.46%*	*6.25%*	*17.87%*	*6.51%*	*24.50%*
Ireland	7.26%	3.40%	11.39%	13.75%	23.46%	4.20%	0.37%	18.44%	91.41%	8.59%	100%
	3.55%	*1.66%*	*5.57%*	*6.72%*	*11.46%*	*2.05%*	*0.18%*	*9.01%*	*44.67%*	*4.20%*	*48.87%*
Italy	15.20%	6.27%	16.06%	13.54%	42.30%	2.47%	1.03%	18.41%	91.40%	8.60%	100%
	4.50%	*1.86%*	*4.75%*	*4.01%*	*12.52%*	*0.73%*	*0.30%*	*5.45%*	*27.05%*	*2.55%*	*29.60%*
Luxemb.	9.16%	2.31%	8.74%	2.16%	46.75%	1.66%	1.34%	17.49%	86.15%	13.85%	100%
	2.68%	*0.68%*	*2.56%*	*0.63%*	*13.69%*	*0.48%*	*0.39%*	*5.12%*	*25.23%*	*4.06%*	*29.29%*
Nether.	15.34%	9.47%	15.16%	12.08%	36.12%	1.96%	0.73%	9.13%	92.54%	7.46%	100%
	6.32%	*3.90%*	*6.25%*	*4.98%*	*14.89%*	*0.81%*	*0.30%*	*3.76%*	*38.14%*	*3.07%*	*41.21%*
Spain	5.19%	6.52%	8.29%	0.94%	47.77%	2.02%	1.31%	17.49%	84.59%	15.41%	100%
	6.06%	*3.66%*	*2.94%*	*1.22%*	*7.37%*	*1.02%*	*0.13%*	*3.00%*	*24.10%*	*3.41%*	*27.50%*
Portugal	22.03%	13.29%	10.67%	4.43%	26.81%	3.72%	0.48%	10.91%	89.46%	10.54%	100%
	0.97%	*1.22%*	*1.56%*	*0.18%*	*8.96%*	*0.38%*	*0.25%*	*3.28%*	*15.76%*	*2.87%*	*18.76%*
Sweden	9.31%	12.51%	14.83%	3.57%	42.75%	1.51%	0.69%	10.57%	89.46%	10.54%	100%
	2.49%	*3.34%*	*3.96%*	*0.95%*	*11.43%*	*0.40%*	*0.18%*	*2.83%*	*23.93%*	*2.82%*	*26.74%*
UK	8.08%	16.72%	2.65%	12.19%	24.76%	1.75%	0.23%	11.09%	92.20%	7.80%	100%
	2.61%	*5.40%*	*0.86%*	*3.94%*	*8.00%*	*0.56%*	*0.07%*	*3.58%*	*29.79%*	*2.52%*	*32.31%*
Norway	6.85%	9.67%	9.92%	12.31%	32.52%	7.41%	0.67%	20.21%	95.04%	4.96%	100%
	2.07%	*2.92%*	*3.00%*	*3.72%*	*9.82%*	*2.24%*	*0.20%*	*6.11%*	*28.71%*	*1.50%*	*30.21%*
Switzerl.	6.47%	15.11%	4.22%	10.00%	38.96%	0.54%	0.31%	18.37%	86.67%	13.33%	100%
	0.82%	*1.90%*	*0.53%*	*1.26%*	*4.91%*	*0.07%*	*0.04%*	*2.31%*	*10.92%*	*1.68%*	*12.60%*

Data for 1972 except for countries with missing data for that year. In that case, we used the data for the closer year available. Numbers in cursive denote the variables expressed as percentage over GDP. The category General Public Services includes expenditure classified as " Other Expenditures".

Table A1: Disaggregated Public Expenditure for every country at the beginning of the sample-period

	Public Services	Defense	Education	Health	SocSecurity	Housing	Culture	Economic Aff.	CurrentExp	CapitalExp	Total Exp.
Austria	14.83%	4.75%	9.63%	13.51%	46.33%	2.55%	0.82%	7.58%	92.62%	7.38%	100%
	5.97%	*1.91%*	*3.88%*	*5.44%*	*18.67%*	*1.03%*	*0.33%*	*3.06%*	*37.32%*	*2.97%*	*40.29%*
Belgium	25.71%	4.75%	12.31%	1.74%	42.30%	2.30%	0.94%	9.95%	94.46%	5.54%	100%
	12.55%	*2.32%*	*6.01%*	*0.85%*	*20.66%*	*1.12%*	*0.46%*	*4.86%*	*46.13%*	*2.70%*	*48.83%*
Denmark	29.32%	6.24%	11.41%	0.68%	41.02%	1.64%	1.88%	7.81%	96.87%	3.13%	100%
	11.02%	*2.34%*	*4.29%*	*0.25%*	*15.42%*	*0.62%*	*0.71%*	*2.93%*	*36.41%*	*1.18%*	*37.59%*
Finland	22.26%	7.43%	10.38%	3.31%	36.39%	2.86%	1.04%	16.33%	95.41%	4.59%	100%
	7.42%	*2.48%*	*3.46%*	*1.10%*	*12.13%*	*0.95%*	*0.35%*	*5.44%*	*31.80%*	*1.53%*	*33.33%*
France	15.79%	6.61%	7.05%	21.71%	38.83%	1.14%	0.61%	8.24%	95.36%	4.64%	100%
	7.29%	*3.05%*	*3.25%*	*10.03%*	*17.93%*	*0.53%*	*0.28%*	*3.81%*	*44.03%*	*2.14%*	*46.17%*
Germany	18.35%	4.24%	0.54%	18.89%	50.03%	0.47%	0.11%	7.37%	95.62%	4.38%	100%
	6.21%	*1.43%*	*0.18%*	*6.39%*	*16.92%*	*0.16%*	*0.04%*	*2.49%*	*32.35%*	*1.48%*	*33.83%*
Greece	39.75%	8.41%	10.83%	7.06%	17.92%	2.29%	1.25%	12.50%	83.05%	16.95%	100%
	12.22%	*2.58%*	*3.33%*	*2.17%*	*5.51%*	*0.70%*	*0.39%*	*3.84%*	*25.52%*	*5.21%*	*30.73%*
Ireland	21.86%	2.90%	13.58%	16.26%	25.94%	2.10%	0.68%	16.68%	90.90%	9.10%	100%
	7.21%	*0.96%*	*4.48%*	*5.36%*	*8.55%*	*0.69%*	*0.23%*	*5.50%*	*29.98%*	*3.00%*	*32.98%*
Italy	25.65%	3.65%	8.30%	11.34%	38.03%	0.57%	0.96%	11.49%	90.83%	9.17%	100%
	11.84%	*1.69%*	*3.83%*	*5.24%*	*17.56%*	*0.26%*	*0.44%*	*5.31%*	*41.73%*	*4.21%*	*46.17%*
Luxemb.	13.41%	3.69%	10.29%	2.25%	52.33%	3.08%	1.64%	13.32%	89.16%	10.84%	100%
	5.32%	*1.46%*	*4.08%*	*0.89%*	*20.77%*	*1.22%*	*0.65%*	*5.28%*	*36.15%*	*4.40%*	*39.68%*
Netherl.	23.19%	6.71%	9.97%	14.79%	37.38%	1.50%	0.34%	6.12%	96.51%	3.49%	100%
	10.65%	*3.08%*	*4.58%*	*6.79%*	*17.16%*	*0.69%*	*0.16%*	*2.81%*	*44.31%*	*1.60%*	*45.91%*
Spain	38.80%	5.66%	10.02%	8.19%	25.25%	1.72%	0.87%	9.84%	90.18%	9.82%	100%
	13.67%	*1.99%*	*3.53%*	*2.88%*	*8.89%*	*0.61%*	*0.31%*	*3.47%*	*31.10%*	*3.39%*	*35.23%*
Portugal	39.23%	6.14%	3.53%	5.85%	39.63%	0.38%	0.53%	4.71%	95.64%	4.36%	100%
	12.84%	*2.01%*	*1.16%*	*1.92%*	*12.97%*	*0.13%*	*0.17%*	*1.54%*	*31.31%*	*1.43%*	*32.74%*
Sweden	26.97%	8.05%	6.70%	1.98%	42.92%	2.26%	0.71%	10.41%	97.58%	2.42%	100%
	10.77%	*3.21%*	*2.67%*	*0.79%*	*17.13%*	*0.90%*	*0.28%*	*4.15%*	*38.95%*	*0.97%*	*39.92%*
UK	27.31%	10.52%	3.99%	15.15%	36.17%	2.20%	0.47%	4.19%	96.21%	3.79%	100%
	9.97%	*3.84%*	*1.46%*	*5.53%*	*13.21%*	*0.80%*	*0.17%*	*1.53%*	*35.13%*	*1.38%*	*36.52%*
Norway	31.26%	6.39%	6.79%	4.76%	39.03%	0.52%	1.20%	12.08%	94.96%	5.04%	100%
	11.38%	*2.33%*	*2.47%*	*1.73%*	*14.21%*	*0.19%*	*0.44%*	*4.40%*	*34.57%*	*1.84%*	*36.41%*
Switzerl.	10.43%	5.43%	2.30%	19.84%	48.78%	0.69%	0.43%	12.10%	95.73%	4.27%	100%
	2.87%	*1.50%*	*0.63%*	*5.46%*	*13.43%*	*0.19%*	*0.12%*	*3.33%*	*26.36%*	*1.18%*	*27.54%*

Data for 1998 except for countries with missing data for that year. In that case, we used the data for the closer year available. Numbers in cursive denote the variables expressed as percentage over GDP. The category General Public Services includes expenditure classified as " Other Expenditures".

Table A2: Disaggregated Public Expenditure for every country at the end of the sample-period

1.9 Appendix III. The Static Model

	Model A: Fiscal variables as % over total exp.			Model B: Fiscal variables as % over GDP		
	(1)	(2)	(3)	(4)	(5)	(6)
	GDPpc gr.	LABpr gr.	TFP gr	GDPpc gr.	LABpr gr.	TFP gr
Public Services	-0.04193 (.053)	-0.0939 (.066)	-0.0029 (.049)	-0.0077 (.018)	-0.0231 (.022)	0.0063 (.016)
Defense	0.0754 (.295)	0.0270 (.378)	0.1004 (.274)	-0.0132 (.085)	-0.0347 (.108)	-0.0041 (.079)
Education	-0.9504*** (.335)	-1.0450** (.413)	-0.6414** (.311)	-0.0425 (.105)	-0.0749 (.129)	-0.0454 (.098)
Health	-0.0014 (.167)	-0.1086 (.208)	-0.0100 (.155)	-0.0110 (.054)	-0.0317 (.067)	-0.0303 (.050)
SocSecurity	-0.1336 (.091)	-0.0855 (.114)	0.0888 (.085)	-0.0533* (.029)	-0.0365 (.036)	0.0097 (.027)
Housing	0.1615 (.331)	0.0538 (.408)	0.2389 (.308)	0.1559 (.131)	0.1438 (.160)	0.1371 (.122)
Culture	0.7889 (1.73)	2.3395 (.2014)	-0.4948 (1.61)	0.1962 (.611)	0.5761 (.752)	-0.1696 (.568)
Economic Affairs	-0.3754** (.154)	-0.4005** (.191)	-0.0997 (.143)	-0.0287 (.051)	-0.0256 (.063)	0.0239 (.047)
Tax revenues	-0.0719 (.075)	-0.0631 (.094)	-0.1548** (.070)			
Surplus (-- public deficit)				0.0653 (.024)	0.0799*** (.030)	0.0269 (.022)
ToT	-0.0487 (.131)	-0.1260 (.171)	0.1360 (.122)	-0.1090 (.133)	-0.2020 (.171)	0.0864 (.123)
LaborFgr	-0.6244** (.277)	-1.4337*** (.349)	-0.9939*** (.258)	-0.3223 (.279)	-1.0901*** (.347)	-0.7764*** (.259)
PrivFixedInv	0.0025*** (.0007)	0.0031*** (.0008)	-0.00005 (.0006)	0.0019** (.0008)	0.0021** (.001)	-0.0004 (.0007)
Observations	356	337	356	355	336	355
F test (joint sig.)	5.57 (Prob>F .000)	4.40 (Prob>F .000)	2.23 (Prob>F .010)	4.64 (Prob>F .000)	4.08 (Prob>F .000)	1.48 (Prob>F .128)

*Significant at 10 percent confident interval
** Significant at 5 percent confident interval
*** Significant at 1 percent confident interval

Table A3: Functional categories of expenditure. Static Model. Fixed-Effects coefficients.

	Model A: Fiscal variables as % over total exp.			Model B: Fiscal variables as % over GDP		
	(1)	(2)	(3)	(4)	(5)	(6)
	GDPpc gr.	LABpr gr.	TFP gr	GDPpc gr.	LABpr gr.	TFP gr
Current expenditure	-0.1525*** (.033)	-0.1529*** (.041)	-0.0331 (.032)	-0.0309 (.031)	-0.0118 (.041)	0.0317 (.029)
Capital expenditure	-0.4701** (.205)	-0.3643 (.251)	-0.3209 (.199)	-0.0427 (.065)	-0.0209 (.081)	0.0472 (.063)
Tax revenues	0.0118 (.036)	0.0104 (.044)	-0.0362 (.035)			
Surplus (- pub. deficit)				0.0303 (.029)	0.0612 (.038)	0.0326 (.028)
ToT	-0.0908 (.127)	-0.1880 (.162)	0.0677 (.123)	-0.1100 (.129)	-0.2250 (.164)	0.0558 (.125)
LaborFgr	-0.4044* (.234)	-1.2479*** (.288)	-0.5320 (.228)	-0.0787 (.241)	-0.8473*** (.295)	-0.5023** (.233)
PrivFixedInv	0.0015** (.0006)	0.0015** (.0007)	-0.0003 (.0006)	0.0020*** (.0006)	0.0019** (.0008)	0.0001 (.0006)
Observations	393	374	393	388	369	388
F test (joint sig.)	11.30 (Prob>F .000)	7.29 (Prob>F .000)	1.86 (Prob>F .086)	7.77 (Prob>F .000)	6.83 (Prob>F .000)	1.16 (Prob>F .329)

*Significant at 10 percent confident interval
** Significant at 5 percent confident interval
*** Significant at 1 percent confident interval

Table A4: Economic categories of expenditure. Static Model. Fixed-Effects coefficients.

1.10 Appendix IV Estimation using variables in First-Differences.

Gupta et al. (2005) propose the estimation of the growth equation including variables in first-differences to check the persintance of the relationships between the variables in the long-run. Tables A5 and A6 present the equivalent long-term coefficients presented in Tables 6 and 7 when the variables are included in first-differences. They estimated less significative coefficients in comparison to the equations estimated in levels and our results seem to present a similar pattern.

	Model A:			Model B:		
	(1)	(2)	(3)	(4)	(5)	(6)
	GDPpc gr.	LABpr gr.	TFP gr	GDPpc gr.	LABpr gr.	TFP gr
Public Services	-0.2355* (.130)	-0.3652** (.176)	-0.2240 (.206)	-0.2388** (.118)	-0.3681** (.156)	-0.2293 (.200)
Defense	-0.2797 (.698)	-0.5420 (.709)	1.2956 (1.00)	-0.2118 (.690)	-0.4435 (.701)	1.2690 (.930)
Education	-0.6490 (1.17)	-1.9033 (1.47)	-0.8949 (1.15)	-0.6771 (.1.06)	-1.9702 (1.36)	-0.9988 (1.09)
Health	-0.8165** (.381)	-0.4998 (.612)	-0.4885 (.451)	-0.8123** (.390)	-0.4348 (.703)	-0.5940 (.449)
SocSecurity	-0.9059*** (.189)	-0.6259** (.288)	-0.4869* (.252)	-0.9111*** (.204)	-0.6004 (.376)	-0.5971** (.236)
Housing	1.1985* (.712)	1.3165** (.629)	0.9995 (.692)	1.0666 (.670)	1.2256* (.664)	0.8292 (.719)
Culture	0.7016 (3.06)	2.5709 (4.33)	-3.0341 (2.35)	-0.3273 (2.30)	0.9849 (3.30)	-2.6702 (2.28)
Economic Affairs	-0.8749 (.275)	-1.0427*** (.281)	-0.5442* (.291)	-0.9415 (.268)	-1.1099*** (.319)	-0.7271*** (.259)
Tax revenues	-0.0227 (.166)	0.0382 (.231)	-0.2431** (.108)			
Surplus (-def)				-0.0331 (.111)	-0.0182 (.170)	-0.1087 (.104)
ToT	0.0001 (.000)	0.0002 (.0001)	0.0000 (.0001)	0.00005 (.000)	0.0001 (.0001)	-0.0000 (.0001)
LaborFgr	0.0029** (.066)	-0.0844 (.089)	-0.0439 (.068)	-0.0244 (.057)	-0.1258* (.075)	-0.0575 (.072)
PrivFixedInv	0.0029 (.0007)	0.0037*** (.001)	-0.0003 (.0006)	0.0033*** (.0008)	0.004*** (.001)	-0.0003 (.0007)
Observations	279	261	279	277	259	277

*Significant at 10 percent confident interval
** Significant at 5 percent confident interval
*** Significant at 1 percent confident interval

Table A5: Functional Categories of Public Expenditure: Long-term coefficients. Variables in first-differences.

In comparison cith table 6, in table A5 we can see weaker evidence of the impact of the public expenditure variable. Still, the significance of expenditure in "Health" and "Social Security" is persistent to the estimation of the model in first-differences. In the contrary, the coefficients attached to "Education" are not statistically significant, in contrast to the model in levels.

	Model A: Fiscal variables as % over total exp.			Model B: Fiscal variables as % over GDP		
	(1)	(2)	(3)	(4)	(5)	(6)
	GDPpc gr.	LABpr gr.	TFP gr	GDPpc gr.	LABpr gr.	TFP gr
Current expenditure	-0.3943* (.232)	-0.4811 (.309)	-0.1928* (.113)	-0.6419*** (.245)	-0.7796*** (.241)	-0.4869*** (.160)
Capital expenditure	-0.4684 (.403)	-.2896 (.485)	-0.4099 (.497)	-0.5879** (.314)	-0.5299 (.474)	-0.6409 (.442)
Tax revenues	-0.3865** (.196)	-0.4522* (.262)	-0.4603*** (.085)			
Surplus (- pub. deficit)				-0.2608 (.198)	-0.3319 (.256)	-0.2359** (.103)
ToT	0.00003 (.0001)	0.0001 (.0001)	-0.0001 (.0001)	0.0001 (.0001)	0.0010 (.0001)	-0.0020*** (.0005)
LaborFgr	-0.1440 (.091)	-0.1144 (.115)	-0.2120** (.098)	-0.1484 (.091)	-0.1209 (.129)	0.0000 (.0001)
PrivFixedInv	0.0017*** (.0005)	0.0014*** (.001)	-0.0020*** (.0005)	0.0018*** (.0001)	0.0017*** (.0006)	-0.2265*** (.087)
Observations	315	297	315	313	295	313

*Significant at 10 percent confident interval
** Significant at 5 percent confident interval
*** Significant at 1 percent confident interval

Table A6: Economic Categories of Public Expenditure: Long-term coefficients. Variables in first-differences.

The coefficients shown in Table A6 also present some slight differences in comparison to the equivalent presented in Table 7. The level of significance of the variable object of the study, public and capital expenditure, are weaker except those estimated in model B attached to current expenditure. The negative impact of tax revenues, instead, seems more evident in this case, reinforcing the suggestion presented in Table 6 about importance of this variable in determining production growth.

CHAPTER 2

DECENTRALIZATION AND THE COMPOSITION OF PUBLIC EXPENDITURE IN SPAIN

2.1 Introduction

Fiscal decentralization has changed the vertical distribution of governmental authority in a great number of countries in the last two decades. Power and revenue are shifting downward in processes that very often respond to both political factors and political economy arguments on the efficient allocation of the provision of public goods. Although economic theory has proposed several hypothesis that may explain the origin and impact of decentralization on economic welfare and growth, the existence of empirical studies analyzing the impact of fiscal decentralization is still very limited, and there is a relative lack of empirical evidence about the allocative efficiency reached with these processes.

The main difficulty is to clearly identify the channels through which fiscal decentralization leads to efficiency. The economic justification for whether the allocation of a part of public resources should depend on a decentralized system has to be built on assumptions that create inefficiencies for the centralized counterpart. It turns out to be difficult to find such inefficiencies in a world in which all agents have perfect access to information. Economic theory has traditionally focused on differences either in perceived utility from public goods provided by different levels of government or in the benefit and costs between local and central governments regarding certain projects.

That has led to the development of sophisticated models that capture the effect of decentralization on economic growth -some of them also linking centralization to the level of public expenditure-,[1]. In response to the theory, many empirical studies have tried to suggest the existence of a relationship between decentralization and growth as a direct or indirect relation.[2] The results are not very conclusive. The link between the level of fiscal decentralization and economic growth and with the level of total public expenditure does not reveal

[1] Panizza (1999), Sanz and Velazquez (2002).

[2] Oates (1993), through better development of the markets (Weingast (1995)) or through macroeconomic stability (Martínez-Vazquez and McNab (2005).

clear causal relationships from the first to the other two, although developed countries tend to have higher levels of public spending as well as more decentralized institutions.

Following the analysis in our first chapter which has looked at the importance of the composition of public expenditure to achieve optimal rates of growth, we propose to analyze the link from decentralization policy to economic growth through the composition of public expenditure. And for this purpose we make use of the two traditional hypotheses that have been used more frequently to explain decentralization: first, the provision of public goods by a level of the public administration closer to the citizen yields higher utility since it tailors more closely its preferences; and secondly, the decentralized provision of public goods, although less efficient, is more costly than centralized provision because of the multiplication of the administrative costs and the economies of scale. Our contribution relies on the fact that this behavior may not affect all kinds of public goods identically, but some categories are more sensitive to the level of decentralization because of their nature. More precisely, we split public expenditure into public investment and public current expenditure, claiming that public current expenditure would experience the two aforementioned effects of the cost and utility of decentralized provision of public goods, while public investment would not be affected by decentralization.

With the purpose of relating decentralization to the distribution of public expenditure and the later to economic growth, we use a version of the neoclassical growth model in which the demand of public goods by the population depends on the distance to the jurisdiction that provides them. Unlike previous attempts to link the impact of fiscal decentralization on public expenditure using a distance-sensitive utility function (Arze et al. (2005), Panizza(1999)), we construct a general equilibrium framework that identifies an optimal level of decentralization. The reaction of public expenditure to changes in the level of decentralization will be able to reveal whether an economy is above or below the optimal and, therefore, will allow the policy maker to draw conclusions about the gains on efficiency induced by the decentralization process.

The traditional empirical approach to testing the effects of fiscal decentralization has been the test of a panel data model from country-level data. However, in our framework the response of public expenditure to economic decentralization depends on the initial conditions of the country, and the inclusion of heterogeneous economies in the same panel could lead to imprecise estimates. Devarajan et. al (1996) prove how the estimations of growth regressions

on fiscal variable are very dependent to the inclusion of developed and developing countries in the same panel . We use instead with regional data from a period in which a set of regions have experienced an asymmetric decentralization process.

Since the acceptance of the Constitution of 1978, Spain has experienced a gradual process of fiscal decentralization. Public spending has increased from less than 30% of GDP in 1976 to more that 50% today. The central government has passed from controlling almost 80% of this public spending before the democratization of Spain to controlling approximately 50% of the public budget. Molero (2001) describes how this decentralization policy has had a much greater effect on the regional level of the government rather than the local one. Using data from the Spanish regions, we test the hypothesis that the economic distribution of public spending is sensitive to the level of decentralization. In particular, looking at the distribution between public current expenditure and public capital, we are able to show that there exists a clear relationship between them that implies that the share of public capital expenditure decreases with decentralization.

According to our distance-sensitive agent model, the fact that the level of public investment decreases with decentralization may be an indicator of an excesive level of decentralization , which could imply an obstacle for economic growth because of the increasing cost of the decentralized provision of public goods. Section 2 reviews the related literature. Section 3 introduces a theoretical model that will help us to interpret the results of our estimations. Section 4 describes the data and analyses the behaviour of public expenditure variables in our sample. Section 5 present the methodology and describe the results and Section 6 concludes.

2.2 Literature review. Empirical studies

Empirical studies about decentralization have traditionally focused their attention on its impact on economic growth. In fact, the direct relationship between fiscal decentralization and growth has received a significant amount of attention in the empirical literature in recent years. Of the studies on individual countries, Xie, Davoodi and Zou (1999) conclude for the US an insignificant effect of fiscal decentralization on economic growth while for China, Zhang and Zou (1998), using a panel data growth model with local level data from 1980 to 1992 for 28 provinces, find that the fiscal decentralization policies taken on the 1980s did not promote economic growth.

The cross-country studies do not seem to find a common answer to the question. Davoodi and Zou (1998) find a negative effect of fiscal decentralization on economic growth for developing countries and no clear relationship for the developed countries, while Woller and Phillips (1998) find no relationship for developing countries. Iimi (2004), using a narrower set of data (from 1997 to 2001) for 51 countries finds decentralization as instrumental for economic growth. Thiessen (2003), using a panel of developed OEDC countries, concludes that there is an optimal level of decentralization over which no additional gains are obtained from decentralizing.

In the light of these results, some other empirical studies have tried to find the channel through which fiscal decentralization could affect economic growth. The impact that decentralization could have on the level of inflation has been found to be insignificant (Treisman (2000), Rodden and Wibbels (2002)). Martinez-Vazquez and McNab (2005) examine the impact that decentralization could have on macroeconomic stability finding a positive relation that would imply an indirect positive impact with economic growth. Other links have been established between decentralization and the level of corruption (Fisman and Gatti (2000) and the level of political participation (Huther and Shah (1998)).

Nevertheless, the literature about fiscal decentralization has not traditionally looked at its possible impact on the composition of public expenditures. This issue has only begun to be addressed recently. Arze , Martinez-Vazquez and McNab (2005) model and test the hypothesis that higher levels of fiscal decentralization increase the shares of consumption expenditures in the public budget (in particular, they refer to education and health expenditures as publicly provided private goods). They estimate a model from a panel data set of 45 countries and 28 years and find strong evidence of the hypothesis, especially for developing countries. Faguet (2004) analyses the effects of the process of decentralization in Bolivia at the local level, and finds that the functional composition of public expenditure changes with decentralization to a more efficient allocation. He looks at several functional categories of expenditure and shows that the distribution of public expenditure is more adapted to local needs after the decentralization process that this country experienced in 1994.

2.3 Theory

As commented above, in principle central government expenditure should be more productive to local or regional governments so long as returns are at least slightly increasing. The

case of decentralized public expenditure -or decentralized levels of government in general- should be justified by a counterbalancing source of efficiency that imposes any advantage to the regional or local authority in comparison to the central government.

Faguet (2004) describes a first theoretical approach to the problem made by Tiebout in 1956, who develops a model in which heterogeneous individuals move costlessly among localities that offer different levels of provision of a public good. The assumptions of perfect population mobility and fixed government behavior seemed too unrealistic. Oates (1972) modelled a central government that produces a common level of public good for all localities while local government can tailor public spending to local tastes, in a world with heterogeneity in tastes and spillovers. Oates´ justification of the existence of decentralized countries depends largely on the assumption of uniform provision of public goods by the central government.

This assumption has been relaxed recently with the introduction of voting rules for distributing expenditure. Lockwood (2002) only needs to assume equal cost sharing in a country with heterogeneous individuals among regions to show that resources would be allocated inefficiently in a centralized country. Besley and Coate (2003) reach a similar conclusion by allowing for heterogeneity of tastes within a region, modelling public expenditure under centralization as determined by a legislature of locally elected representatives. Rubinchich (2005) also relies on the inefficiency of voting rules and centralized taxation to model an environment in which the central authority would find it more efficient to allocate some expenditure decisions to local governments. She proves that it is not necessary to have the existence of asymmetry in policy tools or in information access available to different levels of government to model a strictly welfare improving environment under decentralization. The conflict created by the existence of heterogeneity among regions could be solved in a centralized system only by assuming the existence of a central planner. Nevertheless, under voting rule to decide on public policy, the decentralized equilibrium may be welfare improving in comparison to the centralized outcome of the voting rule.

Another strategy to face the problem has been proposed by Brueker (2005). He uses an overlapping generations model to show that replacing a common tax-burden with head tax burdens that differ between younger and older citizens, who live in different jurisdictions where the public good financed by this tax would be provided at different levels, alters the economy's level of saving enhancing economic growth. The result relies, of course, on the existence of significative demographic differences among regions. Alesina and Spolaore

(1997) and Alesina, Baquir and Easterly (1999) use the heterogeneity of the population to justify the necessity to compute the optimal number of countries or economic jurisdictions.

Panizza (1999) internalizes the selection of the optimal level of decentralization in a model with distance-sensitive individuals and one public good. This optimal level depends positively on taste heterogeneity, democracy, income per capita and country size. The introduction of the level of democracy obeys his assumption that the central government utility depends on a proportion of a central planner combined with a proportion of the outcome from voting rules.

However, none of the above studies addresses the impact of fiscal decentralization on the composition of public expenditures. Two main approaches explore the problem.[3] The approach developed by Faguet (2002,2004), assumes heterogeneous preferences among regions that are accurately captured by local governments when distributing public expenditure, while central government ascertains the exact preferences of locals with a given probability. On the other hand, the central government has a cost advantage. Faguet (2004) describes the relations between the parameters that make a decentralized system preferable, while in Faguet (2002) the author develops a cooperative game in which the local government chooses whether to relay information on local needs to the centre and bargains over the allocation of public goods in a central assembly or remain decentralized.

The second approach, described in Arze et al (2005), is closer to our view here, since they also extend the representative median-voter model described in Panizza (1999), with a model that uses a distance-sensitive utility function to stand for the heterogeneity of the individuals. The model assumes that individuals are uniformly distributed throughout the country area and that the utility obtained from any given public good is decreasing in distance to the middle of the country or the region that provides it. The two mentioned approaches, however, include partial equilibrium frameworks in which the effects of the reallocation of decentralized public expenditures on economic are ignored. With that purpose, we develop a version of the AK model in discrete time with two types of public expenditure: consumption and investment; two levels of the public administration: regional and central governments; and exogenously determined tax and centralization rates under a distance sensitive utility function for the public consumption good.

[3] There are also some interesting studies that analyse the demand of certain types of expenditure under decentralization, among them Falch and Rattso (1997) and Gertham, Sogaard, Jonsson and Andersson (1992).

2.3.1 The basic model: Assumptions and interpretation

The model developed in this section uses a distance-sensitive utility function to introduce heterogeneity of tastes among individuals. In a model with two levels of public administration: national and regional governments, and two types of public goods: public consumption (or public current expenditure) and public investment (or public capital expenditure), the utility perceived by individuals from one type of public good -public consumption- will depend on the distance of the consumer to the administration that provides it.

The inclusion in the utility function of a parameter that represents the distance of the consumer to the provider of the public consumption good has two main implications: the first is that different consumers will get -in general- different utility from the public expenditure depending on their "distance" to the public administration.[4] The second is that, under the standard assumptions about uniformity of distribution of population and administrations that we describe ahead, consumers get higher utility from the public good when it is provided by the regional governments instead of the central government. This second implication creating an advantage towards decentralization that is usually counterbalanced by assumptions about the economies of scale, in our case by the higher cost of providing the public good by regional governments.

The distance-sensitiveness assumption have been previously introduced in the literature, but so far authors have considered either only one type of public good (Panizza (1999), Alesina and Spolaore (1997)) or two types of public goods to which consumers show identical behavior regarding the sensitivity of their perceived utility to the distance of the jurisdiction that provides it (Arze et al. (2005)).

In contrast to the model by Arze et al. (2005), who assume that one of the public goods may exclusively be provided by the central government arguing that it is a pure public good [5], we split public expenditure into public investment and public consumption goods. As long as citizens get utility from public consumption while public investment comes into the

[4] Uunless they are symmetrically situated at the same distance from the public administration

[5] The identification of a public good or a public expenditure type that may only be provided by central government seems a bit problematic, with the exception of some particular activities like defence, weather forecast or foreign policy. The data on public expenditure seem to confirm that there are almost no types of public expenditure, according to the standard functional and economic classifications, that show this pattern. See Molero (2001) for a good description of functional and economic distribution of public expenditure in our sample of Spanish regions.

production function of the economy, the distance sensitiveness of utility affects only the amount of public expenditure devoted to consumption.

Unlike the previous papers, we include the distance-sensitiveness assumption in an extended version of the Solow model with a public sector and a fixed tax rate -similar to the one that we will use in the next chapter to analyze the effect of public grants- with the purpose of linking the reaction of public expenditure to the evolution of economic growth and the behavior of private factors. That will serve us to link the impact of decentralization on the composition of public expenditure with economic growth, under the assumption that public capital expenditure comes into the production function of the economy.

It seems reasonable to us to assume that citizens are sensitive to the level of government that provides public consumption but not public infrastructure. Basically, because public investment is more likely to serve as a production good rather than a consumption good.[6] But we also find quite straighforward that there must be an increase in the cost of the services provided. that must reflect the multiplication of administrative and fixed costs attached to those public goods.

We consider a country with an infinitely lived representative median voter, whose preferences depend on the amounts consumed of a private good and a publicly provided public good. The decisions are taken separately, and the household cannot forecast the behavior of the government while taking their own decisions.[7] The households are also the owners of the technology of the country, that produces according to a constant returns to scale production function with private capital (K) and public capital (G_k) :

$$Y_t = AK_t^{\gamma} G_{k,t}^{1-\gamma} \tag{2.1}$$

[6] Our interpretation is that consumers are not sensitive to the level of administration that provides public capital, in contrast to current expenditure. For example, in a public university the capital expenditure would be represented by the buildings and the general equipment and the current expenditure would be the one translated directly to the academic activities. We think that is in this one in which regional authorities can perform better than the national government, since they are more sensitive and better informed about the specific educational needs of the region.

[7] We assume this for simplicity, since it is equivalent to assuming a model with public policy decided by a representative consumer applying median voter theory, in which the utility function includes private consumption and public services additively separable, in line with Agenor (2007), Ganelly and Tervala (2007) and Van der Ploeg and Bovenberg (1994), among others. The alternative use of a Cobb-Douglas utility function as in Turnovsky (1999) and Baier and Glomm (2001) would not introduce relevant modifications to our results here and would make the problem more cumbersome. Djajic and Maximilians (1987) includes an interesting analysis of the implications of alternative assumption concerning the relationship between public and private consumption in the utility function.

The representative consumer has to pay an exogenously determined income tax rate and consumes and invests to maximize a logarihtmic utility function of the usual sort, as described in Appendix I. The government is able to observe the behavior of the consumer, but has the target of maximizing the utility received by the median voter from the consumption of publicly provided public good, g_c, whose perceived utility depends on the distance to the middle of the jurisdiction that provides it. We assume an exogenous level of centralization, θ[8], which is equal to the fraction of public expenditure provided by the central government.

$$U = \Sigma\beta^t G_{c,t}^{(1-\alpha(\theta x_{ic}+(1-\theta)x_{ij}))} \tag{2.2}$$

where x_{ic} is the distance from individual "i" to the middle of the country and x_{ij} represents her distance to the middle of the region where she lives. The parameter α, $(0 < \alpha < 1)$, measures preference heterogeneity. Preferences become more homogeneous as α approaches to 0.

We assume population N uniformly distributed throughout a country with area A and J regions. For the sake of simplicity we also assume that individuals who are closed to each other in preferences as also closed to each other geographically. In other words, x_{ic} and x_{ij} captures both, the geographical and the preference distance to the administration. We also introduce the assumption that both levels of the government have to offer the same proportion of every type of public good.[9]

The type and quantity of each public good are decided democratically by the median voter (med^k,med^g). With the purpose of avoiding problems related to simultaneous multi-dimensional voting, we assume that individuals vote on one issue at a time and that they have separable preferences.

Public spending is financed by an exogenously determined tax rate "τ" that is fixed over time. It is also assumed that the number of voters is large enough so that the space can

[8]The the level of decentralization is therefore characterized as $(1 - \theta)$, to make the notation compatible with previous models quoted here.

[9]This assumption greatly simplifies the structure of the model but may be thought of as a bit rigid. A reason in favour of it may be that any functional level of competencies that a region may achieve usually includes both current and capital expenditure (for example a region that has the competencies to run the public health system would have to assume both current and capital expenditures attached to it). The main point against the assumption is that not all the functional categories of expenditure have the same share of current to capital expenditure. It is relatively compatible with our data (see figure 3).

serve as a proxy for the voters, and the country size area is normalized to one. There is no possibility of free-riding in this environment, so the representative voter would face a budget constrain:

$$\tau Y_t = G_{c,t}^{\frac{1}{\theta}} + G_{k,t+1} \tag{2.3}$$

The price of public capital is normalized to one while the price of "g" depends negatively on the level of decentralization. We derive in appendix I the maximization problem of equation (2.2) subject to the budget constraint (2.3), that determines the demand of every individual and the equilibrium solution using median voter theory. The following propositions characterizes the result:

Proposition 2.1 *Given a sufficiently high level of centralization, $\theta > \theta^*$,[10] a decentralization process will increase the share of the public budget devoted to the capital good and decrease the level of provision of the heterogeneous consumption good. The convergence to the new equilibrium will enhance economic growth. However, from this point onwards, additional decentralization would induce opposite reactions in the public budget decomposition and would lead to lower growth rates of the economy.*

The formal proof is in the Appendix, but the intuition is simple. The representative agent obtains more utility from public consumption as the level of decentralization of the country, $(1-\theta)$, increases. That will increase the incentives to spend in public investment, since present investment drives the future stream of public consumption through the production function. Therefore, decentralization induces a substitution effect from public consumption to public investment to come back to an equilibria in which the marginal gains of additional units of both public expenditure items are equivalent.

This mechanism works only until a certain level of centralization, θ^*, is reached. That is because the cost of the public consumption good also increases with decentralization due to the economies of scale. From this point onwards the increase in the cost of public

[10] $\theta^* = \frac{1}{2\alpha(x_{mc}^m - x_{mj}^m)}[\sqrt{(\alpha x_{mj}^m + 1)^2 + 4\alpha(x_{mc}^m - x_{mj}^m)} - (\alpha x_{mj}^m + 1)]$

consumption induced by additional level of decentralization overtakes the benefits of the higher perceived utility, and would push down the demand for capital since the consumption good is becoming too costly. The effect on the budget constraint becomes more important than the gains of utility induced by decentralization, and it will be necessary to increase the share of public consumption in the budget to return to the equilibrium.

The implication of this proposition on the interpretation of the results described in section 2.5 is straighforward. We estimate the response of the share of investment in the public budget to additional levels of decentralization, and show that this relationship is significantly negative. If the economies from which the data are collected follow a pattern similar to the one described in our model, the economy would already be too decentralized, and the loss on public investment induced by decentralization would lead to lower levels of economic growth.

2.4 Data description and sources

2.4.1 Sources of data

The model is estimated for a balanced panel of the seventeen Spanish regions over the period 1984-2003. The sample begins in 1984 because, although the first Statutes of Autonomy were approved in 1979, 1984 was the first year in which all the regions started to develop their full activity. We use data until 2003 due to data availability.

The two Autonomous cities, Ceuta and Melilla, have been excluded from the Sample. This decision was taken based on three main reasons: First, the insignificant size of these two small cities in comparison with the other regions, second, because of the particular patterns of behavior of their public bodies due to their different political and fiscal status; and finally, because of the difficulty of getting data from the period previous to their current Statute of Autonomy, approved in 1995.

The main datasource for our variables of interest, disaggregated public expenditure for the Spanish regions, is the yearbook "Presupuestos de las Comunidades y Ciudades Autonomas" edited by the Ministry of Economy of Spain. Some of the data included in this yearbook are also available online in the BADESPE database, elaborated by the "Instituto de Estudios Fiscales".

2.4.2 Dependent variable

The dependent variable is the ratio of capital expenditure to total public expenditure of the Spanish regional governments. Previous empirical studies have used this ratio as an explanatory of factor productivity (Devarajan, Swaroop and Zou (1996)), but it has been rarely used as a dependent variable to be explained (Diaz-Cayeros, McElwain, Romero and Siewierski (2003), Sturm (2001)).

The use of a ratio allows us to observe the importance that governments give to capital goods relative to consumption goods independently of changes in the volume of total expenditure induced by other factors. The main shortcoming is, precisely, the dependence on the volume of total expenditure. The ratio may be sensitive to extraordinary changes on total expenditure, for example, because of a readjustment to the public debt. We will see later (in figure 3) that such a situation may appear for the central government in the year 1987, but rarely may be considered for regional government, because of their lower level of autonomy to run financial operations.

We also run alternative estimations using only data of public expenditure in social public goods, according to the functional classification of public expenditure proposed by the Spanish Ministry of Economics. The motivation to use these alternative data can be found in Appendix II: the major part of the decentralization process is taken over precisely in competencies that affect social public goods. In these alternative estimations, shown in tables 3b, 4b and 5b, the variable cap would represent ratio of capital to total public expenditure in social public goods of the Spanish regional governments

The ratio is built from data on total regional public expenditure and public regional capital expenditure, obtained from the BADESPE[11] database, elaborated by the Instituto de Estudios Fiscales (Fiscal Studies Institute), dependent on the Ministry of Economics of Spain. This database contains economic data from the Spanish public sector, in particular fiscal variables, such as taxes, other revenues or budget.

[11] http://www.estadief.meh.es/

2.4.3 Explanatory variables

Choosing a variable that measures precisely the level of decentralization on fiscal issues may be quite controversial. Martinez-Vazquez and McNab (2003) describe how ideally a panel data set of measures of fiscal decentralization would be able to quantify the activities of sub-national governments resulting from their independent decisions, which would mean, for example, discriminating those expenditures that are under the effective control of the central government as central government activities, even if they are carried out by other levels of the public administration. This would mean that not only the relative volume of public funds distributed by sub-national authorities determine how decentralized an economy is; we should ideally also take into account the level of autonomy with which those funds are managed.

Unfortunately, we cannot address these issues with the available data. The literature has adopted the standard measure of fiscal decentralization described by Oates (1972) based on local or sub-national to total public expenditure ratio.[12] It seems reasonable to assume that the level of fiscal autonomy is correlated to the share of public resources managed by a regional government.

An interesting analysis of alternative definitions of the decentralization variable, based on the autonomy that sub-national levels of governments have over tax revenues, can be found in Ebel and Yilmaz (2002). We have discarded the use of a decentralization measure based on the revenue side of the budget as made by other authors.[13] The main reason is that in our set of regions the expenditure side of the budget accommodates better the implementation of new competencies in regional governments, while the sources of revenues, especially tax revenues, is more dependent on the subsequent reforms made to the financing system of the regions. This issue is described further in the next two subsections.

The level of decentralization is built as the ratio of per capita regional expenditure to per capita central government expenditure, also from the data of the yearbook "Presupuestos de las Comunidades Autonomas", published by the "Instituto de Estudios Fiscales". Following an identical procedure to that used with the dependent variable, we also construct a ratio of fiscal decentralization using data of public expenditure exclusively on social public goods. The use of these alternative data will yield the results presented in tables 3b, 4b and 5b.

[12] This is used for example by Zhang and Zou (1998), Martinez-Vazquez and McNab (2003), Iimi (2004), Jin, Qian and Weingast (2005), among others.

[13] De Haan, Sturm and Sikken (1996) or Diaz-Cayeros, McElwain, Romero and Siewierski (2002), for example

These ratios require more disaggregated data. The variable "capsoc" is constructed as the ratio of public capital expenditure on "Social Public Goods" to total public expenditure on "Social Public Goods ", for every regional government. The variable "decsoc" is the ratio of total public expenditure on "Social Public Goods" run by every regional government to the equivalent value for the central government. Data for regional public expenditure are obtained from the Yearbook "Presupuestos de las Comunidades Autonomas", edited by the Spanish Ministry of Economy and Finance. Data for central government public expenditure on "Social Public Goods " are obtained from the INE database.

We explain later how the rest of control variables in tables 3b, 4b and 5b remain unaltered in comparison to the original estimation presented in tables 3, 4 and 5. The decentralization ratio changes dramatically in comparison to the one used originally. This is because the level of decentralization in policies regarding social policy, especially Education and Health, is far larger that the average decentralization. Regional governments control most of the public expenditure devoted to those policies, while the central government plays a residual role.

Variable	label	Definition	Units	Source
capital share	cap	Ratio for regional government: capital expenditure over total expenditure.	Fraction (0-1)	Badespe
fiscal decentralization	dec	Ratio of per capita public expenditure run by the regional government over per capital public expenditure run by the central government	Fraction	Badespe/ INE
capital stock per capita	Kstockpc		Euro (c.p., base 1986)	IVIE/INE
central gov. capital exp	cgcape	capital expenditure run by central government	Miles Euro, current prices	INE
population	pop	Total region midyear population	Persons	INE
GDP per capita	GDPpc	GDP in current prices per capita	Euro, current prices	INE

INE: Instituto Nacional de Estadística
IVIE: Instituto Valenciano de Investigaciones Económicas

Table 1. Variable description and sources of data

The selection of the remaining control variables has been largely based on studies focused on the determinants of public capital spending as well as on Martínez Vázquez and Mc Nab

(2003), keeping in mind that all these studies use country data and some of the variables that they include would not fit in our regional panel data (budget deficit or industrialized country dummy, for example).

We include population and per capita GDP. Changes in population could be a determinant of the necessities of public capital relative to publicly provided consumption goods. It might also explain the possible scale effects existing in particular kinds of investment via the marginal cost of additional users, in the case of "pure" public goods. Population has been included as an approximation of labor force supply in many studies that examine the productivity of public capital (Ramirez (1998) and Everaert and Heylen (2001)).

It may be expected that the productivity of public capital changes with the level of production. In principle a less wealthy population is expected to have stronger preferences for public investment, to supply the lack of or the minor productivity of private capital. GDP per capita has been frequently used as a control to explain growth (Barro (1991), other fiscal variables (Kneller, Bleaney and Gemell (1999)) and it is used in all the studies consulted identifying determinants of public capital expenditure.[14] Both variables have been obtained from the INE database.

In addition we include capital stock per capita and central government capital expenditure. The first controls for the necessities of more capital, since a region with a smaller stock of capital is expected to have larger marginal returns to capital and, therefore, a higher demand for public capital expenditure. Randolph, Bogetic and Hefley (1996) defend the inclusion of the actual stock of public infrastructure as a variable determining its current level of spending. They find that their results are very sensitive to the alternative variables used to measure the stock of infrastructure, since there is no inventory of stock of public capital for their set of countries. This does not represent a problem for us, since we can count on an inventory of public capital for the Spanish regions at constant prices.

Central government capital expenditure tries to control for the policy of the central government regarding public capital, and the substitution effect that could induce to regions. Data on total public capital stock in the Spanish region are available in the IVIE (Instituto Valenciano de Investigaciones Economicas) website. Data on central government capital expenditure were obtained from the INE database.

[14] Sturm (2001), De Haan, Sturm and Sikken(1996), among others.

	N	mean	St. Deviation	minimum	maximum
cap	340	.2720935	.1294949	.0206426	.6145927
dec	340	.3569552	.2306555	.0502049	1.247196
capsoc	239	.2612	.1712	.0454	.7687
decsoc	238	7.0094	7.8335	.3234	28.7041
kstockpc	340	18.38654	4.099209	10.0384	28.6958
cgcape	340	1.379756	0.601462	0.7850	2.13685
pop	340	2.333307	2.009264	0.256753	7.606848
GDPpc	340	9.512318	4.057546	2.39098	20.38523

Table 2: Summary Statistics

2.4.4 Evolution over time

The process of decentralization of public financing in Spain starts with the approval of the Spanish Constitution of 1978. The national territory is divided into seventeen regions or Autonomous Communities (NUTS 2 using the nomenclature proposed by the European Commission) and two Autonomous cities, Ceuta and Melilla.

The level of competencies of the regions is not symmetric, and the process of constitution of all the regional governments finished in 1983. Simultaneous to this process of political adaptation to the new Constitution, occurred the most important increase of public spending. Total public spending moved to represent a 27.51% of GDP in 1976 to 44.10 % in 1985. This growth continued later but at a slower pace to steady around 54% in 2000.

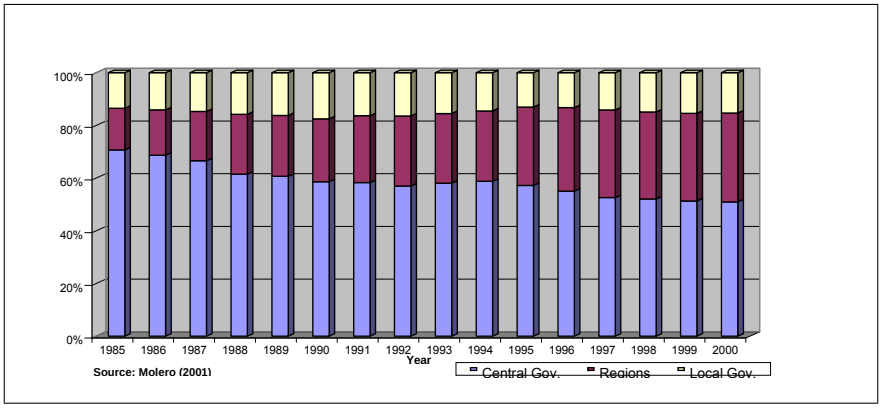


Figure 1: Shares of Public Expenditure by level of administration

The progressive decentralization of public expenditure that has been taking place in Spain since the development of the regional governments is illustrated in Figure 1. This process has affected mainly the regional level, since local public expenditure has only increased its share over total expenditure 2.5 percentage points in fifteen years, while the regional level has increased to 33.9 % of total public expenditure in 2000, compared to 1985 when it represented only 15.8 %.

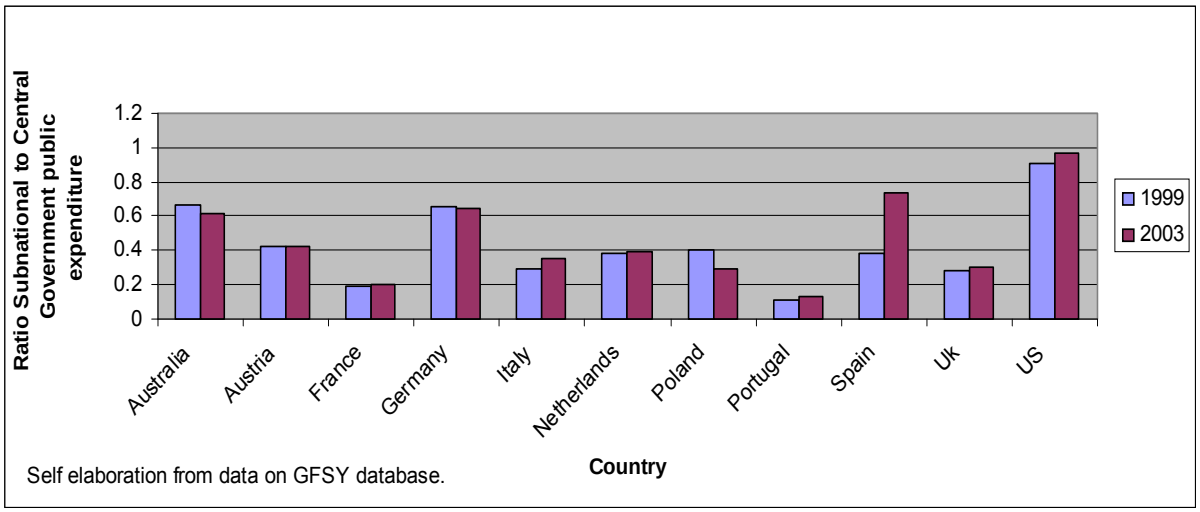


Figure 2: Evolution of fiscal decentralization.

Figure 2 shows the share of non-central government expenditure to total public expenditure in several countries.[15] It shows that the process of decentralization that Spain has suffered is not a general pattern of behavior of the countries in its environment. The level of this ratio has risen in the recent years to reach a situation comparable to federal countries like the US or Germany.

We can see how the decrease in public investment in sub-national levels of the public administration does not correspond to an international trend. We show in Figure 3 how some

[15] The data are accrual data extracted from the Government Finance Statistics Yearbook database, elaborated by the IMF. Consolidated central government expenditure includes public expenditure carried out by the Social Security organism. The database does not provide data to compute the ratio before 1998.

other countries have decreased their shares of sub-national public capital expenditure, but not as much as Spain has done for this period. Many of them have, instead, increased their shares of sub-national public capital expenditure. Although we cannot observe a perfect correlation, more "centralized" countries tend to present a higher share of public investment in comparison with less centralized ones. Unfortunately the GFSY database does not include disaggregated data for the US.

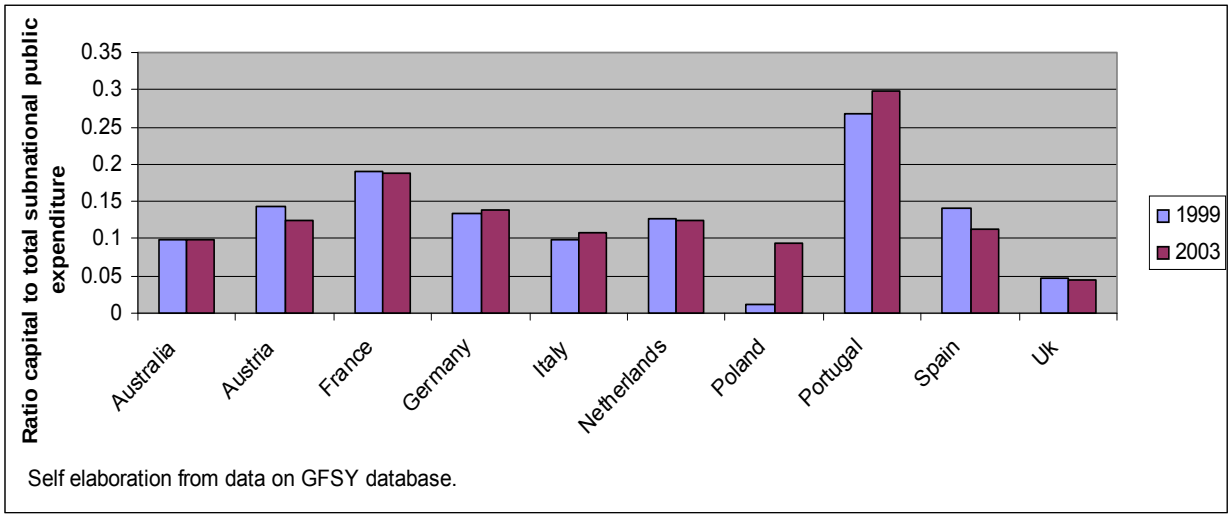


Figure 3: Comparative evolution of the state and local share of public capital expenditure.

But this process has not been homogeneous. The reason is that the Spanish Constitution discriminates the level of competencies of the different regions. The Constitution considers two groups. The first one is the so-called "historic nationalities"[16] or regions with a high level of competencies. Those regional governments have a higher level of independency. The second group consists of the ten remaining regions[17] (and the two autonomous cities) that in principle assume a lower level of competencies.

In practice, the regions with high levels of competencies experienced a higher level of decentralization in the beginning, but the differences have been reduced as long as the decentralization process described above has been taking place. That can be seen in the evolution of the ratio that we have chosen to measure the level of fiscal decentralization.

[16] Andalusia, Canary Islands , Catalonia, Galicia, Navarre, Valencia and Basque Country.
[17] Aragon, Asturias, Baleares, Cantabria, Castile-La Mancha, Castile and León, Extremadura, La Rioja, Madrid and Murcia.

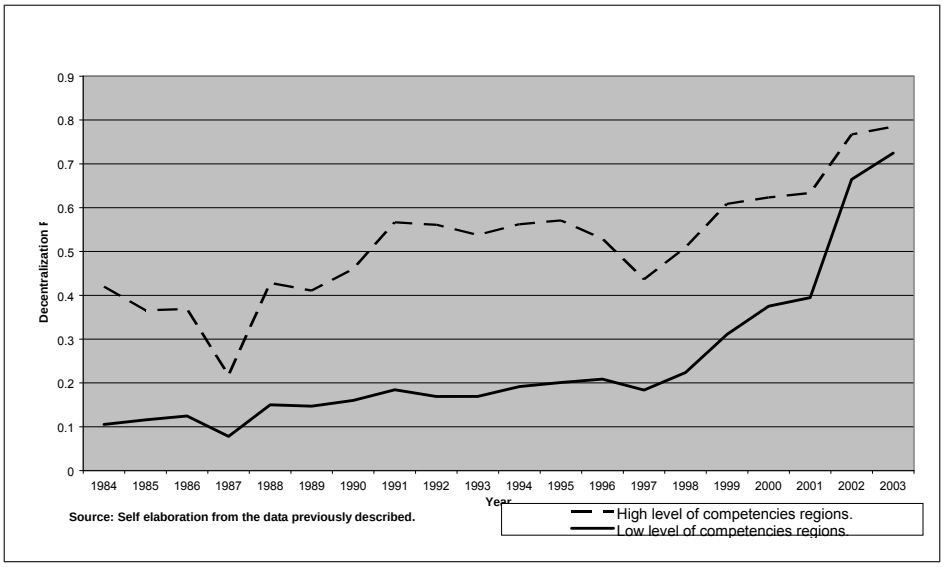


Figure 4: Decentralization Measure

As described above, this ratio formed as a coefficient of per capita public expenditures between the regional and central government may present some weaknesses, for example, the fact that it depends also on expenditure policies run by the central government.[18] However, for our purpose of intra-country analysis this does not represent a great problem, since the denominator is common for all our regions.

The increase in the proportion of public spending run by regional movements has also affected the distribution of public regional spending among the different economic categories. The regions have augmented the share of current spending, devoting a minor part of their funds to increasing their stock of capital:

[18] For example, a great increase of Central Government Expenditure in 1987 due to financial operations after the entrance of Spain in the EU has induced an 'abnormal' decrease of the value of the ratio for all regions in this year.

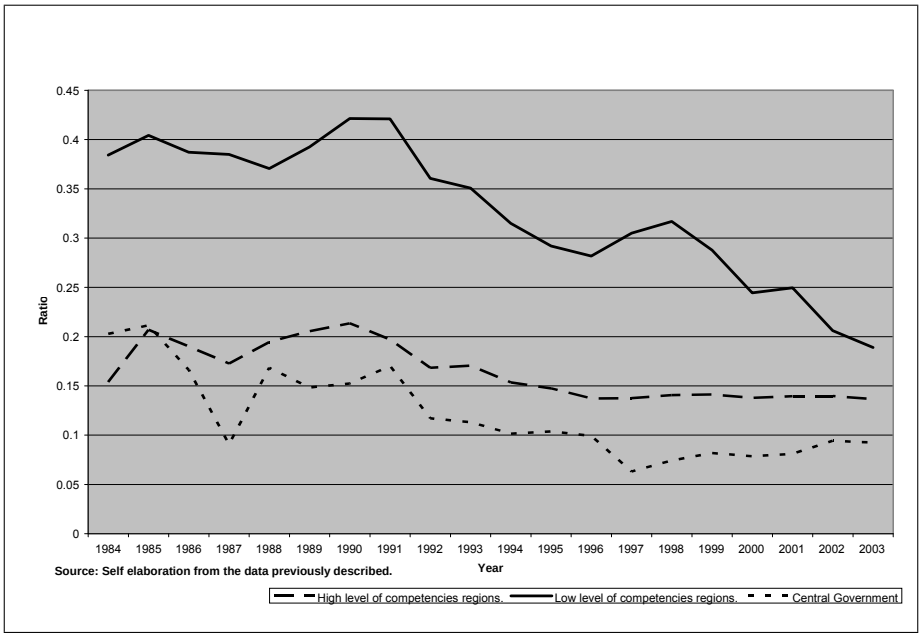


Figure 5: Ratio Capital to Total Expenditure.

One might think that this situation could be induced by a certain reallocation of competencies between the central and regional governments. However, it can be seen that the Central Government has not increased its share of capital expenditure, but has, on the contrary, slightly decreased it. The fall in capital share of public expenditure is clearly more relevant in the regions with low levels of competencies, which are also those that have undergone a more profound process of decentralization. We want to prove in the paper that this fall is a consequence of the process of decentralization.

The graphs in appendix II present a deeper analysis of the functional categories in which the higher level of decentralization takes place, in other words, the areas in which regional governments gain more power. The category "Social Public Goods" -using the nomenclature of the functional classification used by the Spanish "Ministerio de Economía y Hacienda"- is the main area of decentralization for the regions with a low level of competencies as well as the main component of the public budget. In 1994 it represented around 20% of the budget of the regions with low levels of competencies and 55 % of the groups of more autonomous regions, while in 2003 it represented more than 60% of the total budget in both groups. This category includes the two groups of public policies that have experienced a substantial change of competency from central to regional governments: Health and Education. The graphs also reveal how simultaneously there has been a change in the share of capital and current expenditure devoted to this category.

Other functional categories that have experienced a significant level of decentralization have been "Social Security and Promotion", "Economic regulation of Productive Sectors", "General Public Services" and "Economic Public Goods". Among them, only the expenditure devoted to "General Public Services" has increased its share of capital expenditure simultaneously to this decentralization process. It should also be noted that the per capita level of expenditure for some of these categories is quite similar between regions with high and low levels of competencies. Thus, there are some categories of expenditure in which there were no significant differences on the level of competencies.

2.4.5 Sources of Revenues

Given the great heterogeneity of competencies that have been progressively assumed by the different regions, it has been necessary to develop a system able to be adapted to this dynamic environment. The system provides multiple tools to compute the fair amount of the public funds that should be allocated to every region, in proportion to the competencies that it assumes. But the diversity of the Spanish system goes further than this, since two regions have a particular regime of financing called "Régimen Foral".

The system for the remaining 15 regions started to work regularly in 1987. Prior to that date, the system was being progressively established and some of the transfers from the central government were the result of a negotiation process between both levels of government. From 1987 onwards, the general system is revised every five years to increase the power of decisions to regions. Many of the rules to compute the finance necessities that were set for the first period (1987-1991) are still valid.

The difference introduced progressively is the source of this financing. Initially, most of the funds were provided directly by the central government according to these rules (Participation on the Revenues of the State or PRS). But the revisions for the periods 1992-1996 and, more particularly, 1997-2001 give some taxing power to the regions.

In the period 1992-1996, the collection of some taxes[19] is transferred from the central government to regions. In addition, regions perceive 15% directly from the income tax collected by the central government. The amount collected is subtracted from their PRS, which means that so far there is only a change of procedure, but not really of autonomy.

[19] The more important ones are taxes on wealth, gifts, inheritance and gamble.

In the period 1997-2001 regions gained a limited normative capacity about the taxes that they collect as well as over their own portion on the income tax, which moved from 15% to 30% (progressively for the regions with low level of competencies, as they assumed complete competencies on education). They also obtained the capacity of issuing new taxes. From 2002 the system included a higher share of taxes collected by the central government, an arrangement not to be revised after five years, but to be considered permanent.

This system is completed by some complementary sources of revenues. The Social Security funds are collected by an autonomous organism[20] that re-distributes them among regions and central government according to their expenditure needs and competencies, to finance public expenditure in Health policies.

Navarra and Basque Country have a different system as a consequence of some privileges that existed previously to Franco's dictatorship. The regional government in Navarra and subregional levels of government in Vasc Country have the competence of collecting practically all the taxes. They also have a limited normative capacity over them. They are obliged to transfer to the central government an amount representing the cost of the services provided in those regions. The computation of this volume depends on the cost of these services, the population of both the region and the whole country, and also both GDP levels.

All the regions have a very limited capacity of incurring into budget deficit, which is monitored by the central government. In appendix III we analyze the evolution of the different sources of income in the different regions in the period 1986-2001. The data have been collected from the database of the "Instituto de Estudios Fiscales".

2.5 Empirical Analysis

2.5.1 Model Specification and Econometric Issues

In this section we test the hypothesis that decentralization affects the distribution of public expenditure at the regional level. To do so, we estimate an equation in which the dependent variable is the ratio of capital expenditure to total expenditure of the regional government, and as explanatory variables we introduce the decentralization level . Two alternative sets of control variables that could affect the composition of public expenditure

[20] Tesorería General de la Seguridad Social.

have also been included. The first set includes per capita stock of capital and the public capital expenditure made by the central government. The second set also includes GDP per capita and population as suggested in Arze et al. (2005).[21]

We have already defined the dependent variable, cap, as the ratio of capital expenditure to total public regional expenditures. The purpose is to check the impact that increases in decentralization levels may have on the composition of public expenditure, and in particular on the proportion of capital to current spending on regional governments. In terms of the explanatory variables, our main interest lies in decentralization, dec, measured as the share of per capita regional public expenditure to per capita total public expenditure. A matrix X of control variables should include population, budget balance and GDP per capita:

$$cap_{i,t} = \alpha_i + \alpha_0 + \alpha_1 dec_{i,t} + \alpha_2 X_{i,t} + u_{i,t} \tag{2.4}$$

Some discussion has to be made on this specification, since the dependent variable is a fraction constrained to lay in the interval (0,1). In such cases the literature very often suggests the use of a logistic transformation. Papke and Wooldridge (1996) instead suggest quasi-likelihood estimation methods for models in which the dependent variable is bounded. Problems related to these models arise when it is possible to observe values closed to the boundaries. Given that this is not the case of our variable, we do not consider it necessary to apply any transformation to the model to deal with this issue.

The $\alpha_i's$ represent the individual specific term. Some authors suggest the introduction of a time-specific effect,[22] $\delta_t's$, intended to capture the effects of nationwide macroeconomic fluctuation. In our specific case the introduction of time dummies does not alter significantly the results.[23] The introduction of irrelevant variables would normally lead to a loss of precision of the estimates. We report in Appendix IV the estimation of equation (2.4) with time dummies.

[21] They also use a linear equation to estimate the effect of decentralization on the distribution of public expenditure. We may underline two main differences with our study: the first is that they look at the functional distribution of public expenditure, while we use the economic clasification. The second difference is that we use regional-level data while do a cross-country analysis for 45 developed and developing countries.

[22] See, for example, Jin, Qian and Weingast (2005), Arze et al. (2005).

[23] They are generally not significantly different from zero. The estimated values of the control variables are quite close to the ones estimated in the model without time dummies, although the model with times dummies arrows slightly higher standard errors.

We report both fixed effect estimation and random effect estimation results of the AR model for both sets of variables. The comparison and the accuracy of both estimations are related to the (unobserved) individual effect α_i. As Wooldridge (2002) points out, the discussion does not regard whether it should be properly viewed as a random variable or as a parameter to be estimated, but the key issue involving α_i is whether or not it is correlated with the observed explanatory variables $X_{i,t}$ and $dec_{i,t}$, t=1,2...T. Both estimation methods, fixed effects and random effects, assume strict exogeneity of the explanatory variables conditioned on α_i. But random effect methods assume in addition orthogonality between α_i and the explanatory variables, while for fixed effects analysis $E(\alpha_i/x_i)$ is allowed to be any function of x_i.

We do not suspect endogeneity of any of the explanatory variables, but the presence of correlation between the individual effect and any of them does not seem implausible. In such a case, the random effects estimator would be inconsistent. On the other hand, when the individual effect and the explanatory variables are in fact orthogonal, the fixed effects methods impose additional restrictions on the coefficients that would normally lead to larger variances of the estimations. The Hausman (1978) test is able to offer a conclusion about the correlation between the individual effect and the explanatory variable from the difference between the random effects and fixed effects estimates. The implementation of the Hausman test in our specific problem reveals that we cannot reject the null hypothesis of no correlation in all cases.

The random effects models are estimated using feasible GLS while the fixed effects models are estimated using pooled OLS on the standard within transformation.[24] Because of the length of the sample and the nature of the variables, we suspect a priori that serial correlation may be a problem. The Bhargava, Franzini and Narendranathan (1982) test statistics for serial correlation suggest that the error term of the specification may be AR(1).[25] The autoregressive parameters reported are computed from the Durbin-Watson statistics.[26]

In columns [1] and [5] we report the feasible GLS estimation of the first differenced model. The estimators on the first-differenced model may add some more valuable information. Its

[24] This consists of substracting from the original equation "$y_{it} = \alpha_i + x_{it} + u_{it}$" the averaged equation "$\bar{y}_i = \alpha_i + \bar{x}_i + \bar{u}_i$ " and yields $\ddot{y} = \beta\ddot{x}_{it} + \ddot{u}_{it}$, where $\ddot{y}_{it} = y_{it} - T^{-1}\Sigma_{t=1}^{T} y_{it}$, $\ddot{x}_{it} = x_{it} - T^{-1}\Sigma_{t=1}^{T} x_{it}$ and $\ddot{u}_{it} = u_{it} - T^{-1}\Sigma_{t=1}^{T} y_{it}$.

[25] The estimated statistic is 0.77 for the complete model and 0.76 for the model without population and GDPpc as explanatory. See Baltagi (2005) for more details.

[26] 1 - dw/2, where dw is the Durbin-Watson d statistic

comparison to the fixed-effects estimation hinges on the assumptions about the idiosyncratic errors, u_{it}. In particular, the within estimation is more efficient when the errors are serially uncorrelated, while the first-differences estimator is more efficient if u_{it} follows a random walk. In this case the truth is likely to lie somewhere in between. Wooldridge (2002) also suggests that the comparison between both estimators may serve us to arrow conclusions about the exogeneity of the explanatory variables, since in the presence of correlation between x_{it} and u_{it} both estimators have different probability limits.

But first differencing comes at a cost in precision. The process of first differencing the model provokes an important increase in the variance of the estimated coefficients, as well as a small loss of observations.

The presence of serial correlation in the error term might be induced by the omission of dynamics in the static model. We introduce a dynamic version of the model, which includes one lag of the dependent variable to control for this possibility in columns [4] and [8]. In fact, our results here suggest that this is quite a feasible situation. We have estimated the coefficients using the one-step version of the GMM estimator proposed by Arellano and Bond (1991). We rely on the one-step procedure rather than the two-step based on the findings in Judson and Owen (1996) applied to the length of the cross-section and time dimensions of our dataset[27].

2.5.2 Estimation results

Table [3a] shows the results of estimating equation (2.4), using two alternative sets of control variables and three possible estimation methods. Firstly we consider the linear fixed effects regression including the first differences of the variables considered, later we set up an AR model estimated by both random and fixed effects, and finally we estimate a dynamic model using Arellano and Bond (1991) GMM:

[27] We are also aware of the developments made by Arellano and Bover (1995) and Blundell and Bond (1998) to improve the efficiency of the "difference GMM" estimator by introducing additional assumptions of no correlation between the fixed-effects and the first differences of the instrumenting variables. The application of this new estimator -called "system GMM"- to our problem here would introduce slight differences to our results. Although these differences are not dramatic, we rely on the traditional "difference GMM" method since we are not totally comfortable with the additional assumptions required for the "system GMM".

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	8)
	First Differences	Fixed Effects (AR1)	Random Effects (AR1)	Dynamic GMM (A-Bond)	First Differences	Fixed Effects (AR1)	Random Effects (AR1)	Dynamic GMM (A-Bond)
cap_{t-1}				0.6517*** (.051)				0.6578*** (.051)
dec	-0.0957** (.041)	-0.1090*** (.039)	-0.1277*** (.036)	-0.0928*** (.031)	-0.0936** (.041)	-0.1160*** (.038)	-0.1366*** (.036)	-0.0933*** (.031)
GDPpc	0.0004 (.011)	-0.0018 (.007)	0.0032 (.005)	-0.0007 (.005)	-0.0010 (.008)	-0.0095*** (.002)	-0.0064*** (.001)	-0.0022* (.001)
cgcape	-2.4255 (1.94)	-3.5485* (1.70)	-2.6048 (1.63)	-1.9725 (1.68)	-2.5438 (1.93)	-3.6123* (1.69)	-2.6320 (1.62)	-1.8841 (1.67)
Kstockpc	0.0024 (.011)	-0.0110 (.010)	-0.0132* (.006)	-0.0030 (.006)				
pop	0.0724 (.057)	0.0104 (.058)	-0.0228** (.008)	0.0467 (.039)				
Obs.	323	323	340	306	323	323	340	306
Adj R^2	0.344	0.1861	0.482		0.578	0.256	0.2473	

Table 3a: Estimated Coefficients Composition of Public Expenditures

The results undoubtedly support the hypothesis that capital expenditure depends on the level of decentralization. The coefficients estimated for the variable "fiscal decentralization" are negative and highly statistically significant in every model. The values for the coefficients vary from 0.08 to 0.14, which means that an increase in the level of decentralization of one percentage point would induce a decrease on the ratio of capital to total regional public expenditure of at least 0.08%. The sign and the significance of the effect seems quite clear. In terms of our model described in section 2, that means that the level of decentralization of Spain is above the critical point $(1-\theta^*)$ and additional decentralization would be inefficient due to the increasing costs of providing decentralized public goods and services.

Our results are not perfectly comparable to the study by Arze et al. (2005) since they use as dependent variable a proxy for public consumption constructed as the fraction of public education and health on total public expenditure.[28] They estimate a value for the coefficient

[28] Which obeys to a functional classification of public expenditure rather than the economic classification that we use, discriminating current from capital expenditure. Public expenditure in those items also include investment. They also use national data for a set of 45 developed and developing countries, while we are using Spanish regional data.

accompanying Dec from 0.24 to 0.38. They estimate an increase on public consumption around 0.3% while we estimate a decrease on public capital expenditure around 0.12%, as a response to the identical one-percentage point increase in decentralization measure. De Haan, Sturm and Sikken (1996) reach a similar conclusion using a test on a panel of 22 OECD countries for the period 1980-1992, although their measure of fiscal centralization is based on tax collection, instead of the approach based on public expenditure.

The behavior of the control variables seems more sensitive to alterations in the methodology. The influence of the level of population on the dependent variable is insignificant except in the random effects model, thus rejecting the relevance of scale effects at this level.

One could also expect a negative coefficient associated with the actual level of capital stock per capita, as an indicator that governments closer to an optimal level of capital start to deviate public spending funds from it. However, we do not find any significant effect. De Haan et al. (1996), with country level data, find public capital expenditure highly correlated to private investment.[29] We think that the little divergence between the results from the fixed-effects and the random-effects models regarding the variables "Population" and "Capital Stock per capita" in the extended version may be due to the failure of the assumption of no correlation of the explanatory variable with the individual specific effect, necessary for the random-effects estimation.

The coefficient attached to the public capital expenditure made by the central government shows negative coefficients with a poor level of significance. A negative relation would be the reflect of the fact that both types of public investment may not be complementary but substitutes and therefore an increase in public capital expenditure by the central government should push down that of regional governments. As for the GDPpc, we should expect that poorer regions tend to spend a higher share of their budgets on capital, probably as a reflection of their intention to catch up the richer ones. But the conclusions are not clear, since we find significant coefficients only in the reduced version of the model.

An important question to answer regarding the validity of the results, concerns the functional classification of public expenditure described in section 2.4 and appendix II. Decentralization has mainly affected policies on Education and Health. In the functional classification made by the Spanish authorities these functional categories of expenditure are included together under the denomination of "Social Public goods ". The fact that the decentralization

[29] They estimate a coefficient of 0.076, defining the dependent variable cap in a similar way to ours and the explanatory variable private investment as its share on the GDP.

process affects some categories more than others could be a source of distortion on the results since some functional categories of expenditure are by nature more related to expenditure in capital than others. As an example, we can check in the data described in appendix II that public expenditure in economic public goods, which includes expenditure in "Transport and Communication", implies a higher share of capital to current expenditure than, for example, "Social Security" or "Social Public Goods ". For that reason we have estimated equation (2.4), using data of regional public expenditure only on the category "Social Public Goods ". We present the data used for the construction of the variables equivalent to "cap" and "soc" using only public expenditure on "Social Public Goods" under the lables "capsoc " and "decsoc". These variables are introduced in the summary statistics in Table 2. The coefficients used as a dependent variable, capital to total expenditure, and as an explanatory variable, decentralization measure are constructed from regional and national data regarding only expenditure on "Social Public Goods", which at the end of the period considered counts for more than a half of the total budget of the regional governments.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	8)
	First Differences	Fixed Effects (AR1)	Random Effects (AR1)	Dynamic GMM (A-Bond)	First Differences	Fixed Effects (AR1)	Random Effects (AR1)	Dynamic GMM (A-Bond)
$capsoc_{t-1}$				0.4966*** (.074)				0.4809*** (.073)
decsoc	-0.0074*** (.001)	-0.0079*** (.001)	-0.0068*** (.001)	-0.0031** (.001)	-0.0071** (.001)	-0.0077*** (.001)	-0.0068*** (.001)	-0.0026** (.001)
GDPpc	0.0248* (.012)	0.0063 (.013)	-0.0028 (.009)	0.0219* (.011)	0.0156 (.012)	0.0106 (.007)	-0.0105** (.004)	0.0237** (.006)
cgsoce	0.9237 (1.93)	3.566* (2.02)	0.4241 (1.89)	10.352*** (2.50)	0.6215 (1.88)	3.5584* (2.00)	0.2563 (1.87)	10.23*** (2.48)
Kstockpc	-0.0036 (.020)	0.0038 (.016)	-0.0094 (.009)	-0.0041 (.014)				
pop	0.1789** (.073)	0.0836 (.087)	-0.0333*** (.010)	0.1206 (.080)				
Obs.	221	221	238	187	221	221	238	187
Adj R^2	0.260	0.230	0.541		0.236	0.119	0.478	

Table 3b: Estimated Coefficients Composition of Public Expenditures in Social Public Goods.

The results are again conclusive regarding the significance of the variable of interest "Fiscal decentralization". However, from the comparison with the previous tables we can observe how the absolute values of the coefficients estimated are far smaller. The explanation for this phenomenon is the different sensitivity that the construction of this ratio has using data only for "Social Public Goods" in comparison to the one used before with total expenditure data. Fiscal decentralization is "more volatile", since the denominator of this ratio, i.e. central government expenditure, is much smaller.

In the control variables we can observe also smaller levels of significance, especially regarding the variables "Population" and "Central Government Capital Expenditure".

2.5.3 Robustness Check

Now we analyze the robustness of the results from the main regression shown in tables [3a] and [3b] to some alterations in the data used. Firstly, we want to discriminate from the results the effect that could have been induced by the existence of a common business cycle. For that, we have computed the same estimations (tables [4a] and [4b]) substituting the economic series by filtered data using the Hodrick-Prescott method. In particular, we apply the Hodrick-Prescott filter to the ratios cap and dec, which are the main object of our interest. We also apply the filter to the series central government capital expenditure, capital stock per capita and GDP per capita, while the series population remain unaltered.

The findings using data on total public expenditure are shown in table [4a].[30] The significance of the effects that decentralization has on public capital expenditure remain robust to this alteration, although the absolute values of the coefficients estimated are definitely different as a consequence of the filtering process.

[30] No dynamics have been considered for the filtered data. We use the command xtabond2 for the GMM estimation in columns (4) and (8) because xtabond does not allow for a completely static model.

	(1) First Differences	(2) Fixed Effects	(3) Random Effects	(4) GMM (A-Bond)	(5) First Differences	(6) Fixed Effects	(7) Random Effects	8) GMM (A-Bond)
dec	-0.0990*** (.024)	-2.4389*** (.518)	-0.8350*** (.222)	-1.6588*** (.366)	-0.0948*** (.024)	-2.1474*** (.427)	-0.8746*** (.222)	-1.3198*** (.310)
GDPpc	0.0205*** (.007)	0.0500** (.041)	-0.0007 (.022)	0.0494* (.029)	0.0193*** (.006)	0.0241 (.016)	-0.0187* (.010)	-0.0048 (.012)
cgcape	11.497*** (1.66)	-260.32*** (44.71)	-236.89*** (44.43)	- 244.83 (30.41)	11.82*** (1.62)	-269.28*** (44.55)	-235.27*** (44.25)	-248.59*** (30.24)
Ktockpc	-0.0010 (.002)	0.0937* (.051)	-0.0218 (.022)	0.0659* (.037)				
pop	0.0127 (.018)	0.3895 (.300)	-0.0222 (.021)	0.1421 (.212)				
Obs.	323	340	340	323	323	340	340	323
Adj R^2	0.31	0.21	0.18		0.30	0.20	0.18	

Table 4a: Robustness check. Estimated Coefficients Composition of Public Expenditures. Hodrick-Prescott filtered data

The table estimated while using data of public expenditure on social public goods(Table [4b]) is less conclusive. The coefficients estimated for the variables of interest, dec, remain negative but the level of significance varies among estimation methods and models. Also the behaviour of the rest of control variables is less stable than in the case in which total public expenditure is used.

	(1) First Differences	(2) Fixed Effects	(3) Random Effects	(4) GMM (A-Bond)	(5) First Differences	(6) Fixed Effects	(7) Random Effects	8) GMM (A-Bond)
decsoc	-0.0147*** (.002)	-0.0043 (.004)	-0.0062*** (.002)	0.0092 (.012)	-0.0138*** (.002)	-0.0051 (.004)	-0.0076*** (.002)	-0.0025 (.014)
GDPpc	0.0116 (.024)	0.0442*** (.015)	0.0196** (.008)	0.0651 (.053)	0.0184 (.017)	0.0494*** (.014)	-0.0015 (.001)	-0.0156 (.044)
cgcape	-0.0004*** (.000)	0.0003** (.000)	-0.0001*** (.000)	0.0001 (.000)	-0003*** (.000)	0.0002** (.000)	-0.0001*** (.000)	-0.0001 (.000)
Ktockpc	-0.0103 (.014)	0.0069 (.009)	-0.0287*** (.007)	-0.1437** (.057)				
pop	-0.0297* (.016)	0.0191 (.014)	-0.0320*** (.009)	0.0458 (.174)				
Obs.	221	221	238	221	221	221	238	221
Adj R^2	0.27	0.27	0.67		0.26	0.25	0.63	

Table 4b: Robustness check. Estimated Coefficients Composition of Public Expenditures in Social Public Goods. Hodrick-Prescott filtered data

In a second check we run the original regression using data only from those regions classified as "with low level of competencies". As we described before, the regions with "high levels of competencies" show a highly heterogenous financing system and assumption of competencies, while for the ten remaining regions the rules were almost identical. In addition, this is the set of regions that have experienced a broader change in its decentralization level. The results, described in table [5], support the original hypothesis of the paper that decentralization has an effect on the level of public capital spending, although the levels of significance for the set of control variables is poorer. The coefficients estimated for fiscal decentralization also show slightly poorer levels of significance. This could be a consequence of the smaller number of observations that we use in this regression. The estimated coefficients are, however, a bit larger in absolute value than those from table [3].

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	8)
	First Differences	Fixed Effects (AR1)	Random Effects (AR1)	Dynamic GMM (A-Bond)	First Differences	Fixed Effects (AR1)	Random Effects (AR1)	Dynamic GMM (A-Bond)
cap_{t-1}				0.6366*** (.064)				0.6504*** (.062)
dec	-0.1464** (.069)	-0.1715*** (.062)	-0.1538*** (.057)	-0.1273*** (.042)	-0.1468** (.073)	-0.1590** (.062)	-0.1492** (.057)	-0.1276*** (.042)
GDPpc	0.0226 (.017)	-0.0057 (.006)	0.0056 (.004)	0.0002 (.003)	0.0147 (.015)	0.0122** (.004)	-0.0109*** (.003)	-0.0021 (.002)
cgcape	-0.8151 (2.38)	-1.6001 (2.63)	-0.6564 (2.52)	-0.8583 (2.57)	-0.7267 (2.78)	-1.5666 (2.62)	-0.4130 (2.50)	-0.6004 (2.56)
Ktockpc	-5.3717 (5.30)	-3.8020 (2.74)	-3.6245* (2.15)	-1.7645 (1.59)				
pop	0.1618 (.190)	0.1047 (.151)	0.0772** (.046)	0.0750 (.096)				
Obs.	190	190	200	180	190	323	200	180
Adj R^2	0.321	0.083	0.409		0.134	0.350	0.347	

Table 5a: Robustness check. Estimated Coefficients Composition of Public Expenditures. Regions with low level of competencies

In this case the results using data of public expenditure on social public goods are almost identical to the ones obtained with the original variables including total public expenditures and suggest that the level of decentralization is a key determinant of the propensity to invest of the regional governments and that this pattern of behaviour could be even more evident in the subset of regions in which decentralization has taken place in a later stage.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	8)
	First Differences	Fixed Effects (AR1)	Random Effects (AR1)	Dynamic GMM (A-Bond)	First Differences	Fixed Effects (AR1)	Random Effects (AR1)	Dynamic GMM (A-Bond)
$capsoc_{t-1}$				0.2640*** (.070)				0.2775 *** (.084)
decsoc	-0.0143*** (.003)	-0.0124*** (.002)	-0.0105*** (.002)	-0.0104*** (.002)	-0.0127*** (.002)	-0.0124*** (.002)	-0.0102*** (.002)	-0.0094*** (.002)
GDPpc	0.0368 (.029)	-0.0093 (.019)	-0.0105 (.011)	0.0276* (.015)	0.0240 (.022)	-0.0095 (.008)	-0.0200*** (.005)	0.0127 (.011)
cgcape	-0.0008 (.027)	-0.0229 (.028)	-0.0281 (.025)	-0.0180 (.016)	-0.0086 (.027)	-0.0248 (.028)	-0.0268 (.024)	-0.0191 (.015)
Ktockpc	0.0123 (.026)	-0.0016 (.019)	-0.0092 (0.01)	-0.0003 (.000)				
pop	0.5684** (.256)	0.0601 (.139)	-0.0039 (.013)	-0.0027 (.002)				
Obs.	130	130	140	120	130	130	140	120
Adj R^2	0.225	0.541	0.717		0.191	0.542	0.715	

Table 5b: Robustness check. Estimated Coefficients Composition of Public Expenditures in Social Public Goods. Regions with low level of competencies

2.6 Conclusions.

In this paper we examined the implications of public expenditure decentralization on the economic distribution of the public budget, in particular, on the share of public capital to current expenditures.

We first investigate this issue from a theoretical point of view, with the use of a distance-sensitive representative agent model. We model a version of the AK model in discrete time, with two types of public expenditure: public consumption and public investment; two levels of the public administration: central and regional governments; and exogenously determined tax-rate and decentralization level. The agent gets utility from private consumption as well as from public consumption, being distance-sensitive towards the level of the administration that provides the later. Public investment, in contrast, involve no utility for the agent, but

comes in the production function of the economy as a separate factor. Regional administrations have to pay a increasing cost of public decentralization as a result of the economies of scale.

In this model, there is a critical point, under which decentralization induces higher levels of public investment, enhancing economic growth. This happens as a result of the gains on the utility resulting from the reduction of the distance from the consumer to the public administration providing public consumption goods. But above this critical point the cost of the decentralization provision of the consumption good is too high, and overcomes the gains in the utility function. The level of public investment would decrease with additional decentralization, pushing down economic growth. According to this framework, decentralization would only be beneficial as long as it enhances public investment.

The Spanish economy has experienced one of the fastest processes of decentralization in Europe since the arrival of democracy in 1978. This process has also been very peculiar, since the development of the regional governments has been quite asymmetrical, and, even now, some of them present significant differences in their levels of fiscal autonomy. With data from the Spanish economy, we test the hypothesis that decentralized regions spend a higher share of their budget on current expenditure than centralized ones. The results are very conclusive and robust to several sensitivity analyses that have been run to the original equation: decentralization is a crucial factor to explain the share of public expenditure devoted to capital. Decentralized regions devote a smaller share of their budget to public capital, in contrast to public current expenditure.

Under the framework of our theoretical model, this result implies that the level of decentralization in Spanish regions could be above the optimal and this situation could represent an obstacle for economic growth.

2.7 Appendix I: Theroetical model

We consider an economy populated by a constant amount of infinitely lived households. There are a private consumption and a public good from and two types of capital, private

physical capital, k, and public infrastructure services, g_k. Production can be devoted indistinctly to purchase any of the types of consumption or production factors. For the sake of simplicity we do not include labour. Our economy will be driven by the Cobb-Douglas technology represented by the production function:

$$Y_t = AK_t^{\gamma} G_{k,t}^{1-\gamma} \tag{2.5}$$

Thus, production exhibits constant returns to scale in all factors. There is total depreciation in both inputs.

The household-producer maximizes the discounted stream of future utility:

$$U_s = \Sigma_{t=s}^{\infty} \beta^s [\ln C_t] \tag{2.6}$$

where c_t represents private consumption in period t. The consumer ignores the present and future decisions of the public government. He faces the budget constraint:

$$(1-\tau)Y_t = C_t + K_{t+1} \tag{2.7}$$

The maximization problem yields the euler equation:

$$\frac{C_{t+1}}{C_t} = \Pi_c = \beta\gamma(1-\tau)\frac{Y_{t+1}}{K_{t+1}}$$

That we expect to be constant in the steady state.

The government has the target of maximizing the utility perceived by the median voter from the publicly provided public good, g_c, which follows a distance-sensitiveness pattern as described in the utility function (2.6). We assume that the equilibrium amounts provided of every good are decided according to the median voter theory.[31] Given symmetric preferences, the quantity preferred by the median voter is located a distance equal to the "median distance

[31] See Congleton (2002) for a good introduction to the topic and its controversies.

to the median". For a country with area A, the central government would be situated in the middle. That means that the maximum distance to it is A/2. Given that the individuals are uniformly distributed , the median distance to the media is A/4. Analogously, for everyone of the J regions the median distance to the median is A/J4.

Production is taxed at the constant rate $\tau \in (0,1)$.The government distributes the public budget among public consumption, $G_{c,t}$ and public capital accumulation for next period, $G_{k,t+1}$, taking into account that the relative price of public consumption depends positively on the level of centralization, θ, as described in the budget constraint (2.7). The government maximizes the discounted present value of lifetime utility, (2.6), subject to technology, (2.5), and the budget constraint (2.7). Let $(1-\alpha(\theta x_{ic}+(1-\theta)x_{ij}))>0$, x^m_{mc} be the median distance to the country median and x^m_{mj} be the median distance to the region median. The maximization problem yields the following euler equation:

$$\frac{G_{c,t+1}}{G_{c,t}} = \Pi_g = [\beta\tau(1-\gamma)\frac{Y_{t+1}}{g_{k,t+1}}]^{\delta} \tag{2.8}$$

where $\delta = \frac{1}{\frac{1-\theta}{\theta}+\alpha[\theta x^m_{mc}+(1-\theta)x^m_{mj}]}$

This economy will converge immediately to an equilibria where all factors grow at a constant rate Π. We can work out the equations for the relative proportions of the production factors used in equilibrium as well as the constant growth rate:

$$K_t = [A^{1-\delta}\frac{\beta(1-\tau)\gamma}{[\beta\tau(1-\gamma)]^{\delta}}]^{\frac{1}{1-\gamma+\gamma\delta}} g_{k,t}$$

$$\Pi = (A^{\delta}[\beta(1-\tau)\gamma]^{\gamma\delta}[\beta\tau(1-\gamma)]^{(1-\gamma)\delta})^{\frac{1}{1-\gamma+\gamma\delta}} \tag{2.9}$$

As long as $\Pi>1$, there is a constant rate of consumption growth and it is entirely independent of the level of capital stock per person. This will also imply that there are no transitional dynamics in this model. Starting from any level of initial wealth, the economy will immediately start growing at a constant rate. We have to impose the additional condition that A has to be large enough[32] to ensure positive economic growth.

[32] $A > \beta[(1-\tau)\gamma]^{\gamma}[\tau(1-\gamma)]^{(1-\gamma)}$

We are ready to analyze the outcome of an increase in fiscal decentralization, i.e. a decrease in the parameter θ. $\frac{d\Pi}{d\theta}$ will be positive as long as θ is smaller than θ^*[33]. That means

that, given a sufficiently high level of centralization, $\theta > \theta^*$, a decentralization process will imply both an increase in the utility perceived by the consumer from the publicly provided consumption good and in its relative price. The positive effect on utility is larger and if there were no change in public investment the Euler equation would not hold anymore because the marginal productivity of public capital would be too large in comparison to the consumption path. Therefore, the decision planner will decide that a larger level of the public budget will be devoted to the homogeneous public good (public investment) and a smaller share of the budget is devoted to provision of the heterogeneous public good, G_c.

Once this economy is "too decentralized" and θ descends under θ^*, the negative effects caused by the increasing costs of decentralization overcome the benefits from a closer provision of public goods and both effects reverse. In that case, although the consumer still perceive a benefit in the perceived utility from the public consumption good, the effect on the price provokes that with the share of public expenditure devoted to G_c before decentralizing, the utility perceived from the amount resulting with the new relative prices would be much lower and the decision maker has to move part of the public budget from investment to consumption to converge to the new equilibrium

Private decisions and economic growth respond to the changes of public investment. Therefore, an decentralization process will enlarge economic growth only if we are above the critical level θ^*, and in the contrary, when the economy has already reached this level of decentralization, additional increases in θ would retard economic growth. This happens because in a more decentralized country there will be more utility for the individuals from the consumption of heterogeneous public goods, this causing an important wealth effect making the demand for public investment increase to the point in which marginal utility equals the marginal benefit of investment. But decentralization comes at the cost of paying an increasing price for the heterogeneous public good whose effect will at some point overcome the benefits in the utility function, making the increase on the demand of ´G_k´ to die out progressively as we reach θ^*.

[33] $\theta^* = \frac{1}{2\alpha(x^m_{mc} - x^m_{mj})}[\sqrt{(\alpha x^m_{mj} + 1)^2 + 4\alpha(x^m_{mc} - x^m_{mj})} - (\alpha x^m_{mj} + 1)]$, for our range of possible values of the parameters this value will always be compressed in the interval (0,1)

2.8 Appendix II: The functional distribution of the decentralization process

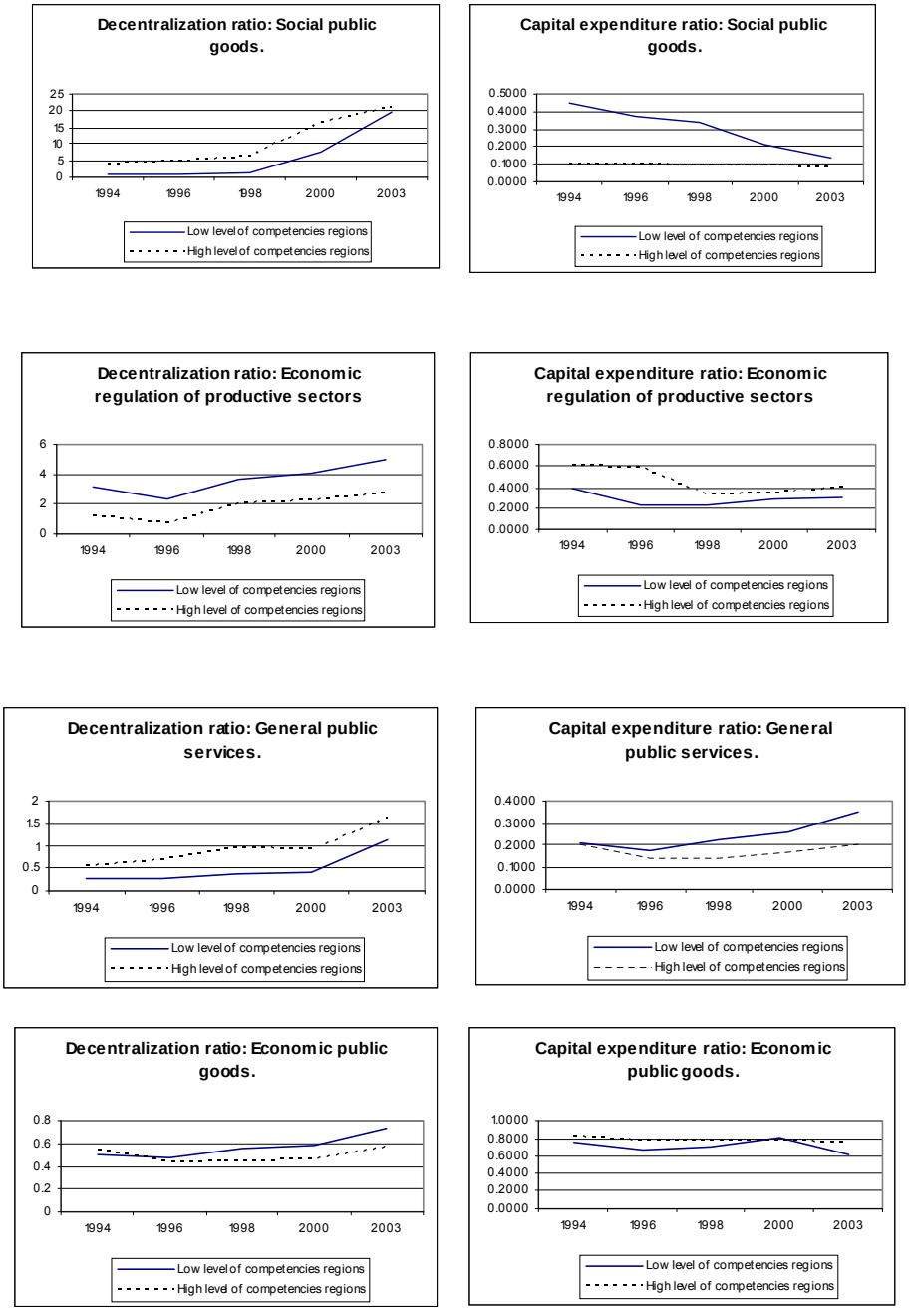


Figure A.1: Fuctional distribution of Public Expenditure

Data source: Presupuestos de las Comunidades Autónomas. Several years.

2.9 Appendix III: Evolution and sources of public regional revenues

The graphs show the different nature of income between the two regions with "Régimen Foral" and the rest. The category tax revenues includes all the taxes whose control lies in regional governments as well as the participation that they have in other taxes collected by the central government. We can see how the revisions introduced for the period 1991-1996 and especially that of 1997-2001 have produced a great increase in tax income that has substituted part of the Participation on the Revenues of the State (PRS).

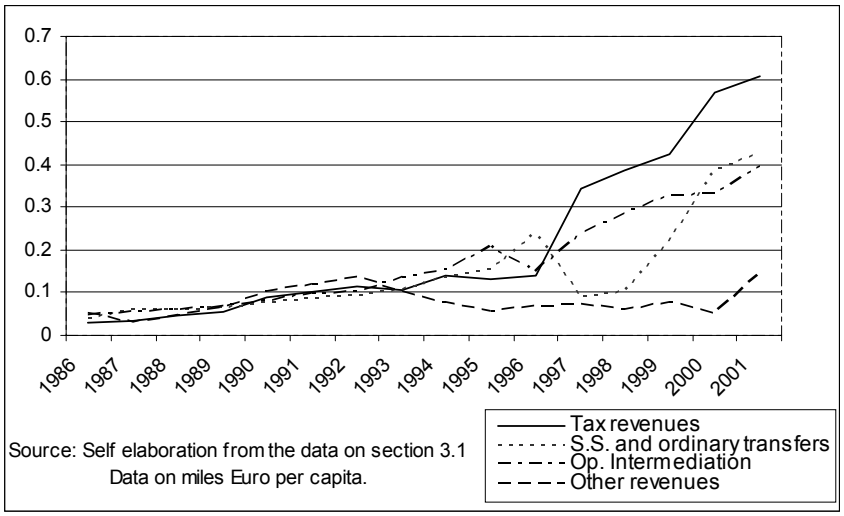


Figure A.2: Sources of revenues: Regions with low level of competencies

The category Social Security and ordinary transfers includes basically two main components. The first one is the translation of funds from the Social Security organism (Tesorería General de la Seguridad Social) to the regions to face the expenditure regarding social security (mainly Health[34]). The second main component is the PRS, which accounts for the transfers from the central government to finance the competencies assumed by the regions. This is calculated according to economic, demographic and political variables and taking into account the different amount of competencies that the regions may assume (many of them are assumed freely).

[34]The regions complete their expenditure in health policies with other complementary funds from the central government (or deduced from the amount to be paid, in the case of Vasc Country and Navarra) given that the amount provided by the Social Security cuotas is declared to be insufficient.

The category operations of intermediation counts for the transfers from central government and European Funds in which the regions are only the "link" between the funds provider and their destination. Other revenues include a quite heterogeneous sources of revenues, among them the Fund of Interterritorial Compensation (FCI)[35] and public debt.[36]

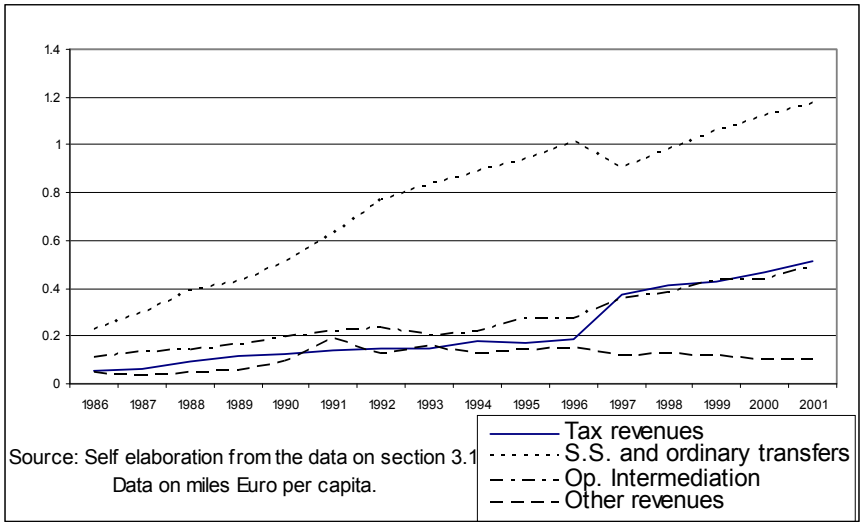
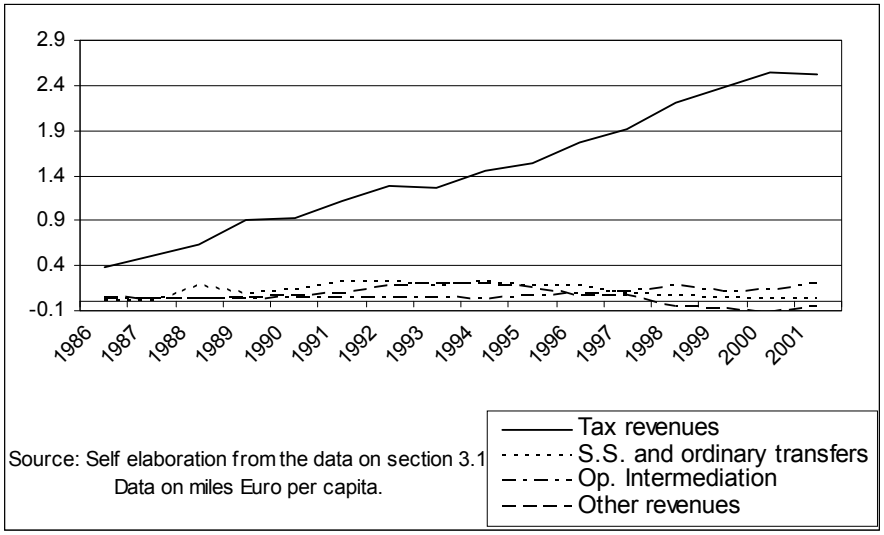


Figure A.3: Sources of Revenues: Regions with high level of competencies (Ex. Navarra and Basque Country)



[35] An incentive to develop the regions with lower production per capita. It is a fund provided to be invested in activities that enhance growth.

[36] Ocasionally, the value of this category lies under zero, precisely because of the effect of the amortization of public debt.

Figure A.4: Sources of Revenues: Navarra and Basque Country

2.10 Appendix IV

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	8)
	First Differences	Fixed Effects (AR1)	Random Effects (AR1)	Dynamic GMM (A-Bond)	First Differences	Fixed Effects (AR1)	Random Effects (AR1)	Dynamic GMM (A-Bond)
cap_{t-1}				0.5723*** (.056)				0.5697*** (.055)
dec	-0.0556 (.069)	-0.1291** (.061)	-0.172*** (.051)	-0.1395*** (.054)	-0.0674 (.067)	-0.1512*** (.057)	-0.1861*** (.052)	-0.1538*** (.048)
GDPpc	0.0080 (.013)	0.0112 (.009)	0.0054 (.007)	0.0126* (.006)	0.0067 (.011)	0.0034 (.007)	-0.0044 (.005)	0.0129** (.005)
cgcape								
Ktockpc	-0.0003 (.014)	-0.0158 (.011)	-0.0157** (.007)	-0.0009 (.007)				
pop	0.1156 (.071)	0.0219 (.066)	-0.0231** (.009)	0.0199 (.042)				
Obs.	323	323	340	306	323	323	340	306
Adj R^2	0.183	0.016	0.4879		0.110	0.080	0.218	

Table A.1: Estimated Coefficients Composition of Public Expenditures. Time dummies

CHAPTER 3

AN EVALUATION OF EU REGIONAL POLICY. DO STRUCTURAL ACTIONS CROWD OUT PUBLIC SPENDING?

3.1 Introduction

In the early seventies much was written about the effects of intergovernmental grants on public expenditure. Transfers between different governments -usually from upper to lower levels of the public administration- became an oft-used tool often with the purpose of enhancing public expenditure in pre-determined areas (education, infrastructure, etc.). These subsidies were usually given on the condition that they were invested in certain targeted policies or programs. However, as long as the subsidized government was free to administer the rest of its budget, these transfers could simply crowd out the resources previously allocated in the subsidized areas to other alternative uses or to reduce tax revenues.

In fact, in a neoclassical model of local government, with fully informed agents and perfect political competition, alterations to private income are perfectly substitutable by equivalent alterations to public revenue. The result of giving a lump-sum grant to households or giving it to public bodies would be identical. Governments receiving grants would increase their public expenditure only because of a wealth effect, which would be identical to distributing the grants homogeneously through the population. However, many empirical studies[1] have revealed that the grants provided by the US federal government have boosted state and local public expenditure. These grants were shown not to crowd out totally public expenditure in the policy areas in which they were introduced. Economic theory has responded to this evidence through two main strands of research.

A first line of research analyzed the necessary conditions that make lump-sum public grants boost public spending more than an equivalent increase in private income, i.e. the

[1] Weicher (1972) and Feldstein (1975) among others. Fisher (1982) includes a complete literature review.

"flypaper effect". The most standard explanations refer to the rigidities in the decision-making process (Dougan and Kenyon (1988)). Pressure groups that perceive higher utility from public spending than the average voter take advantage of the "fiscal illusion " induced by a lump-sum subsidy. But alternative ways to explain the phenomenon have also emerged. According to Hamilton (1983) and King (1984), the variations of the public expenditure decisions could come as a response to changes in local socioeconomic characteristics induced by the grants.

The second strand of the literature has been largely inspired by the work of Bradford and Oates (1971), and tries to identify under which conditions public grants are more effective in boosting public expenditure. In particular, this literature evaluates the use of matching-grants, which provide a funding for a particular public good proportional to the level of expenditure of the subsidized government in that public good. More recently, Chubb (1985) and Melo (2002) have tried to model how in less popular policy areas lump-sum grants do lead to local spending cuts that push the level of public expenditure down to its original level. This makes the use of matching grants more advisable if the purpose is to push up expenditure. As opposed to more popular policies areas: policy-makers would always find incentives to enlarge public spending in those, making lump-sum grants also a valid tool to reach the desired increase in spending.

We evaluate the effectiveness in enhancing public investment of the grants system established under the European Structural Actions. The European Union began its Cohesion policy in 1975 devoted to reducing the existing differences among the various regions and promoting economic growth, especially in less favoured areas. It implemented a system of matching grants through the Structural and Cohesion Funds, which were conceived to push up public investments and expenditures in key areas for enhancing growth. The channel through which the Funds try to push public investment up in those areas is by making an EU contribution to certain projects conditional on a certain level of expenditure of the member countries on those projects. The aim of this "matching" system is to prevent that the share of public expenditure that would otherwise be devoted to certain kinds of public investment from being deviated to a different category of public expenditure after the implementation of the grant.

Using panel data from 15 European countries for the period 1993-2005 we test the extent to which these grants enhance public investment effectively. We use standard fixed-effects

and random-effects estimation in a linear model with autocorrelated errors and the GMM Arellano and Bond (1991) estimator in a dynamic modification of the model that takes into account the endogeneity of the explanatory variables. We repeat a similar analysis with data from the Spanish regions (NUTS 2) to control whether the previously estimated effect is homogeneous among levels of the public administration.

We estimate that only 60 percent of the increase in the Structural Funds received by the subsidized government are used to increase public investment. The remaining 40 percent of the transfer is crowded out towards other alternative uses, like public consumption.

Using an extended version of the AK model, we examine the link between matching grants and public investment under neoclassical technology and an exogenously determined tax rate. The model compares the effect on public investment of a matching grant policy with that from an equivalent lump-sum transfer and shows how the effect of the matching grant depends on the relative amount used of the subsidized capital

According to our theoretical model, the pattern estimated in our panel can be interpreted as a relatively good performance of the matching process of the grants established by the European Union. Taking into account the decision process that drives the allocation of the Structural Funds, subsidized governments may take as given an important share of the grants that they perceive, and their behavior towards those would be more likely to consider them as lump-sum grants rather than matching-grants. This may happen because the European Commission is not totally autonomous negotiating the investment projects in which to invest the Funds. Instead, it must stick to the predetermined amount of Funds agreed in the European Council.

Section 2 introduces a theoretical framework about matching grants, section 3 summarizes the econometric techniques and modelling used in previous related studies, section 4 describes the European cohesion policy, section 5 introduces the variables and data used, section 6 explains the model and interprets the results and section 7 concludes.

3.2 Theory on the effectiveness of public grants.

Bradford and Oates (1971) is the response to previous efforts to find a common theory on intergovernmental grants. They prove that under simple majority rule with fixed tax shares

and a single public good, a matching grant will always lead to a larger public expenditure than a lump-sum grant of the same amount. The key assumptions are the presence of an individual decision-maker with preference patterns of the usual sort and a collective decision made by simple majority rule. Gramlich and Galper (1973) develop the analysis further by including in a model three different types of grants,[2] and a local government with a very complete utility function that includes, among other factors, the level of current public expenditures. They conclude that matching grants have a larger effect on public expenditure, while the impact of closed-end lump sum transfers on public expenditure remains quite low.

Most subsequent work on intergovernmental grants has focused on exploring theoretical explanations to explain why lump-sum grants to public bodies boost public expenditure more than an equivalent increase in public wealth (flypaper effect). These explanations concentrate on complexities in the public policy process, agenda setting, fiscal illusion, etc. A good example is the setter model proposed by Romer and Rosenthal (1980), in which an agent whose target is to maximize public expenditure takes part in the process of determining the public budget. Hamilton's (1986) explanation relies on the deadweight loss of welfare created by increases in taxation. Borge (1995) develops the fiscal illusion model of Wallace Oates and shows that it unambiguously predicts a flypaper effect.[3]

However, for many years the conditions under which public grants boost a larger share of public expenditure have been relatively unexplored. Chubb (1985) expands the interpretation in Bradford and Oates (1971) by arguing that the implementation of matching or lump-sum grants responds to the solution of a hierarchy principal-agent problem existing between federal and state governments. Other studies, like Bahl and Duncombe (1988), Bahl and Sjoquist (1990), and Deller and Walzer (1995), have focused their attention on the persistence of the policies, by considering budgetary decision-making in a slightly longer-term view. Grants revenue can be viewed as something more or less permanent. If a public body can count on grant revenues for the long term, they will easily substitute their own revenues. Alternatively, if aid is considered transitory, they will be less likely to substitute other revenues and will serve better to their purpose of enlarging the public budget, using these funds for one-time ventures.

Knight (2002) uses a bargaining model, based also on Bradford and Oates (1971, 1971b),

[2] Open-end matching grants, closed-end lump-sum transfers and closed-end categorical grants, that transfers a limited amount of money to be used for a specific program.

[3] Bailey and Connolly (1998) include a complete summary of theoretical explanations and critics of the flypaper effect in which they list 10 existing theoretical reasons that previous analyses have used to model the flypaper effect.

in which grants and public expenditure are the result of a two-stage process: the first (federal budgetary stage), in which a federal legislature, with one representative from each state, determines the distribution of grants across states from the federal budget, and a second stage (state budgetary stage) in which state governments, taking first-stage intergovernmental grant levels as given, allocate federal grants and private income between public and private consumption. He shows that the allocation of grants is endogenous to the state's preference to increase its expenditure. This may be the reason why many estimations may upwardly bias the public expenditure response to grants.

One of the more recent and outstanding contributions to the theory of intergovernmental grants is the paper by Volden (2007). His model includes a game, solved through subgame perfect equilibrium and backward induction, in which elected politicians in a national and subnational governments compete with each other to claim credit for providing goods and services in a given policy area. The politicians are seeking to represent the desires of their constituency.

His more interesting findings regarding the response of public expenditure to federal grants are, firstly the dependence of the effect on the capacity of the recipient government to efficiently raise taxes, so that governments with greatest tax efficiency would experience higher crowding-out induced by the grant. Secondly, the donor government would increase its grant size under some conditions (namely demand for the good) that also affect the propensity to spend of the subnational government. This would give the appearance of a smaller crowding-out effect, since the increase in the good provision would have occurred without the grant. Identically, a decline in the tax efficiency could provoke an opposite reaction under which more of a crowding-out effect would be detected.

3.2.1 Matching grants in a simple model of neoclassical growth

We will use a version of the simplest neoclassical model of substained growth to see the transition mechanism that drives the impact of matching grants to public investment onto public expenditure . We have modified the so-called AK model, where the production technology is linear in capital, including separately public capital in the production function. Since our interest is exclusively on the behavior of public expenditure, we assume an exogenously determined fixed tax rate.

Our purpose is to replicate the effects of the implementation of a matching grants system, similar to the one established in the European Union through the Structural and Cohesion Funds. The main target of these policies is to increase economic growth by enhancing public investment. The choice of matching-grants instead of lump-sum grants has precisely the purpose of making public investment more attractive in comparison to public consumption.

We consider a country with an infinitely lived representative median voter, whose preferences depend on the amounts consumed of a private good and a publicly provided public good. The decisions are taken separately, and the household cannot forecast the behavior of the government while taking their own decisions. The households are also the owners of the technology of the country, which produces according to a constant returns to scale production function in which, in addition to private capital, there is public capital:

$$Y_t = AK_t^{\gamma} G_t^{\alpha} \tag{3.1}$$

The model is developed in the Appendix.

The subsidizer, in our case the European Union's structural policy, gives a matching grant to selected types of public capital. The implementation of a matching grant would be translated into the model as a decrease in the relative price of public capital, represented by the parameter δ ($\delta \in (0.1)$). The subsidizer would then share the cost of part of the purchase of public capital $(1-\delta)G$ while the remaining δG is still paid by the subsidized government through its tax revenues.

In section 3.6 we estimate the response of total public investment to the introduction of a grants system in the economy is given by the variation on total public investment after and before the implementation of the grant, that is, the increment ΔG. If there is an increase in public investment higher than the grant actually perceived we say that there is crowding-in of public investment induced by the matching grant, while when the increase in public investment is smaller than the grant we define it as crowding-out. The case in which there is zero or a negative increment of public investment is called total crowding-out.

In the Appendix we are able to develop the consequences of the introduction of a matching-grant in our particular framework, summarized in the following proposition:

Proposition 3.1 *In our model of neoclassical technology, a matching-grant to public capital will always induce a crowding-in effect onto public investment.This means that there will be a positive increase in final public investment higher than the amount granted as a reaction to the transfer.*

This result would imply that if the Structural Funds behave really as matching grant, the coefficient estimated in section 3.6 should be larger than one, because there will always be crowding-in of public investment. We could admit the possibility that the Funds are not really matching grants since, as we describe later in section 3.4, their amounts are negotiated in the European Council every seven years and the subsidized States could take as given that they will perceive then.

For this reason, we introduce in our model the possibility for the grants perceived through the Structural Funds to behave as lump-sum grants rather than matching-grants. The joint analysis of our estimations and the decision process described in section 4 may induce us to be skeptical about whether the Structural Funds do actually work as matching grants or as lump-sum transfers. Although they are designed as matching grants, the broad numbers are the result of a bargaining process in the European Council. This means that subsidized governments may take as given that they will receive at least a share of the Funds agreed in the Council. Later on, it will be the work of the European Commission to negotiate with these governments the particular projects and conditions under which the Funds will be invested.

Therefore, we want to check in our model how lump-sum transfers of capital do affect public expenditure. This is done in case C in the appendix, whose conclusions are reported in proposition 2:

Proposition 3.2 *In our economy with neoclassical technology and a fixed tax-rate, a lump-sum transfer to the government from an external agent will induce a deviation of public resources from public investment towards public consumption such that the government will increase public consumption by a quantity higher than the transfer received. Therefore, there will be a negative increase in final public investment as a reaction to the transfer.*

According to this proposition, lump-sum transfers will induce a very strong crowding-out effect on public investment. In fact, proposition 3 states that the estimated coefficient β_1 in

equation (3.2) associated with a lump-sum grant should be negative[4] since the crowding-out effect would be larger than the grant transferred.

We expect the impact of the matching grants designed for the Structural Funds on public investment to depend on the leeway of the European Commission to effectively decide on the final amount of grants allocated according to the subsidized government's behavior. As long as governments take as given an important part of the transfers, they will treat them as lump-sum transfers and these transfers will crowd out public investment. But if the European commission also has some margin to decide particular investment projects to be developed and the granted amount of money could fluctuate according to the State's investment on these projects, the Funds will work as matching grants and they will crowd in public investment.

Our real scenario could lie somewhere in between a system of lump-sum transfers and matching grants. So, if we assume that a share σ of the increase on the Structural Funds is considered as lump-sum transfers by the subsidized governments while the rest of it, $(1-\sigma)$, is transferred according to a matching grant system, from equations (3.13) and (3.15) we get the final effect on public expenditure:

$$\frac{\Delta(G)}{\Delta SF} = \beta\tau\boldsymbol{\alpha}\left(\frac{\left(\frac{\mathbf{1}}{\boldsymbol{\delta}^{\mathbf{1-\alpha}}}-\mathbf{1}\right)}{\Pi_0\Delta(1-\delta)G} + \frac{\left(\frac{1}{\Pi_{gS}}-\frac{\mathbf{1}}{\Pi_g}\right)}{\Delta L}\right)$$

where $\Delta L = \sigma\Delta SF$ and $\Delta(1-\delta)G = (1-\sigma)\Delta SF$

The first term inside the brackets represents the crowding-in effect induced by the matching grants, and is always larger than one, while the second term represents the crowding-out effect induced by the lump-sum part of the funds, and is always negative. We have estimated a coefficient 0.6 for β_1, therefore the Structural Funds are not understood as working precisely as matching grants or lump-sum transfers, but rather as a combination of both

[4] While it is only necessary a coefficient smaller than one for the existence of crowding-out

depending on the extend to which subsidized governments treat them as unconditionally given.

Finally we will briefly discuss how some of the implications of this model match the results estimated in section 6. Firstly, the level of public investment, $\frac{G_{1,t}+G_{2,t}}{Y_t}$, depends positively on the exogenous tax rate. We do not include tax rate among our explanatory variables, but public consumption as an approximation of public expenditure. We estimate a positive coefficient associated with this variable which is perfectly consistent with this theoretical model. Secondly, private capital in our model is endogenously determined, but if any exogenous shock alters private capital, according to equation (3.11) in the Appendix, the relative amounts of public investment would also decrease, which is also consistent with the negative coefficient estimated in section 3.6. Finally, our model predicts a negative reaction of public investment towards exogenous changes in economic growth (due, for example, to a change in the technology represented by A) which this time does not coincide with our estimations since we are able to identify an insignificant coefficient attached to growth.

3.2.1.1 Extension: subsidized and non-subsidized public capital.

In the Appendix we also develop a version of the basic model with two types of public capital. We want to see the role that the output elasticities of the public factors have on the response to matching grants. Two types of public capital have been included to make the model more intuitive, one of which has a larger output elasticity ($\alpha 1 > \alpha 2$).

The implementation of the matching grant would be translated into the model, in a similar way that in the basic model, as a decrease in the relative price of any of these two types of public capital, represented either by the parameter δ_1 or δ_2 respectively (δ_1,$\delta_2 \in (0.1)$). The subsidizer would then share the cost of part of the purchase of public capital $(1-\delta_1)G_1$or $(1-\delta_2)G_2$, while the remaining $\delta_1 G_1$or $\delta_2 G_2$ is still paid by the subsidized government through its tax revenues.

To explore the importance of the elasticity of substitution of the subsidized type of public capital on the crowding-in effect and on economic growth we compare in the appendix the effects of two alternative grants to each type of public capital: in the first case with identical rate of subsidy and in the second with identical cost for the subsidizer, yielding propositions 3 and 4:

Proposition 3.3 *The response of a public authority towards a matching grants policy on certain kind public investment run by an external institution depends on the relative amount of this kind of public investment used previously. The higher the output elasticity of this kind of public investment with respect to the other production factors, the higher the increase in public expenditure induced by the grant.*

Proposition 3.4 *The cost to the subsidizer of running a matching grant policy with the purpose of reaching a predetermined increase of public investment does not depend on the output elasticity of the subsidized type of public investment. However, the higher this elasticity of the public investment, the higher the increase in economic growth induced by the reallocation of factors.*

Propositions 3 and 4 summarize the importance of the output elasticity (which indicates also the relative amount of the factors used in equilibrium) on the response of public investment to the matching grants. Proposition 3 explains that the response of a certain type of capital to a matching grant program will depend on its output elasticity (α). Therefore, the comparison of the reaction of public investment to different matching-grant programmes may serve the policy-maker to infer the properties of the subsidized capital: the higher the response, the higher the α associated with this type of capital.

Proposition 3 is useful for the policy maker to identify the type of capital with a higher output elasticity, α ; according to proposition 4, however, the impact of a matching-grants policy on economic growth does not depend only on the amount of money invested, but also on the elasticity of the subsidized capital. Therefore, to make grants more efficient they should be allocated to the type of capital with a higher coefficient α, which is also the more commonly used in equilibrium.

These two propositions can be used for an optimistic interpretation regarding the capacity that the policy maker may have to focus the target of the matching grants policy on the types of public investment that will imply a larger effect on growth. As long as the

policy maker must be able to observe the dynamics described in proposition 3 regarding the response of the subsidized capital to the grant -in particular they know the coefficient δ-, that, combined with our estimation here, would serve him to obtain conclusions about the size of the crowding-out effect of the matching-grant policy[5] on non-subsidized capital.

However, regarding the estimation made on this paper, we should expect the estimated coefficient $\beta_1$in section 3.6 (equation (3.2)) to be independent of the final effect on economic growth. According to proposition 4 the cost of running a matching grant policy, i.e. the relationship between the subsidized amount and the response of public investment, does not depend on the output elasticity of the subsidized capital. Since in principle we are not able to observe the final effect on output growth, we cannot assess whether the subsidized capital has been optimally targeted or not.

3.3 Modelling the Effect of Grants on Public Expenditure

The earlier literature about the effects of grants policies on local and state expenditure emerged in the early seventies, most of them using data from the several federal grant programs implemented in the US to boost economic growth in less developed States and areas. During this decade, a great number of studies, probably encouraged by the findings presented by Bradford and Oates (1971), examined the extent to which additional grants receipts were associated with greater government expenditure. These studies generally relied on taking cross-sectional variations in grants to be exogenous to the level of public expenditure which they affect. We recall here the study by Gramlich and Galper (1973) in which they estimated an effect of a 25 percentage point response on public local expenditure to alterations in state and federal aid to ten urban governments. More detailed literature reviews on this period may be found in Hines and Thaler (1995) and Bailey and Connolly (1998).

Winer (1983) considered a dynamic specification of the model, but these results did not differ from its static counterpart, and he concluded that public expenditure in Canadian provinces experience an increase slightly higher than the increase in grants perceived, therefore rejecting the crowding-out hypothesis.

[5] We regress $\Delta\frac{G_{subsidized}+G_{nonsub}}{Y}$ on $(1-\delta)\frac{G_{subsidized}}{Y}$. For the policy maker it must be relatively easy to observe the impact of $(1-\delta)G_{subsidized}$ on $\Delta G_{subsidized}$, and, therefore, obtain conclusions about the crowding-out effect of $(1-\delta)G_{subsidized}$ on ΔG_{nonsub}. We ignore the output elasticities of the capital subsidized through the Structural Fund, so we are not able to identify $G_{subsidized}$ with either G_1 or G_2 in this model.

Case, Rosen and Hines (1993) estimated the flypaper effect of federal grants on US states in a study in which the main target was to analyze fiscal policy interdependence among states. They setup their model as a standard "fixed effects" linear panel data model in which they introduced common random shocks among neighbors. They also included among the explanatory variables decisions about public expenditure taken by the neighbor states.

They estimated the effect of federal grants on state spending between 0.014 (for "State Administration") and 0.278 (for "Health and human services " expenditure). However, their estimated effect was much closer to 1 in the models that included total public expenditure. These results should be treated with scepticism. Firstly because the results are obtained using very heterogeneous definitions of the weighting matrix used to define "neighborhood ". Apart from physical distance they also consider per capita income and the proportion of the population that is black. Secondly, the results regarding our variable of interest, federal grants, are too volatile. One possibility might be that the absence of some relevant variables provoke both the high level of fiscal interdependence among states as well as the high variance of the results regarding the effects of public grants.

The accuracy of the Case et al. (1993) estimations was soon questioned. Becker (1996) used two main arguments. The first regarded the feasibility of estimating a linear model, while proposing a logarithmic form. The second issue concerned the assumption of the exogeneity of grants received by states with respect to the dependent variable, local and state public expenditure. She estimated a residual response of public expenditure in the US states to external aid of around 2.2 percentage points. The estimation only includes lags of the dependent variable, income per capita and tax prices as explanatory variables. This leaves open the possibility that her results may have been influenced by the omission of other factors usually included in related studies, especially demographic variables.

The paper by Bailey and Connolly (1998) included an interesting extension of those critiques applied to previous literature, putting emphasis on the use of inappropriate variables and on the use of an inappropriate functional form as the main types of errors identified in previous studies.

Besley and Case (2000) explore the use of different methods for estimating policy incidence when there is a concern about policy endogeneity. Based on their results, most of the previous related regressions might be biased since grants allocation may be considered an endogenous variable in a legislative bargaining model, correlated to preferences for public

goods. The Literature on grant policies would need to take into account the possibility of the presence of endogenous variables, in particular the possibility that the distribution of grants and the public expenditure policies are somehow driven by a common preferences pattern. Besley and Case (2000) proposed the use of IV estimation as an alternative to control for endogeneity. They illustrate their conclusions with an example of State policy on workers ' compensation benefits in which the women's political involvement works as a valid instrument of the public policy.

Knight (2002) studied the response of state expenditure on public highways to grants provided by the Federal aid highway program. His interpretation is that the target of this Federal grants program is to enlarge public expenditure in a determinate area by the same amount as the grant received or even more.[6] He takes endogeneity into account by using instruments based on the political power of state congressional delegations, which are correlated to the actual distribution of grants. He finds that federal grants do significantly crowd out state expenditure on highways.

Gordon (2004) estimates the effect induced by US federal grants to elementary and secondary education. She uses IV,[7] since she finds that the amount of these grants (called Title I) are computed partially based on former public expenditure on education per pupil. She uses as instruments the set of remaining variables actually used to allocate grants and estimates one to three year first differenced data from 7047 school districts. Her results are very interesting, since she finds a one-to-one short-term effect of federal grants on instructional expenditure, but in the long term the districts "accommodate " their budgets to the grants that crowd out public expenditure and produce a decreasing effect on local revenues (probably because of decreasing taxes).

Probably because of the different political settings, there has been little work with European data. A notable exception is the work by Pallesen (2006), in which the author estimates the effect of a change from matching grants to unconditional lump-sum grants from the central government to Danish local government. He shows how for almost all the policy areas the use of lump-sum grants does not seriously alter the pattern of public spending.

[6] According to this interpretation, when the flypaper effect covers less than the grant received we can consider that there is a "crowding-out " effect from the grant on this category of public expenditure. Identically, a flypaper effect higher that the grant would mean that the grant perceived "crowds-in " public expenditure on this policy area.

[7] However, her results using OLS do not throw significant differences.

Author	Sample	MPC* from grants	model/est. method	Dep. variable	Other covariates
Gramlich, Galper, Goldfeld and McGuire (1973)	Federal and state aid to 10 local governments, 1962-1970	0.25	Linear/ pooled OLS	General (urban) gov. exp. per capita	grants price effect, robbery rate, suburban taxes
Winer (1983)	Federal grants to Canadian provinces, 1952-1969	1.20	dynamic/2SLS	total actual provinces expenditure	population
Olmsted, Denzau and Roberts (1993)	Public grants to 344 school districts in 1980, Missouri, US.	0.58 - 1.10	tobit/ML	school expenditure in Missouri districts	tax price, students in private schools, number students, urban population, poor pop., black pop., homeowners
Case, Hines and Rosen (1993)	Federal grants to 49 US States, 1970-1985.	0.65 - 1	spatial/ML	state expenditure per capita	population density, pop. over 65, pop. under 17, black pop.
Becker (1996)	Federal grants to local governments, 1977-1986.	0.61	logarithmic/ ML	Per capita pub. exp. by state and all local governments within each state	tax price, income per capita, laged dependent
Gramkhar and Oates (1996)	Federal grants to state and local governments (times series data), 1953-1991	0.62	Linear/2SLS	Total state and local exp. in the US (times series)	unemployment, school aged pop., urban population
Knight (2002)	Federal Highway Aid Program grants to 47 US States, 1983-1997	0.13	linear/IV	state expenditure on highways per capita	Income, population, drivers per capita, vehicles per capita, political representatives
Gordon (2004)	Title I grants to over 7000 US school districts	0.98	linear/IV	school district expenditure / revenues per capita	none

*Marginal propensity to consume public services denoting the increase in Public Expenditures induced by increases in Public grants received by the administration.

Table 1: Selected literature review.

3.4 The European Cohesion Policy.

In this section we describe the system of grants introduced in the European Union through the Cohesion Policy. This Cohesion Policy involves the development of certain projects determined by the European Council and the European Commission called Structural Actions, which are partially financed by the Structural Funds and the Cohesion Fund. There are four Structural Funds: the European Regional Development Fund (ERDF), which is intended to finance large infrastructure projects and has the largest weight in the budget; the European Social Fund (ESF), which is the main financial instrument allowing the Union to realize the strategic objectives of its employment policy; the European Agricultural Guidance and Guarantee Fund (EAGGF - Guidance Section), which contributes to

the structural reform of the agriculture sector; and the Financial Instrument for Fisheries Guidance (FIFG), which is the specific Fund for the structural reform of the fisheries sector.

These Structural Funds, in particular the ERDF, and the Cohesion Fund (CF), are the main target of our study, since they are intended to promote public investment, not only by the EU, but also by the member countries that receive them, through a system of matching grants that we introduce later.

3.4.1 Evolution of Structural Actions

Since the signing of the Treaty of Rome in 1957, the European Union has declared the harmonious development of the economies of the member states as one of its main objectives, by reducing the differences existing among the various regions and the backwardness of the least favoured regions. The initial plan put a lot of emphasis on the development of a common agricultural policy. The creation of the European Regional Development Fund (ERDF) in 1975 represents the beginning of an active cohesion policy. Starting in the European Council in Brussels in 1988, the provision and allocation of the Structural Funds (then referred to as Solidarity Funds) is intended to be overhauled periodically by the Council every five to seven years. The first allocation was negotiated for the period 1989-1993.

Cohesion policy became specially reinforced after the acceptance of the Treaty of the European Union in 1992 that established it as one of the main objectives of the union, and created the Cohesion Fund to support projects in the least prosperous Member States. The distribution of resources accorded in the Edinburgh European Council in 1993, for the period 1994-1999, allocated one third of the Community budget to cohesion policy, almost three times the sum negotiated for the period 1989-93.

The European Council of Berlin in 1999 reformed the Structural Funds for the period 2000-2006 with a budget similar to the period before but with a reorganization of the objective regions into three groups instead of the seven existing before. The main principals regarding objectives, namely procedure, cofinancing rates and supervision remained almost unchanged. The European Council and the European Parliament have approved the reform of cohesion policy for the period 2007-2013 (European Union. Regional Policy (2006)), with a substantial increase in the budget due to the entrance of the new member states into the EU.

3.4.2 The European Regional Development Fund in the budget of the EU

In 2005 Agricultural policy represented approximately half of the total expenditure in the budget of the European Union.[8] The structural actions represented approximately 34% of the budget, allocated among Structural Funds (31.7%) and Cohesion Funds[9] (2.3%). More than a half of the Structural Funds corresponded to the ERDF and the rest to the other structural funds.

	ERDF	ESF	EAGGF	FIFG	Total SF
Objective 1	44.88%	16.44%	9.11%	1.30%	71.73%
Objective 2	9.68%	1.10%	0.00%	0.00%	10.79%
Obj. 3 and out.	2.89%	13.16%	0.95%	0.48%	11.51%
Total objectives	57.46%	30.71%	10.06%	1.78%	100.00%

Source: European Commision (2005a), Report on the Structural Funds 2004

Table 2: Allocation of Structural Funds by Fund and Objective areas.

More than two thirds of the structural actions and ERDF were invested in Objective 1 regions (Objective 1 and 6 in the plan for the period 1994-1999), which are those with a lower per capita income in the EU.[10] The emphasis of the ERDF in those regions is to promote large infrastructure projects, particularly in the context of trans-European networks: transport, telecommunications and energy as well as any other productive activities. In Objective 2 regions (objective 2 and 5b in the plan for 1994-1999) the efforts are focused on diversification of economic activities, rehabilitation of industrial sites and infrastructure on a local scale and finally, for the rest of the regions the ERDF acts through the initiatives Interreg III and urban II.[11] (European Commission (2006))

[8] More precisely, the execution of the EU expenditure budget in 2005 allocates 48 465.8 million Euro to Agriculture, 30 526.5 mill. E. to Structural Funds, 2 228.9 mill. E. to Cohesion Fund, 7 520.8 mill E to Internal Policies and the rest to other categories, to reach the total sum of 104 835.2 million Euro. (European Commission (2006))

[9] Intended to finance Transport and Environmental projects in member countries with levels of per capita income below 90% of the EU-average.

[10] Below 75% of the average of per capita GDP of the European Union.

[11] Interreg III is intended to support inter-regional cooperation, specially integrating remote regions and those that share borders with candidate countries. Urban II is the initiative for substainable development in the troubled urban districts of the EU.

	Objective 1	Objective 2	Obj. 3/other*	Total
Productive Environment	24.78%	6.24%	2.50%	33.52%
Agr. Forestry and Fisheries	*5.80%*	*0.03%*	*0.59%*	*6.42%*
Development of rural areas	*4.61%*	*0.26%*	*1.15%*	*6.01%*
Large, SMEs and craft sector	*8.69%*	*3.85%*	*0.37%*	*12.91%*
Tourism	*2.18%*	*0.99%*	*0.25%*	*3.42%*
Research	*3.49%*	*1.11%*	*0.14%*	*4.74%*
Human Resources	16.50%	1.18%	13.24%	30.92%
Basic Infrastructure	28.03%	3.18%	1.20%	32.42%
Transport	*13.49%*	*0.65%*	*0.37%*	*14.51%*
Telecommunications	*2.57%*	*0.36%*	*0.29%*	*3.22%*
Energy	*0.70%*	*0.10%*	*0.04%*	*0.84%*
Environmental Infrastructure	*4.59%*	*0.45%*	*0.12%*	*5.15%*
Other	*6.68%*	*1.62%*	*0.39%*	*8.70%*
Miscellaneous	1.58%	0.57%	0.98%	3.14%
Total	70.90%	11.17%	17.93%	100.00%

*Objective 3, fisheries outside objective 1 and Community Initiatives.
Source: Annex to the Report on the Structural Funds 2004

Table 3: Use of Structural Funds in the 2000-06 period by Objective and field of intervention.

Table 2 shows this functional allocation of the ERDF and the other structural Funds. The ESF is invested in enhancing Human Capital, through Educational and Labor Market policies. The EAGGF and FIFG are in the first two subcategories of productive environment, while the ERDF includes all the basic infrastructure plus other productive expenditures affecting private sector reconversion, Tourism and Research and development.

As for the Cohesion Fund, it finances projects regarding environmental policies (focusing particularly on waste management, waste water treatment and water supply) and transport (therefore it would fit in the category "Basic Infrastructure" in the table above). It is invested in the least wealthy member states (Greece, Portugal and Spain. Ireland until 2003. Ten new members since 2004). In 2004, around 51.8% of the CF was invested in Transportation projects while the remaining 48.2% was devoted to environmental investment.[12]

[12] 2 889 and 2 685 million Euro respectively (European Commission (2005b)).

3.4.3 Matching Grants

The grants are not distributed unconditionally among states. In fact, there is quite a long administrative process before the Funds are effectively paid. They are allocated according to action programmes whose priorities are identified in cooperation with the European Commission. The choice of measures and the practical projects is the sole responsibility of the Member States.

The European Council decides following a proposal from the European Commission on the budget of the Structural Funds, the rules governing their use and the allocation country by country and by priority objective. The approximate allocation of the Funds to be received by every Member Country and Objective area for a period of six to eight years is, therefore, the result of tense negotiations between the Member States.

Following certain common thematic guidelines proposed by the Commission, each Member Country has to negotiate with the Commission on the concrete plans. From this point onwards, national and regional authorities are responsible for the planification and implementation of concrete programmes, about which the European authority make a preliminary control to check that they fit in the plan before the implementation, and supervise the progress of the programmes.

The Structural Fund contribution never finances the whole cost of the program, but only a part of it.[13] The amounts negotiated by each Council are therefore conditional on the performance of the national and regional authorities that have to run the specific projects.

3.4.4 The Performance of the Member Countries

3.4.4.1 Previous evaluations of the effectiveness of the Cohesion Policy

The map of the geographical areas that are the target of structural actions in the several programs run by the EU, has remained unchanged through the several programs.[14] It

[13] The General ceilling is a maximum of 75% of the total cost of the project (85 % for areas covered by the Cohesion Fund) in objective 1 areas and 50% in the rest. Those ceilling are revised when the project includes investment in firms (35% in Objective 1 areas and 25% in Objective 2) or with regard to investment in infrastructure generating substantial revenue (50% under Objective 1 and 25% under Objective 2) (European Commission (1999)).

[14] 1994-1999 and 2000-2006. The regulations for the period 2007-2013 are already aproved.

therefore becomes difficult to interpret the extent to which these structural actions have been useful for the achievement of the desired catching-up effect, especially since most of the policies might only show their effects on the long run. Studies trying to evaluate the impact of European Structural Funds in Objective 1 regions are not in general very optimistic. Dall 'Erba and Le Gallo (2003) use a model that controls for spatial spillover effects among regions, since they detect the presence of a growth diffusion process, especially on the core regions of the EU. They suggest that the small extent of spillover effects in peripheral regions could be an explanation of their backwardness, and that even greater targeted funds do not allow spillovers in periphery. Rogríguez-Pose and Fratesi (2004) use panel data analysis to identify the lack of upward mobility of assisted regions and the absence of regional convergence. They think that the failure of the EU Structural policy may come from the excessive skewness towards infrastructure and business support of development strategies in Objective 1 regions.

There are also some more optimistic results, especially in studies focused on particular member countries. Percoco (2005) analyses the effect of the Structural Funds on the economic growth of the Italian Objective 1 regions. He finds that induced growth rates vary highly across regions. He argues that is because regions that decide on their public investment based on the estimated marginal productivity of the investment projects are the ones that experience best performance in terms of output increase. The results in De la Fuente (2003) for the Spanish regions are even more optimistic. Using a similar framework, he suggests that the impact of the Structural Funds in Spain has been quite sizable, adding around a percentage point to annual output growth in the average Objective 1 region and 0.4 points to employment growth.

3.4.4.2 The Performance of Public Investment

In this paper we look into the public response to the Structural Funds as an intermediate stage to understand the effectiveness of the Cohesion Policy. The question of whether the structural actions are reinforcing the investment policies run by member states and their regions, or whether on the contrary, they are substituting their own resources with those from the EU might help us to yield conclusions about whether the European policies are properly designed to reach the desired catch-up effect.

In appendix I we show a detailed analysis of the evolution of public expenditure in two groups of countries. On the one side are the four countries that have been the main beneficiaries of the Structural Funds- Greece, Ireland Spain and Portugal. On the other side are the five countries that have received fewer Funds in per capita terms- Denmark, France, Luxembourg, The Netherlands and Sweden. The joint analysis of per capita public expenditure for some specific functional categories is shown in figure 2. This reveals that while most of the categories of public expenditure that could be considered public consumption (health or education, for example) have maintained their relative differences among both groups of countries, the gap for public expenditure in "Economic Affairs" has been considerably reduced for the time period considered. The group of Structural Funds receivers could have partly reduced this gap on spending influenced by the matching-grants received. "Economic Affairs" includes most of the "productive" activities, such as infrastructures in transport, communication or energy. One could expect that most of the activities financed by the Structural Funds, concretely by the ERDF and the CF, will be included under this denomination.

Attending to the economic classification of public expenditure we look at public investment. Public investment includes public expenditure devoted to any functional category, but exclusively spending on gross fixed capital formation. This covers in particular machinery and equipment, vehicles, dwellings and other buildings. These are precisely the target of the main financing projects included in the Social Cohesion policy (with the exception of the ESF). We show in figure 3 in Appendix II how in our sample period the differences in public investment per capita have slightly decreased between the two groups of countries. We could even infer some preliminary conclusions about the simultaneous behavior of the gap in public investment per capita and Structural Funds expenditure. The gap seems to be reduced in the periods in which the amount of Funds increases and remains steady in those periods in which the expenditure of Structural Funds per capita decreases.

3.5 Data and variables

3.5.1 Dependent Variable. Increase in Public Investment

Our sample uses data from the 15 oldest member states of the European Union[15] for the period 1993-2005. We use the first difference of Public Investment as the dependent variable, expressed in millions of Euro. This is obtained from Eurostat, in which it is defined as public expenditure on gross fixed capital formation, consisting of net acquisitions of fixed tangible or intangible assets. This covers, in particular, machinery and equipment, vehicles, dwellings and other buildings. It also includes certain additions to the value of non-produced assets realized by productive activity. This covers mainly improvements to land, such as draining of marshes.

3.5.2 Explanatory Variables. Determinants of Public Investment

The main variable, EUSF, includes the increase in payments of transfers from the European Union budget to the member states under the concept of any of the Structural Funds or the Cohesion Fund. We have seen in tables 2 and 3 that the main focus of the Structural Actions is to promote public expenditure in capital formation, with the important exception of the European Social Fund which promotes expenditure in education policies. The ESF is therefore subtracted from our variables, leaving the other Structural Funds (ERDF, EAGGF and FIFG) plus the Cohesion Fund.

The rest of the control variables have been selected on the basis of previous studies determining the main forces driving public investment. The degree of population density or of urbanization has been shown to be an important determinant of the necessities of public investment for middle and low income countries (Sturm (2001), Randolph, Bogetic and Hefley (1996)). However in our panel of European countries there are no significant shifts of this variable among units, and its inclusion would not add useful information to the panel. But we have included Population growth among our control variables as a determinant of public investment. A growing population would naturally increase its demand for some selected categories of public investment, in telecommunications for example. Simultaneously, the scale effects of some other categories of investment, like infrastructures, could imply that

[15] Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden and United Kingdom.

per capita necessities decrease as population grows. We do include population (in first differences, population growth) in our set of control variables.

The actual stock of public infrastructure is a natural determinant of current infrastructure expenditure needs. Assuming diminishing returns to public investment the level of stock of public capital would affect negatively the demand for additional investment, although it should be taken into account that due to depreciation there would be an additional demand for public expenditure to replace existing infrastructures. The final effect is not clear and depends upon the relative strength of opposite forces (Randolph et al. (1996)). Time-independent variables, such as initial level of GDP per capita or education level, can accounted for by the unit specific term, so we do not have include them explicitly.

variable	Label	Definition	Units	Source
Public Investment	**Pinv**	Gross fixed capital formation, sometimes simply referred to as investment, consists of resident producers acquisitions, less disposals, of fixed tangible or intangible assets	Mill. €	GFS (Eurostat). Years 1993 and 1994 from Eurostat in % GDP and then converted.
EU Structural Funds	**EUSF**	EU expenditure executed corresponding to Structural funds, by Member State.	Mill. €	EU (budget), several years, Allocation of EU expenditure by Member State
Real GDP growth	**GDPgr**	Real GDP growth	%	Eurostat
Public Consumption	**PCons**	(ESA95 code P.3) Expenditure incurred by resident general government units on goods or services that are used for the direct satisfaction of individual needs or wants or the collective needs of members of the community. May take place on the domestic territory or abroad.	Mill. €	Eurostat
Private Investment	**PrivInv**	Gross fixed capital formation (GFCF) consists of resident producers' acquisitions, less disposals of fixed assets plus certain additions to the value of non-produced assets. The private sector consists of non-financial corporations, financial corporations, households and non-profit organizations serving households	Mill. €	Eurostat
Population growth	**Pop**	Population growth	Miles people	Eurostat
Public Balance	**Pbal**	Net borrowing (+)/net lending (-) of general government is the difference between the revenue and the expenditure of the general government sector. GDP used as a denominator is the gross domestic product at current market prices.	% GDP	Eurostat

Table 4: Variables and data sources.

The rate of production growth is traditionally included as a determinant of public expenditure.[16] It has been argued that the income elasticity of the demand of some public goods could affect the allocation of public expenditure as growth rates fluctuate. (This is a version of Wagner's Law) It could also take cyclical factors into account, especially when there is no other variable attached to the business cycle in the model.

Restrictive fiscal policy measures may also be induced by high levels of budget deficits or government debt. Roubini and Sachs (1989) show that capital expenditures suffer more drastically under the implementation of these restrictive fiscal policies. This is a consequence of the fact that very often this kind of expenditure is less rigid than other public expenditure categories(De Haan et al (1996)). More recent results by Mehrotra and Valila (2006) using cointegration techniques support this hypothesis.

The results in Kneller et al. (1999) suggest that we should also include a variable to account for the public spending not devoted to investment. Increases in the level of public consumption and in general, in the spending possibilities of the country should naturally have an effect on Public Investment. We consider Public Consumption as an indicator of the variations of the spending capacity in the budgets of the public bodies of the country.

The inclusion of private investment among the set of explanatories has been inspired by the results in De Haan et al. (1996) and Sturm (1998). They estimate a rage of model specifications using panel data for 22 OECD countries for the period 1980-1992, concluding that movements in public investment tend to follow those in private investment.

There have been several studies trying to link political variables to the tendency to alter patterns of public spending. The political variables that could affect government spending might be the kind of party in power, the kind of government (coalition, majority government or minority government) and the political influences of lobbying. The more conclusive results have been found in studies that link the influence of political variables on the level of public spending (Roubini and Sachs (1989)) or debt-related issues.[17] However, studies focused on public investment have not been able to find any significant link of the current level of public investment with political variables. We recall here the results in Sturm (2001), for non OECD countries, De Haan, Sturm and Sikken (1996), for OECD countries, and Mizutani

[16] See for example Miller and Russek (1997), Kneller, Bleaney and Gemmell (1999) Bose, Haque and Osborn (2003),

[17] De Haan and Sturm (1997), see Sturm (2001) for a detailed literature review

and Tanaka (2005), who use regional data from Japan prefectures. Therefore, we do not include any political variable among our set of controls.

	Obs.	Mean	St. Dev.	Min	Max
Pinv	178	378.93	1727.1	-7948.7	11365
EUSF	180	64.136	636.99	-2451.8	2879.9
GDPgr	195	2.9558	2.4616	-2	16
PCons	177	4856.87	6973.03	10483	41184
PrivInv	162	4033.90	8079.85	-28797	36838
Pop	195	99.961	144.40	-62.9	720.2
Pbal	175	748.64	11417	-85980	56992

Table 5: National Data. Summary Statistics

3.6 Empirical Model and Results

3.6.1 Econometric model

To test the hypothesis that public investment may be affected by European Structural Funds ' grants, we have constructed a model in which the dependent variable is the public investment made by the consolidated government, including central, regional and local governments as well as social security funds, I_{it}. The set of explanatory variables (X_{it}) includes our main variable of interest, EU Structural Funds allocated to the member country "i " in the current year "t ", s_{it}. We have also introduced in the model other control variables: GDP, population, public balance, public consumption and private investment, included in the vector c_{it}.

$$I_{it} = \beta_1 s_{it} + \beta_2 c_{it} + \eta_i + u_{it} \tag{3.2}$$

$$X_{it} = \{s_{it}, c_{it}\} \qquad \beta = \{\beta_1, \beta_2\}$$

The coefficient β_1 representsin the extended model of our neoclassical framework presented in section 2 and Appendix I the increase in public investment compresed the grant $(\Delta(g_{sub} + g_{nonsub}) + (1-\delta)g_{sub}$) in relation to the increment on the grant $(\Delta(1-\delta)g_{sub})$. In practice would be represented by the relation: $[1+\frac{\delta^{\alpha s-1}-1}{(1-\delta)\delta^{\alpha s-1}}]+[\frac{\alpha_{sub}}{\alpha_{nonsub}}\frac{\delta^{\alpha s-1}-1}{(1-\delta)\delta^{\alpha s-1}}]$, where the first braket represents the (crowding-in) effect in the subsidized capital while the second braket includes the (crowding-out) effect on non subsidized capital.

All variables have been included in first differences to avoid the probable nonstationary behavior of many of them. We also suspect a serially correlated error term, due to the nature of the variables and the length of the time dimension of the sample. T-statistic to control for first-order autocorrelation of the error term are reported in next subsection. This motivates the inclusion of an autocorrelated error in model (3.2):

$$u_{it} = \rho u_{it-1} + \varepsilon_{it} \qquad where \qquad \varepsilon_{it} \tilde{} N[0, \sigma_e]$$

The original model in equation (3.2) has been estimated in the presence of serially correlated errors, but under the assumption of strict exogeneity of the explanatory variables, i.e.

$$E[x\prime_{is}, u_{it}] = 0 \qquad t, s = 1, 2, ...T.$$

This assumption may be considered too strong for our model. Especially after the results in Knight (2002), the allocation and execution of the structural funds may be thought to respond to some unobserved necessities and conjuncture that simultaneously drives decisions on public investment.

The immediate solution to the problem would be to find some instrumental variables correlated to structural funds but orthogonal to public investment. Alternatively, we can use lags of the dependent and explanatory variables as instruments. The GMM estimation method developed by Arellano and Bond (1991) relies on the orthogonality of the dependent and explanatory variables with the first differences of the error component in lagged periods. This method allows us to include endogenous and predetermined dependent variables. These GMM methods construct moment conditions that reflect this orthogonality,

under assumption of serially uncorrelated shocks, error components and predetermined initial conditions ($E[\eta_i] = E[u_{it}] = E[\eta_i u_{it}] = 0$, $E[u_{is}u_{it}] = 0 \; for \; s \neq t$ and $E[y_{i1}u_{it}] = 0 \;\; for \; t = 2, ...T$.respectively.). The problem would be, therefore, that we have previously admitted the possibility of the existence or AR(1) errors in the original model [3.2], which implies that lagged values of i_{it} and x_{it} are correlated with past shocks and the moment conditions that should be used, $E[i_{it-s}\Delta u_{it}] = 0$ for t=3,...T and s$\geq$ 2 and $E[x_{it-s}\Delta u_{it}] = 0$[18] are no longer valid.

But we can still transform the static model (3.2) to obtain a dynamic representation with serially uncorrelated shocks.

$$I_{it} = \beta_1 s_{it} + \beta_2 c_{it} + \eta_i + u_{it} \qquad\qquad where \qquad u_{it} = \rho u_{it-1} + \varepsilon_{it}$$

$$\rho I_{it-1} = \rho\beta_1 s_{it-1} + \rho\beta_2 c_{it-1} + \rho\eta_i + \rho u_{it-1}$$

$$I_{it} = \rho i_{it-1} + \beta_1 s_{it} - \rho\beta_1 s_{it-1} + \beta_2 c_{it} - \rho\beta_2 c_{it-1} + (1-\rho)\eta_i + \varepsilon_{it} \tag{3.3}$$

This is a dynamic model with serially uncorrelated shocks that we can estimate using Arellano and Bond (1991) GMM estimator for dynamic panels. The explanatory variables are correlated with the individual effects and are predetermined or endogenous with respect to the serially uncorrelated shocks ε_{it}. Note that the original betas are still the long-run relationship if we assumed long-run stability, with $i_{it} = i_{it-1}$, $s_{it} = s_{it-1}$ and $c_{it} = c_{it-1}$ as we did in the first chapter to compute the long-term relationship of public expenditure composition with economic growth.

3.6.2 Estimation results

We consider two alternative sets of explanatory variables. Columns [1] to [3] show the results in the model with GDP growth, public consumption and private investment while columns [4] to [6] include in addition population growth and public balance. Columns [1] and

[18] t=3,...T and s$\geq$ 2 if x_{it} contains endogenous variables. If they are predetermined or strictly exogenous there would be a larger set of moment conditions available.

[4] show the results for the fixed-effects model while columns [2] and [5] are the random-effects coefficients.

The difference between both, fixed-effects and random-effects estimation models are almost imperceptible. In fact, when we run the Hausman test to both estimators, we cannot reject the null of no systematic difference in coefficients in both cases.[19] We therefore expect correlation between the individual specific effects and the error term not to be problematic in our model. Also as expected, random-effects estimation yield narrower standard errors.

Both static models include autocorrelated errors, since the results of the Baltagi-Wu test and the modified Durbin-watson test proposed by Bhargava et al. (1982) suggest the presence of autocorrelated errors. The results of the F-test allow us to reject the null of no significant difference among the group effects.

	(1)	(2)	(3)	(4)	(5)	(6)
	F-E	*R-E*	*GMM-ABond*	*F-E*	*R-E*	*GMM-ABond*
EUSF	**0.6141*** (.192)**	**0.6979*** (.176)**	**0.6350*** (.188)**	**0.5760*** (.201)**	**0.6097*** (.182)**	**0.5681*** (.194)**
GDPgr	90.35 (66.80)	89.64 (54.90)	166.75** (65.56)	95.45 (68.86)	106.45** (54.17)	159.02** (66.29)
PCons	0.0854*** (.025)	0.0887*** (.022)	0.0739*** (.023)	0.0824*** (.030)	0.0696*** (.025)	0.0646*** (.024)
PrivInv	-0.0718*** (.019)	-0.0498*** (.018)	-0.0563*** (.017)	-0.0767*** (.024)	-0.0572** (.022)	-0.0545*** (.017)
Pop				1.8798 (1.66)	3.2090*** (1.12)	1.927 (1.370)
Pbal				0.0049 (.012)	0.0033 (.011)	15.293 (57.35)
F-test group eff.	*2.32 (Prob>F=.0 071)*			*1.57 (Prob>F=.09 83)*		
Tests autocorr. err.	*Mod. Durbin-Watson = 2.173 Baltagi-Wu = 2.249*		*A-B t. order 1 -7.51 (P = .00)* *A-B t. order 2 0.12 (P = .90)*	*Mod. Durbin-Watson = 2.226 Baltagi-Wu = 2.3036*		*A-B test o. 1 -7.57 (P = .00)* *A-B t. order 2 0.32 (P = .74)*
Sargan test over. restr.			*139.82 P > Ch2= 0.325*			*139.53 P > Ch2= 0.999*
Obs.	*147*	*162*	*133*	*144*	*159*	*133*

Table 6: EU Structural Funds Crowd-out. National-level data: EU 15, 1993-2005.

Columns [3] and [6] report estimation results for the dynamic model (3.3), estimated using the Arellano and Bond (1991) GMM estimator. Again, the differences in the results

[19] The test-statistic takes a value of 7.72 for the first model and 3.46 for the second.

are not dramatic in comparison to those obtained previously. Endogeneity thus seems not to be a problem in our case, in contrast to Knight (2002). This may be related to the different decision processes in the allocation of aid. Knight (2002) is able to describe how, for his data, State governments have a certain level of influence in the Federal Highway program grants ' allocation, so that states with a higher preference for investment in highways would be able also to push harder in the committee that allocates the grants.

Our case is slightly different. The broad numbers are negotiated in the European Council for a long period, according to general rules of identical application to all member countries in accordance with their economic, social and geographical situation. But the actual application of the policies is supervised by the European Commission. The bargaining power of member states to get additional resources at this stage is practically non-existent.

The results from our regressions are also quite different from Knight (2002) and reasonably consistent with a large part of the literature. Unlike him, we reject the total crowding-out hypothesis and conclude that endogeneity is not as problematic as he claimed. Obviously, the main explanation for this disagreement is the different nature of the data and the political economy environment from which they come. The discussion about the endogeneity of the allocation of grants in the case of the Federal Highway program might be related to the decision to consider them lump-sum grants instead of matching grants, as long as they are highly correlated to the preferences of the state governments.

In general, the results concerning our variable of interest, EUSF, do not differ among regressions. The inclusion of population and public balance among the set of explanatory variables, although suggested by the literature, do not add much relevant information in our case. On the contrary, in the dynamic model the Sargan test reports a rejection of the null of the validity of the instruments used as a consequence of the inclusion of these two variables.

We can conclude that we do not have total crowding-out from Structural Policies. Member countries increase their public investment around 60 percent of the received funds. However, with these results we cannot say that there is absolutely no deviation of public expenditure, since the estimated coefficients are also smaller than one.

If we interpret these results using the theoretical framework described in Section 2, we can say that the matching process established by the European Commission after the negotiation in the European Council works reasonably well, so that member states do not consider the Structural Funds as unconditional grants, even if the amount allocated has

already been decided previously. If those funds were considered by subsidized governments as lump-sum transfers, we would expect a negative coefficient associated with the variable EUSF, although a perfect matching system should yield a coefficient larger than one. In addition, also according to the theoretical model, this result does not tell us whether to ensure that the type of capital subsidized is more effective in terms of enhancing economic growth.

3.6.3 An alternative view: Implementation on Spanish regional data

In the second chapter of this thesis we have showed how regional governments are more reluctant to invest. One could be suspicious whether the EU Funds work with the same effectiveness when they are allocated to regional governments. That is the reason why in this subsection we will run an almost identical regression to the one above with regional data from the same sample of seventeen Spanish regions (NUTS 2) analyzed in the second chapter.

We have already seen in chapter 2 how there is a contrast between poorer southern regions which perceive an important amount of Structural Funds (many of them are among the Objective 1) while the northern regions are in general richer. Table 7 describes the variables used in the regression. Their definition is very similar to the variables for national data.

variable	*Label*	*Definition*	*Source*	*Units*
Public Investment	**Pinv**	Capital Expenditure	Badespe database, Instituto de Estudios Fiscales	Miles €
EU Structural Funds	**EUSF**	Transfers from the European Union to the capital account of the regional governments	Badespe database, Instituto de Estudios Fiscales	Miles €
Real GDP growth	**GDPgr**	Gross domestic product (GDP)at current market prices at NUTS level 2	INE	FD, miles €
Public Consumption	**PCons**	Current Expenditure	Badespe database, Instituto de Estudios Fiscales	Miles €
Private Investment	**PrivInv**	Private Gross Fixed Capital Formation	Eurostat	Million €
Population growth	**Pop**	Population at first of January	Eurostat	people
Central government capital expenditure	**Cgcape**	Central Government Gross Fixed Capital Formation expenditure	Spain: Badespe	Million €

Table 7: Variables and Sources of Regional Data.

The model has been slightly accommodated to the regional data. The main difference with the one used for the country-level data is the elimination of the variable "Public balance" and the inclusion of "Central Government Capital Expenditure". The inclusion of indicators of public deficits would not add relevant information since sub-national levels of government are usually quite constrained in terms of incurring deficit. Alternatively, as suggested by our findings on chapter 2, the behavior of the central government as an investor could influence the policies run by sub-national governments regarding public expenditure.

The fiscal variables included exclusively concern regional governments. We rely on fewer observations than in the regression with national data, due to the reduced number of years for which the variable EUSF is available and to the lack of data for private investment before 1995. The summary statistics describing the variables are in Appendix III.

	(1)	(2)	(3)	(4)	(5)	(6)
	F-E	*R-E*	*GMM-ABond*	*F-E*	*R-E*	*GMM-ABond*
EUSF	**0.6718*** (.131)**	**0.6820*** (.122)**	**0.6968*** (.128)**	**0.6448*** (.141)**	**0.6591*** (.122)**	**0.6143*** (.122)**
GDPgr	0.0359** (.014)	0.0301*** (.006)	0.0320** (..013)	0.0336 (.023)	0.0264*** (.006)	0.0228 (.015)
PCons	0.0082 (.034)	-0.0138 (.028)	-0.0222 (.027)	-0.0130 (.035)	-0.0049 (.029)	-0.0158 (.026)
PrivInv	-0.0338*** (.011)	-0.0290*** (.010)	-0.0278*** (.009)	-0.0332** (.012)	-0.0295*** (.010)	-0.0238** (.009)
Pop				0.2727 (.601)	0.3061 (.196)	0.4559* (.248)
CGcape				0.0243 (.050)	0.0089 (.041)	0.0376 (.042)
F-test group eff.	1.72 (Pr>F=.064)			1.72 (Pr>F=.066)		
Tests autocorr. err.	Mod. Durbin-Watson = 1.972 Baltagi-Wu = 2.366		A-B t. order 1 -5.97 (P = .00) A-B t. order 2 -0.07 (P = .04)	Mod. Durbin-Watson = 2.023 Baltagi-Wu = 2.400		A-B test o. 1 -7.61 (P = .00) A-B t. order 2 0.30 (P = .13)
Sargan test overid. Restrict.			88.77 P > Ch2= 0.0268			91.35 P > Ch2= 0.017
Obs.	86	103	86	86	103	86

Table 8: EU Structural Funds Crowd-out. Regional Data: Spain, 1994-2001.

We have to be prudent while interpreting the results, especially taking into consideration the reduced length of the sample. Some of the specification tests yield adjusted test-statistics (in particular, the second order autocorrelation test in column 3). The estimation of the effects of EUSF are almost identical among models. The estimated effect is also very close to the one estimated with the country-level data, although we have to keep in mind the difference in the definition of the variables. It looks like regional governments in Spain do accommodate their budgets to the income from the Structural and Cohesion Funds in a similar way to our sample of European nations.

Regarding the rest of the explanatory variables, we can also check how the Spanish data replicate quite accurately the results obtained with national data, except the coefficients estimated for Public consumption. We find this coefficient insignificant for Spanish regions while it is an important determinant of public investment at the national level. The interpretation for this it not straightforward. Given that this variable is an indicator of the public budget or the "availability of funds", it might be that regional governments find themselves less constrained to enlarge their investment. As for "GDP" and "Private Investment", the results are quite similar to those estimated with national data and reveal how the public administration tries to compensate for the lack of private capital.

These estimations imply that the larger propensity to consume of regional governments shown in chapter 2 does not affect their reaction towards EU grants. In other words, the matching grants system run by the European Commission works with the same effectiveness at this level of the public administration.

3.7 Conclusions

This paper evaluates the response of public governments to EU Cohesion policy. In particular, we estimate the impact of Structural and Cohesion Funds on public expenditure, and conclude that member countries increase their public investment around 60 percent of the new Funds received. Therefore, there is a small crowding-out effect of those funds on

public investment. The system of "matching grants" used by the European Commission to allocate the funds seems to work reasonably well. We describe in the paper how the European Commission has developed a system in which grants are given conditional on public investment made by the public governments. This system of matching-grants has partly succeeded in enhancing public investment in less developed countries inside the Union.

With the help of a simple version of a neoclassical growth model, we interpret the coefficient estimated as an indicator of the effectiveness of the matching grants system designed for the Funds. According to our model, the estimated coefficient should be larger than one if the Funds were completely administered as matching grants, while it would take a negative value if they were considered unconditional transfers. Taking into account the bargaining process in the European Council according to which the Funds are distributed, it would not be surprising that the majority of these Funds were considered by subsidized countries as lump-sum transfers.

The relevant literature developed since the early seventies, especially that using US data, forecast similar reactions to federal grants. However, more recent studies have questioned the validity of these results by suggesting the necessity of taking into account the possibility that the variables that define the allocation of grants are endogenous. We estimate the efficiency of to the particular case of the Structural Funds, setting up a dynamic model estimated using the GMM Arellano-Bond estimator for panels that takes into account for the possibility of endogeneity.

The paper also investigates whether more disaggregated levels of data might reveal deeper information. In particular, the fact that regional governments could have a different pattern of behavior towards the grants. We showed in chapter 2 that regional governments are sensitive to their level of autonomy regarding the distribution of their public expenditure. In this case we cannot identify a different response from the regional administrations to the EU Structural Policy. However, more investigation needs to be done with regional data to find out whether there are substantial differences in the behavior of public expenditure towards EU Structural grants among countries.

3.8 Appendix I Public Grants in a neoclassical growth model

3.8.1 Basic framework, the model without grants

For simplicity, we choose to set up a discrete-time model with a unique final good. We consider a single, infinitely lived representative household. Aggregate output, Y, is produced with private physical capital, K, public infrastructures services, G, using a Cobb-Douglas technology represented by the production function:

$$Y_t = AK_t^{\gamma} G_1^{\alpha} \tag{3.4}$$

where $\gamma = 1 - \alpha$, and $A > 1$.

Thus, production exhibits constant returns to scale in all factors. There is total depreciation in both inputs.

The behavior of the representative consumer

The household-producer maximizes the discounted stream of future utility:

$$U_s = \Sigma_{t=s}^{\infty} \beta^s [\ln C_t] \tag{3.5}$$

where c_t represents private consumption in period t. The consumer ignores the present and future decisions of the public government about g1, g2 and g3. He faces the budget constraint:

$$(1 - \tau) Y_t = C_t + K_{t+1} \tag{3.6}$$

The maximization problem yields the Euler equation:

$$\frac{C_{t+1}}{C_t} = \Pi_c = \beta\gamma(1 - \tau)\frac{Y_{t+1}}{K_{t+1}} \tag{3.7}$$

Which we expect to be constant in the steady state.

The behavior of the government.

The government is able to observe the behavior of the consumer. However, it does not internalize the consumer's problem,[20] but seeks to maximize the utility received by the median voter from the publicly provided public good, G_{cons}. Therefore, its utility function will be:

$$U_s = \Sigma_{t=s}^{\infty} \beta^s [\ln G_{cons,t}] \tag{3.8}$$

Production is taxed at the rate $\tau \in (0,1)$.The government distributes the public budget among public consumption, G_{cons} and public capital accumulation for next period, G_t.Thus, its budget constraint will be:

$$\tau Y_t = G_{t+1} + G_{cons,t} \tag{3.9}$$

3.8.2 Matching grants to public capital

Let us assume now that an external agent, a higher level of government, for example, is interested in boosting economic growth by subsidizing the purchase of public capital to the public sector through a matching grant. The matching grant would be transcribed in our model as a change in the relative price of public capital in the budget constraint of the public sector. Equation (3.9) would then become:

$$\tau Y_t = \delta G_{t+1} + G_{cons,t} \tag{3.10}$$

[20] Identically to the second chapter, we introduce this assumption for simplicity, since it is equivalent to assuming a model with public policy decided by a representative consumer applying median voter theory, in which the utility function includes private consumption and public services additively separable, in line with Agenor (2007), Ganelly and Tervala (2007) and Van der Ploeg and Bovenberg (1994), among others. We recall again the analysis by Djajic and Maximilians (1987) that includes an interesting analysis of the implications of alternative assumption concerning the relationship between public and private consumption in the utility function.

where $\delta \in (0,1)$ represent the share of cost that the public sector has to pay on the purchase of public capital, G, after the implementation of a matching grant system. The subsidizer would pay the remaining (1-δ)G. The parameter δ would take the value 1 if G is not subsidized or 0 if public investment is fully subsidized.

The government maximizes the discounted present value of lifetime utility,(3.8), subject to technology, (3.4), and the budget constraint (3.10) The maximization problem yields the following Euler equation:

$$\frac{G_{cons,t+1}}{G_{cons,t}} = \Pi_g = \beta\tau\frac{\alpha}{\delta}\frac{Y_{t+1}}{G_{t+1}} \tag{3.11}$$

Equilibrium

It is easy to check that this economy will find its equilibria where the growth rates for consumption and public expenditure are identical, $\Pi_g = \Pi_c = \Pi$. We can then substitute and work out the constant growth rate in equilibrium:

$$\frac{C_{t+1}}{C_t} = A\beta(1-\tau)^{\gamma}\tau^{1-\gamma}\frac{\alpha^{\alpha}\gamma^{\gamma}}{\delta^{\alpha}} \tag{3.12}$$

As long as Π>1, there is a constant rate of consumption growth, which is entirely independent of the level of capital stock per person. This will also imply that there are no transitional dynamics in this model. Starting from any level of initial wealth the economy will immediately start growing at a constant rate. We assume A to be large enough to ensure positive economic growth.

We can now derive the relative amounts of the production factors used in equilibrium:

$$\frac{K_{t+1}}{Y_t} = \beta\gamma(1-\tau); \qquad \frac{G_{t+1}}{Y_t} = \frac{\beta\alpha\tau}{\delta};$$

and the relative amounts of consumption goods:

$$\frac{C_t}{Y_t} = (1-\tau)(1-\beta\gamma); \qquad \frac{G_{cons,t}}{Y_t} = \tau(1-\beta\alpha)$$

Although the relative amount of wealth devoted to private capital remains unchanged[21],

[21] This is a consequence of our constant elasticity of substitution production function.

the actual proportion of production allocated to it is slightly smaller since production grows faster than in the situation without grants. Private capital decrease because of the wealth effect produced by the increase of income in the public sector.

Public capital will experience an increase in its relative share of wealth. It is also affected by the wealth effect induced by the faster growth, but the crowding-in provoked by the decrease in the relative price of the factor will always be larger.

The following equation defines the response of public expenditure to the grants policy, $\Delta\frac{G}{Y}$, exclusive of the granted amount, which is also invested. According to this definition, there is crowding-out of a matching-grant policy on public investment when the value of this expression is negative, while a positive value will imply that the policy crowds in public investment.

$$\Delta\frac{G_t}{Y_t} = \frac{\boldsymbol{\beta\alpha\tau}}{\Pi_o}(\frac{1}{\delta^{1-\alpha}} - 1) \tag{3.13}$$

Where Π_o represents the constant growth rate of the economy before the implementation of the matching-grants system, i.e. the equivalent to equation 3.11 with $\delta = 0$. This expression will always be positive regardless and allow us to summarize the impact of matching grants to public capital in our neoclassical growth model in proposition 1: "In our model neoclassical technology, a matching-grant to public capital will always induce a crowding-in effect onto public investment. This means that there will be a positive increase in final public investment higher than the amount granted as a reaction to the transfer".

Later we will see that the result in this proposition holds also in the presence of two types of public capital, one of which cannot be subsidized by the matching grant.

3.8.3 Lump-sum grants

In this subsection we analyze the alternative situation to the matching grant in which the government receives in stead a lump-sum grant.[22] Let us assume that the government receives no grant until period s, and that at that time it is announced that it will start receiving a

[22] Given that there is perfect mobility among both categories of public expenditure, we could also assume that the lump-sum transfer is of any kind of public good.

permanent lump-sum quantity L from period s+1 onwards. Until period s, equation (3.12) (with $\delta = 1$) defines the constant growth rate in equilibrium for all variables. But in period s+1 the budget constraint (3.9) changes to:

$$\tau Y_{s+1} + L = G_{s+2} + G_{cons,s+1} \tag{3.14}$$

This implies that in period s, in order for equation (3.11) to hold, G_{t+1} should decrease to anticipate some public consumption from the future increase in public wealth. This will provoke a new rate of growth of G_{cons}, larger than Π_o described previously, which we could name Π_{gS} :

$$\frac{G_{3s+1}}{G_{3s}} = \Pi_{gS} = \beta\tau\alpha\frac{Y_{s+1}}{G_{s+1}}$$

From this moment onwards $\frac{G_{cons,t+1}}{G_{cons,t}}$ will start to decrease and converge to the value that it used to have before s. Parallelly, $\frac{G_t}{Y_t}$ will also increase to converge gradually to their previous value, or immediately if the grant were retired. The effect of the introduction of a lump-sum grant in period s+1 over G_{s+1} is:

$$\boldsymbol{\Delta}\frac{G_{t+1}}{Y_{t+1}} = \boldsymbol{\beta\tau\alpha}(\frac{1}{\Pi_{gS}} - \frac{\mathbf{1}}{\Pi_o})] \tag{3.15}$$

The value of this expression will always be negative since $\Pi_{gS} > \Pi_o$. Therefore, the introduction of the lump-sum grant not only does not induce an increment in public investment larger than the sum of the grant received, as happens with the matching grants, but conversely withdraws resources from public capital. This happens because the government anticipates public consumption in period S from the increase in wealth in S+1 induced by the transfers, which pushes down public investment for period s+1 (decided on period s). The level of production of the economy will also decrease.

This result drives proposition 2: "*In our economy with neoclassical technology and a fixed tax-rate, a lump-sum transfer to the government from an external agent will induce a deviation of public resources from public investment towards public consumption such that the government will increase public consumption by a quantity higher than the transfer received.*

Therefore, there will be a negative increase in final public investment as a reaction to the transfer ".

We could define the result of a lump-sum transfer of capital described in proposition 2 as a situation of total crowding-out, because we have a negative increase in total public investment. This result justifies many findings of the flypaper literature summarized in section 3. The assumption of fixed tax rate has consequences for the relationship between public and private consumption, but the main mechanism is driven by the decrease in marginal utility of consumption induced by the grants, which pushes down the equilibrium amounts of production factors.

3.8.4 Extension: Subsidized and non subsidized public capital

Finally we will analyze an extension of the basic model that will include interesting additional conclusions to the analysis above. We will assume now that there are two types of public capital instead of one. In this new framework we will examine the role of the elasticity of substitution of the public production factor, α, in the response of the granted government towards the grant. This new view will let us understand better how the granting authority would optimize its policy when it has to decide between several types of public investment to allocate the grants.

We consider now that aggregate output, Y, is produced with private physical capital, K, and two types of public infrastructure services, that we will call G_1 and G_2, using a Cobb-Douglas technology represented by the production function:

$$Y_t = AK_t^{\gamma} G_{1t}^{\alpha 1} G_{2t}^{\alpha 2} \tag{3.16}$$

where $\gamma = 1 - \alpha 1 - \alpha 2$, $\alpha 1 > \alpha 2$, and $A > 1$.

Thus, production exhibits constant returns to scale in all factors. There is total depreciation in all three inputs. We include two types of public capital, assuming larger output elasticity in one of them (G_1) with the purpose of examining the implication of subsidizing with a matching grant public investment on any of them, and the role played by the output elasticities ($\alpha 1$ and $\alpha 2$).

The behavior of the representative consumer does not change with respect to the basic model, it maximizes the discounted stream of future utility represented by equation 3.5, facing identical budget constraint 3.6 and yielding the Euler equation described by equation 3.7.

The government also behaves identically to the basic model, but faces a distribution of the public budget among public consumption, $G_{cons,t}$ and two types of public capital goods accumulation for next period, G_{1t} and G_{2t}.Thus, its budget constraint will be:

$$\tau Y_t = G1_{t+1} + G2_{t+1} + G_{cons,t}$$

We have included two types of public capital to be able to compare the different response of public expenditure when either of them is subsidized. Now the external agent willing to give a matching grant, a higher level of government, for example, has to decide on which of the types of public capital will subsidize through this grant. The external agent is interested in boosting economic growth by subsidizing the purchase of one of both types of public capital to the public sector through a matching grant. The matching grant would be transcribed in our model as a change in the relative price of public capital in the budget constraint of the public sector. Equation (3.9) would then become:

$$\tau Y_t = \delta_1 G1_{t+1} + \delta_2 G2_{t+1} + G_{cons,t} \tag{3.17}$$

where δ_1 and $\delta_2 \in (0,1)$ represent the share of cost that the public sector has to pay on the purchase of both types of public capital, G_1 and G_2 respectively, after the implementation of a matching grant system. The subsidizer would pay the remaining (1-δ_1)G_1 and (1-δ_2)G_2. The parameters δ_1 and δ_2 would take the value 1 if either G_1 or G_2 are not subsidized respectively.

The government maximizes the discounted present value of lifetime utility,(**??**), subject to technology, (3.16), and the budget constraint (3.17) The maximization problem yields the following Euler equations:

$$\frac{G_{cons,t+1}}{G_{cons,t}} = \mathbf{\Pi}_g = \boldsymbol{\beta\tau}\frac{\alpha_1}{\delta_1}\frac{Y_{t+1}}{G1_{t+1}}$$

$$\frac{G_{cons,t+1}}{G_{cons,t}} = \boldsymbol{\Pi}_g = \boldsymbol{\beta\tau}\frac{\alpha_2}{\delta_2}\frac{Y_{t+1}}{G2_{t+1}}$$

And the new equilibria where the growth rates for consumption and public expenditure are identical, $\Pi_g = \Pi_c = \Pi$ **:**

$$\frac{C_{t+1}}{C_t} = A\beta(1-\tau)^{\gamma}\tau^{1-\gamma}\frac{\alpha_1^{\alpha_1}\alpha_2^{\alpha_2}\gamma^{1-\alpha_1-\alpha_2}}{\delta_1^{\alpha_1}\delta_2^{\alpha_2}}$$

The relative amounts of the production factors used in equilibrium will be:

$$\frac{K_{t+1}}{Y_t} = \beta\gamma(1-\tau); \qquad \frac{G1_{t+1}}{Y_t} = \frac{\beta\alpha 1\tau}{\delta_1}; \qquad \frac{G2_{t+1}}{Y_t} = \frac{\beta\alpha 2\tau}{\delta_2}$$

While the relative amounts of consumption goods remains unchanged to that of the basic model. The relative reasoning driving Proposition 1 in the basic model remains in the extended version. If one of the public goods is subsidized with a matching grant represented by a parameter δ, the following equation defines the response of public expenditure to the grants policy, $\Delta\frac{G_{sub}+G_{nonsub}}{Y}$, exclusive of the granted amount which is also invested.

$$\begin{aligned}\boldsymbol{\Delta}\frac{G_{subsidized}+G_{nonsub}}{Y} &= \boldsymbol{\beta\tau}\left(\frac{\alpha_{sub}+\alpha_{nonsub}\delta}{\delta^{1-\alpha_{sub}}\Pi_0}-\frac{\alpha_{sub}+\alpha_{nonsub}}{\Pi_0}\right)\\ &= \frac{\beta}{\Pi_0}\tau[\boldsymbol{\alpha}_{sub}(\frac{1}{\delta^{1-\alpha_{sub}}}-\mathbf{1})+\boldsymbol{\alpha}_{nonsub}(\boldsymbol{\delta}^{\alpha_{sub}}-\mathbf{1})] \qquad (3.18)\end{aligned}$$

Where Π_0 represents again the constant growth rate of the economy before any grants system is implemented. The first term inside the brackets represents the increment in the share of G_{sub} on production, due to the decrease of its relative price. The second term is negative, since $\delta_1^{\alpha 1} < 1$, and represents the decrease of the share of G_{nonsub} on production induced by the faster growth (wealth effect). The effect on the subsidized type of capital is larger than the negative wealth effect on non-subsidized capital. This expression will always

be positive regardless of the values taken by $\boldsymbol{\alpha}_{sub}, \boldsymbol{\alpha}_{nonsub}$, and δ: the total increase on public investment will always be larger than the grant perceived by the subsidized government, which yields proposition 1:

Now we want to turn to examine how the effects of the matching grants policy depend on the relative coefficient α associated to the subsidized capital, that represents also the relative amount used of this type of capital in equilibria and its output elasticity. We will do comparing the effects of allocating a determined matching grant to either one of the types of public capital in two alternative environments. First we will compare the effect of allocating the same δ to any of both, G_1 and G_2, and later we will compare the results of allocating a grant δ_1 to an alternative grant δ_2, when both of them imply an equivalent cost to the subsidizer. Finally, we will examine briefly also the case of an unconditional lump-sum transfer.

3.8.4.1 Case A, an identical grant to each type of capital

First we will compare the different response of public expenditure to alternatively subsidizing G_1 or G_2 with a matching grant of identical value. That is, the subsidizer has to choose between the alternative of establishing $\delta_1 = \delta$ or $\delta_2 = \delta$.

If the external agent chooses to subsidize G_1, the new constant growth rate would be $\frac{\Pi}{\delta^{\alpha 1}}$ and the increment of public investment will be represented by the equation:

$$\Delta \frac{G1_{t+1} + G2_{t+1}}{Y_{t+1}} = \beta\tau\left(\frac{\alpha_1 + \alpha_2\delta}{\delta^{1-\alpha 1}\Pi_0} - \frac{\alpha_1 + \alpha_2}{\Pi_0}\right) = \frac{\beta}{\Pi_0}\tau[\alpha_1(\frac{1}{\delta^{1-\alpha 1}} - 1) + \alpha_2(\delta^{\alpha 1} - 1)] \quad (3.19)$$

If the external agent chooses instead to subsidize G_2 through an identical matching grant, the alternative constant growth rate would be $\frac{\Pi}{\delta^{\alpha 2}}$ and the increment of public investment will be represented by the equation:

$$\boldsymbol{\Delta} \frac{G1_{t+1} + G2_{t+1}}{Y_{t+1}} = \boldsymbol{\beta\tau}\left(\frac{\alpha_1\delta + \alpha_2}{\delta^{1-\alpha 2}\Pi_0} - \frac{\alpha_1 + \alpha_2}{\Pi_0}\right) = \frac{\beta}{\Pi_0}\tau[\boldsymbol{\alpha}_1(\boldsymbol{\delta}^{\alpha 2} - \mathbf{1}) + \boldsymbol{\alpha}_2(\frac{1}{\delta^{1-\alpha 2}} - \mathbf{1})] \quad (3.20)$$

For our range of possible values for the parameters, the value of equation (3.19) will always be larger than equation (3.20). The increment in economic growth will also be larger in the case of the matching grant to the first type of public capital G_1. This result lead us to proposition 3 that stands: "*The response of a public authority to a matching-grants policy on a certain kind of public investment run by an external institution depends on the relative amount of this kind of public investment used previously (i.e. its output elasticity). The higher the output elasticity of this kind of public investment with respect to the other production factors, the higher the increase in public expenditure induced by the grant*".

3.8.4.2 Case B, a grant with identical cost to each type of capital

The case discussed above includes two options that are not perfectly comparable from the point of view of the subsidizer, since he would have to face a higher cost if he attached the matching grant to the more productive capital G_1 in comparison to the alternative of granting G_2. Alternatively, we may want to compare the outcome of allocating a grant to each one of the types of public capital that would imply an equivalent cost to the grant subsidizer. For that we have to choose δ_1 and δ_2, so that the cost of granting either G_1 or G_2 would be identical, that is:

$$(\mathbf{1}-\boldsymbol{\delta}_1)\frac{G_1}{Y}=(\mathbf{1}-\boldsymbol{\delta}_2)\frac{G2}{Y}. \tag{3.21}$$

We will denote any pair of coefficients δ_1 and δ_2 for which equation (3.21) holds as $\bar{\delta}_1$ and $\bar{\delta}_2$. In that case, the effect of implementing the grant system for each one of the alternatives would be given by the following expressions:

$$\boldsymbol{\Delta}\frac{G_{1t+1}+G_{2t+1}}{Y_{t+1}}=\frac{\beta}{\Pi}\tau[\boldsymbol{\alpha}_1(\frac{1}{\bar{\delta}_1^{1-\alpha 1}}-\mathbf{1})+\boldsymbol{\alpha}_2(\bar{\boldsymbol{\delta}}_1^{\alpha 1}-\mathbf{1})] \tag{3.22}$$

$$\Delta\frac{G_{1t+1}+G_{2t+1}}{Y_{t+1}}=\frac{\beta}{\Pi}\tau[\alpha_1(\bar{\delta}_2^{\alpha 2}-1)+\alpha_2(\frac{1}{\bar{\delta}_2^{1-\alpha 2}}-1)] \tag{3.23}$$

It is easy to show that for any pair $\bar{\delta}_1$ and $\bar{\delta}_2$ the outcome from equations (3.22) and (3.23)

will always be identical. Therefore, we expect an identical effect on total public investment from either of the alternatives: implementing a grant $\bar{\delta}_1$ to the purchase of g1 or alternatively implementing a grant $\bar{\delta}_2$ to g2, provided that the relationship between δ_1 and δ_2 comes given by (3.21).

However they do not induce an identical effect on growth. The new constant growth rate would be $\frac{\Pi}{\bar{\delta}_1^{\alpha 1}}$ if we allocate the grant to G_1 and $\frac{\Pi}{\bar{\delta}_2^{\alpha 2}}$ if the grant is attached to G_2. Given $\alpha 1 > \alpha 2$, $\bar{\delta}_1^{\alpha 1}$ will always be smaller than $\bar{\delta}_2^{\alpha 2}$, therefore, the new growth rate would always be larger under a matching grant $\bar{\delta}_1$ attached to the first type of public capital, G_1, than under an alternative matching grant with value $\bar{\delta}_2$ attached to G_2. The provider of the grant would share the same cost under both alternatives, but the first option would be more efficient in terms of growth-enhancement.

Proposition 4 characterizes this result: *"The cost to the subsidizer of running a matching grant policy with the purpose of reaching a predetermined increase of public investment does not depend on the output elasticity of the subsidized type of public investment. However, the higher this elasticity of the public investment, the higher the increase in economic growth induced by the reallocation of factors ".*

3.8.4.3 Case C. Lump-sum grants

Finally we have to mention that in the alternative case in which the government does not receive a matching grant, but a lump-sum grant, the results remains unaltered when there are two types of public goods. The new governments budget constraint for period s+1 changes to:

$$\tau Y_{s+1} + L = G_{1s+2} + G_{2s+2} + G_{3s+1} \tag{3.24}$$

And the equivalent equilibrium growth rate Π_{gS} :

$$\frac{G_{cons,s+1}}{G_{cons,s}} = \Pi_{gS} = \beta\tau\alpha_1\frac{Y_{s+1}}{G_{1s+1}} = \beta\tau\alpha_2\frac{Y_{s+1}}{G_{2s+1}}$$

After period s+1, $\frac{G_{cons,t+1}}{G_{cons,t}}$ will start to decrease and converge to the value that it used to have before s. Parallelly, $\frac{G_{1t}}{Y_t}$ and $\frac{G_{2t}}{Y_t}$ will also increase to converge gradually to their previous value, or immediately if the grant were retired. The effect of the introduction of a lump-sum grant in period s+1 over G_{1s+1} and G_{2s+2} is:

$$\boldsymbol{\Delta}\frac{G_{1t+1}+G_{2t+1}}{Y_{t+1}} = \boldsymbol{\beta\tau}(\boldsymbol{\alpha}_1+\boldsymbol{\alpha}_2)(\frac{1}{\Pi_{gS}}-\frac{\mathbf{1}}{\Pi_o})] \tag{3.25}$$

which is negative since $\Pi_{gS} > \Pi_0$. As in the basic model, there is a situation of total crowding-out, because we have a negative increase in total public investment. T

3.9 Appendix II

Portugal, Greece, Spain and Ireland are clearly the main beneficiaries of the Structural Funds. Figure [1] shows the allocation per capita of the Structural Fund for the 15 European countries in our dataset. The allocation to Greece or Portugal is clearly above 200 Euro per capita while richer countries hardly reach 50. In 2005 these four countries received 45% of the total budget of the Structural Funds.[23]

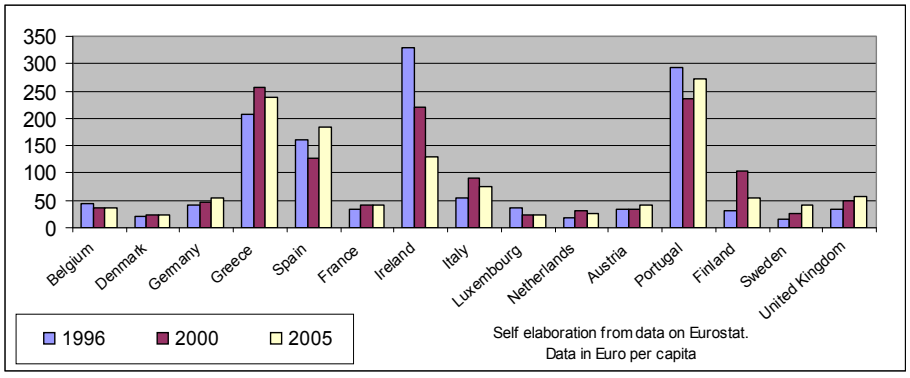


Figure A.1: Per capita allocation of SF by member country.

[23] approximately, 14030 out of 3853 million Euro. They count with approximately 17% of the population over the total sample of 15 countries.

We want to evaluate the relative changes in the pattern of public investment that the Structural Funds may have induced in our sample. In figure [2] we show the evolution of the public expenditure on some keys functional categories for two sub-groups of our sample.[24] On one side we have aggregated data for Greece, Ireland, Portugal and Spain (GIPS), the four main receivers of Structural Funds. In the other group we included the five countries that receive the fewest Funds per capita, namely Denmark, France, Luxembourg, Netherlands and Sweden (DFLNS). The first group includes approximately 68 million people, while the second around 93.

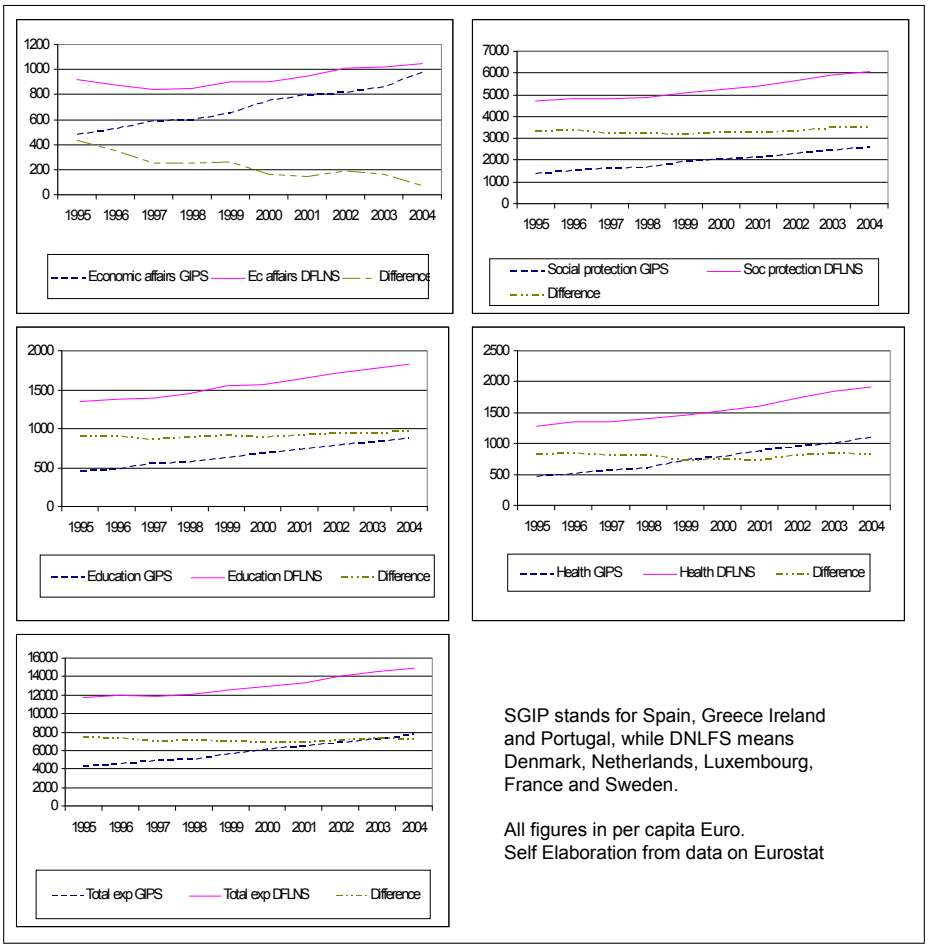


Figure A.2: Analysis of the evolution of public expenditure by functional categories and groups of countries.

[24] The rest of functional categories of public expenditure not included in the figures are "General public services", "Defence", "Public order and safety", "Environment protection", "Housing and community amenities" and "Recreation, culture and religion". They have been omitted in the analysis since their examination would not include additional information relevant for our purposes.

In the period considered, the SPIG group has reduced very slightly the gap of public expenditure per capita in comparison with the DFLNS group. This change has not affected homogeneously all the categories of public expenditure, but has served to reduce the gap in the category "Economic Affairs and Services", which is the one precisely oriented towards reducing the production differences.[25] In the meanwhile, other categories like "Social Security", "Education" and "Health" have maintained almost steady the gap between these two groups of "poor" and "rich " countries.[26]

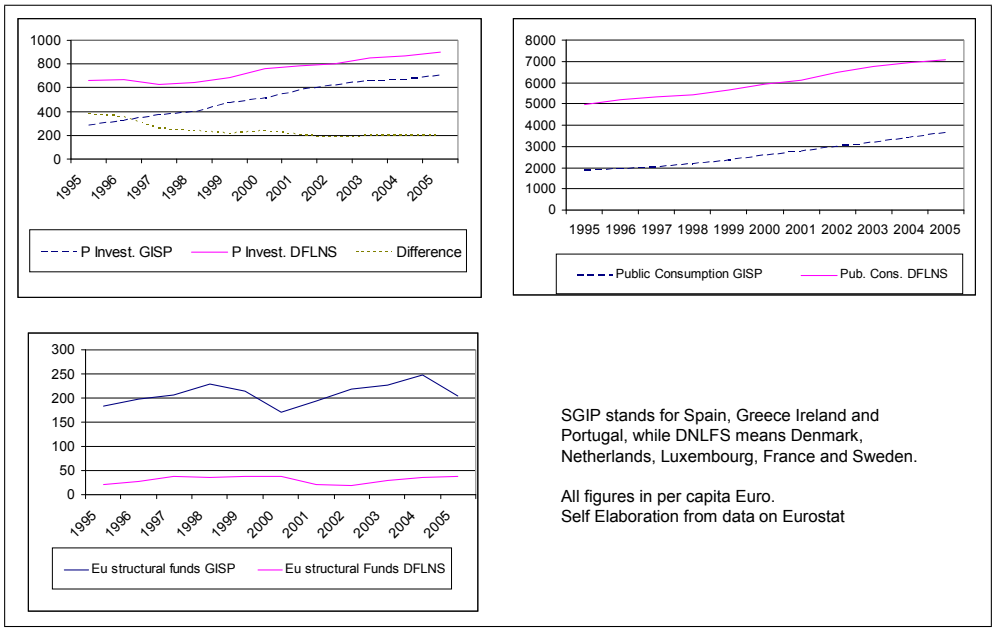


Figure A.3: Analysis of the evolution of public expenditure by economic categories and groups of countries.

[25] The gap has been reduced in 365 Euro per capita, while the difference in total public expenditure per capita has decreased 288 Euro.

[26] In particular, the gap for those three categories of expenditure has increased approximately 124, 44 and 8 Euro per capita in the period considered in the figures.

3.10 Appendix III

	Obs.	Mean	St. Dev.	Min	Max
Pinv	136	43747.45	86807.24	-194270.6	473657.6
EUSF	136	13347.36	60290.75	-196428.8	230578.3
GDPgr	136	1772733	2222053	-605718.1	1.71e7
PCons	136	273263.6	327047.1	-316868.8	1698880
PrivInv	103	660044.7	943726.6	-188200	6934000
Pop	136	9659.596	36501.66	-159370	167025
Cgcape	136	81234.75	269850.6	-203332	678706

Table A.1: Spanish Regional Data: Summary Statistics.

BIBLIOGRAPHY

[1] AFONSO, A. and GONZALEZ ALEGRE, J. (2008), "Economic Growth and Budgetary Components: a Panel Assessment for the EU", European Central Bank,Working paper series no 848.

[2] AGELL, J., LINDH, T. and OHLSSON, H. (1997), "Growth and the public sector: A critical review essay", European Journal of Political Economy, vol. 13, 33-52.

[3] AGENOR, P.R. (2007), "Fiscal Policy and Endogenous Growth with Public Infrastructures", Centre for Growth and Business Cycle Research, Discussion Paper Series no. 59

[4] ALESINA A., ARDAGNA, S. (1998), "Tales of Fiscal Adjustment ", Economic Policy, 27,487-546.

[5] ALESINA A., ARDAGNA, S., PEROTTI, R. and SCHIANTARELLI, F. (2002), "Fiscal Policy, Profits and Investment ", American Economic Review, 92 (3), 571 - 589.

[6] ALESINA, A., BAQIR, R. and EASTERLY, W. (1999), "Public Goods and Ethnic Divisions", Quarterly Journal of Economics, 114 (4).

[7] ALESINA, A., LONDREGAN, J. and ROSENTHAL, H. (1993), "A model of the Political Economy of the United States", American Political Science Review, 87 (1), 12-33.

[8] ALESINA, A. and PEROTTI, R. (1995), "Fiscal Expansion and Fiscal Adjustments in OECD countries ", Economic Policy 21, 205-248.

[9] ALESINA, A. and PEROTTI, R. (2004), "The European Union: A Politically Incorrect view", NBER Working paper 10342.

[10] ALESINA, A. and SPOLAORE, E. (1997), "On the number and size of nations", Quarterly Journal of Economics, 112.

[11] ANGERMANN, I., BROYER, C., KAISER-TILOSEN, J., LEIM, W. and SEIFFART, C. (2005), "The Lisbon Process, how far are the big EMU Countries faring?", Economic Research: Allianz Group-Dresdner Bank, Working paper No. 48.

[12] ARDAGNA, S. (2001), "Fiscal Policy Composition, Public Debt and Economic Activity ", Public Choice, 109, 301-325.

[13] ARELLANO, M. and BOND, S. (1991), "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations", Review of Economic Studies, 58, 227-297.

[14] ARELLANO, M. and BOVER, O. (1995), "Another look at the instrumental variables estimation of error-component models", Journal of Econometrics, 68.

[15] ARONSSON, T and WIKSTROM, M. (1996), "Local Public Expenditure in Sweeden: A Model where the Median Voter is not Necessary Decisive", European Economic Review, 40.

[16] ARROW, K.J. and KURZ (1970), "M. Public Investment, the Rate of Return and Optimal Fiscal Policy", The John Hopkins Press, Baltimore, USA.

[17] ARZE, F.J., MARTINEZ VAZQUEZ, J. and MCNAB, R. (2005), "Fiscal Decentralization and the Composition of Public Expenditures", International Studies Program Working Paper, 05-01.

[18] ASCHAUER, D.A., (1988) "The Equilibrium Approach to Fiscal Policy ", Journal of Money, Credit and Banking, 20, 41–62.

[19] ASCHAUER, D.A. (1989), "Is Public Expenditure Productive?", Journal of Monetary Economics, 23, 177-200.

[20] ATUN, R.A. and FITZPATRICK, S.(2005), "Advancing Economic Growth: Investing in Health", A summary of the issues discussed at a Chatham House conference held on 22–23 June 2005, The Royal Institute of International Affairs.

[21] BAHL, R. and DUNCOMBE, W. (1988), "State and Local Government Finance: Was there a Structural Break in the Reagan Years?", Growth and Change, 19(4), 30-48.

[22] BAHL, R and SJOQUIST, D.L. (1990), "The State and Local Fiscal Outlook: What Have We Learned and Where Are We Headed?", National Tax Journal, 43(3), 321-342.

[23] BAIER, S.L. and GLOMM, G. (2001), "Long-run Growth and Welfare Effects of Public Policies with Distortionary Taxation", Journal of Economic Dynamics & Control vol. 25, 2007-2042.

[24] BAILEY, S.J. and CONNOLLY, S. (1998), "The flypaper effect: Identifying areas for further research", Public Choice, 95, 335–36.

[25] BALDACCI, E., CANGIANO, M., MAHFOUZ, S., and SCHIMMELPFENNIG, A. (2001), "The Effectiveness of Fiscal Policy in Stimulating Economic Activity. An Empirical Investigation", IMF, mimeo.

[26] BALTAGI, B. (2005), "Econometric analysis of panel data ", John Wiley & Sons (3rd ed.), Chichester.

[27] BAJO-RUBIO, O. and SOSVILLA-RIVERO, S. (1993), "Does Public Capital affect Private Sector Performance? An Analysis of the Spanish Case, 1964-88", Economic Modelling, 9 (3).

[28] BARRO, R.J. (1980), "A Capital Market in an Equilibrium Business Cycle Model ", Econometrica, 48 (6), 1393-1417.

[29] BARRO, R.J. (1990), "Government Spending in a Simple Model of Endogenous Growth", The Journal of Political Economy, 98 (5), 103-125.

[30] BARRO, R.J. (1991), "Economic Growth in a Cross Section of Countries", Quarterly Journal of Economics, 106, 407-430

[31] BARRO, R.J. (1998), "Determinants of Economic Growth a Cross-Country Empirical Study ", Cambridge : MIT Press.

[32] BARRO, R.J. and SALA i MARTIN, X. (1992), "Public Finance in models of Economic Growth", The Review of Economic Studies, vol. 59, no. 4.

[33] BARRO, R.J. and SALA i MARTIN, X. (1999), "Economic Growth", McGraw-Hill, Boston, USA.

[34] BASSANINI, A. and SCARPETTA, S. (2001), "The Driving Forces of Economic Growth: Panel Data evidence for OECD Countries ", OECD Economic Studies no. 33.

[35] BECKER, E. (1996), "The illusion of fiscal illusion: Unsticking the flypaper effect ", Public Choice, 86, 85-102.

[36] BEN-DAVID, E. and KIHMI, A. (2004), "Trade and the Rate of Income Convergence", The Journal of International Trade & Economic Development, 13 (4), 419 - 441.

[37] BESLEY, t. and CASE, A. (2000), "Unnatural Experiments? Estimating the Incidence of Endogenous Policies ", The Economic Journal, vol. 110, No. 467.

[38] BESLEY, T. and COATE, S. (2003), "Centralized versus Decentralized Provision of Local Public Goods: a Political Economy Approach", Journal of Public Economics, 87.

[39] BHARGAVA, A.,FRANZINI, L. and NARENDRANATHAN, W. (1982), "Serial Correlation and the Fixed Effects Models " Review of Economic Studies, 49 , 533-549.

[40] BLEANEY, M, GEMMELL, N. and KNELLER, R. (2001), "Testing the Endogenous Growth Model: Public Expenditure, Taxation, and Growth over the Long-run ", Canadian Journal of Economics, vol. 34, no. 1.

[41] BLUNDELL, R. and BOND, S. (1998), " Initial conditions and moment restrictions in Dynamic Panel Data Models", Journal of Econometrics 87.

[42] BOND, S. and WINDMEIJER, F. (2002), " Finite Sample Inference for GMM Estimators in Linear Panel Data Models", cemmap working paper CWP04/02.

[43] BORGE, L.E. (1995), "Lump-sum intergovernmental grants have price effects: A note", Public Finance Quarterly, 23, 271–274.

[44] BOSE, N., HAQUE, M.E., and OSBORN, D.R. (2003), "Public Expenditure and Economic Growth: A Disaggregated Analysis for Developing Countries", Centre for Growth and Business Cycle Research Discussion Paper Series (University of Manchester), No. 30.

[45] BRADFORD. D.F. and OATES, W.E. (1971), "Towards a Predictive Theory of Intergovernmental Grants ", The American Economic Review, Vol. 61, No. 2.

[46] BRADFORD. D.F. and OATES, W.E. (1971b), "The Analysis of Revenue Sharing in a New Approach to Collective Fiscal Decisions ", The Quarterly Journal of Economics, 85(3), 416-439.

[47] BRUECKNER, J.K (2005), "Fiscal Federalism and Economic Growth", University of California Working Paper.

[48] CASE, A.C., ROSEN, H.S. and HINES, J.R. (1993), "Budget Spillovers and Fiscal Policy Interdependence: Evidence from the States ", Journal of Public Economics, 53, 285-307.

[49] CASHIN, P. (1995), "Government Spending, Taxes and Economic Growth", IMF Staff Papers, 42 (5).

[50] CASSOU, S.P. and LANSING, K.J. (2004), "Growth Effects of Shifting from a Graduated-rate Tax System to a Flat Tax," Economic Inquiry, 42 (2), 194-213.

[51] CELLINI, R. (1997), "Growth empirics: evidence from a panel of annual data ", Applied Economics Letters, 4, 347–351.

[52] CHUBB, J.E. (1985), "The Political Economy of Federalism ", American Political Science Review, Vol. 79.

[53] COE, D.T. and HELPMAN, E. (1995), "International R&D Spillovers ", European Economic Review, 39, 859-887.

[54] COMMISSION OF THE EUROPEAN COMMUNITIES (2002), "The Lisbon Strategy. Making Change Happen", European Commission Communication, COM(2002)14 final.

[55] CONGLETON,R. (2002), "The Median Voter Model", In C. K. Rowley (Ed.); F. Schneider (Ed.) (2003): "The Encyclopedia of Public Choice." Kluwer Academic Press. Retrieved from "http://en.wikipedia.org/wiki/Median_voter_theory"

[56] CORSETTI, G. and ROUBINI, N. (1996), "Optimal Government Spending and Taxation in Endogenous Growth Models", NBER Working Papers, 5851.

[57] CRISCUOLO, C. (2007), "Boosting Innovation and Productivity Growth in Europe: The Hope and Realities of the EU's Lisbon's Agenda ", Centre for Economic Performance, LSE, mimeo.

[58] DALL 'ERBA, S. and LE GALLO, J. (2003), "Regional Convergence and the Impact of European Structural Funds over 1989-1999: An Spatial Econometrics Analysis ", Regional Economics Applications Laboratory (REAL), University of Illinois, Discussion paper.

[59] DAVOODI, H. and ZOU, H. (1998), "Fiscal decentralization and economic growth: a cross-country study", Journal of Urban Economics, 43,244-257.

[60] DE GREGORIO, J. (1993), "Credit Markets and Stagnation in an Endogenous Growth Model," IMF Working Papers 93/72.

[61] DE HAAN, J. and STURM, J.E. (1997), " Political and Economic Determinants of OECD Budget Deficits and Government Expenditures: A Reinvestigation", European Journal of Political Economy, 13, 739–750.

[62] DE HAAN, J., STURM, J.E. and SIKKEN, B.J. (1996), "Government Capital Formation: Explaining the Decline", Weltwirtschaftliches Archiv, vol 132 (1).

[63] DE LA FUENTE, A. (1997), "Fiscal policy and Growth in The OECD. Volume II: Appendix," UFAE and IAE Working Papers 401.97, Unitat de Fonaments de l'Anàlisi Econòmica (UAB) and Institut d'Anàlisi Econòmica (CSIC).

[64] DE LA FUENTE, A. (2002), "The effect of Structural Fund Spending on the Spanish Regions: an Assessment of the 1994-99 Objective 1 CSF", CEPR Discussion Paper, no. 3673.

[65] DELLER, S.C. and WALZER, N. (1995), "Structural Shifts in the Treatment of Intergovernmental Aid: The Case of Rural Roads", Journal of Agricultural and Applied Economics 27(2), 1-14.

[66] DEMETRIADES, P.O. and MAMUNEAS, T.P. (2000), "Intertemporal Output and Employment Effects of Public Infrastructure Capital: Evidence from 12 OECD Countries", Economic Journal, vol. 110, pp. 687-712.

[67] DENIS, C., MC MORROW, W., ROGER, W and VEUGELERS, R. (2005), "The Lisbon Strategy and the EU's Structural Productivity Problem" , European Commission, Directorate-General for Economic and Financial Affairs, Economic Paper no. 221.

[68] DEVARAJAN, S., SWAROOP, V. and ZOU, H. (1996), "The Composition of Public Expenditure and Economic Growth", Journal of Monetary Economics, 37, 313-344.

[69] DIAZ-CAYEROS, A., McELWAIN, K.M., ROMERO, V. and SIEWIERSKI, K.A. (2002), "Fiscal Decentralization and Particularistic Spending across Countries", Conference on Comparative Analysis of Political Institutions, Princeton University, April 18-19.

[70] DIRECTORATE-GENERAL FOR ECONOMIC AND FINANCIAL AFFAIRS (2004), "Public Finance in EMU- 2004", European Economy. No. 3. Office for Official Publications of the EC. Luxembourg.

[71] DIRECTORATE-GENERAL FOR HEALTH AND CONSUMER PROTECTION (2005), "The contribution of health to the economy in the European Union", Office for Official Publications of the European Communities, Luxembourg.

[72] DJAJIC, S. and MAXIMILIANS, L. (1987), "Government Spending and the Optimal Rates of Consumption and Capital Accumulation ", Canadian Journal of Economics, vol. 20, no. 3, pp. 544-554.

[73] DOMENECH, R. and .GARCIA, J.R. (2002), "Optimal Taxation and Public Expenditure in a Model of Endogenous Growth", Topics in Macroeconomics, vol. 2 (1), pp.1-24.

[74] DOUGAN, W.R and KENYON, D.A. (1988), "Pressure Groups and Public Expenditure: The Flypaper Effect Reconsidered ", Economic Inquiry, Vol. 26.

[75] EASTERLY, W. and REBELO, S. (1993), "Fiscal Policy and Economic Growth. An Empirical Investigation", Journal of Monetary Economics, 32, 417-458.

[76] EBEL, R.D. and YILMAZ, S. (2002), "On the measurement and Impact of Fiscal Decentralization", World Bank Policy Research Working paper, no. 2809.

[77] ENGLANDER, A.S. and GURNEY, A. (1994), "OECD Productivity Growth: Medium-Term Trends ", OECD Economic Studies, no. 22, 111-154.

[78] EUROPEAN COMMISSION (1999), "Regulation (EC) No. 1260/1999 of the Council of 21 June 1999 laying down general provisions on the Structural Funds ".

[79] EUROPEAN COMMISSION (2005a), "16th annual report on implementation of Structural Funds 2004 " COM(2005) 533.

[80] EUROPEAN COMMISSION (2005b), "Annual report of the Cohesion Fund (2004) ", Commission Staff Working Document COM(2005) 544 .

[81] EUROPEAN COMMISSION (2006), "Allocation of 2005 EU Expenditure by Member State ".

[82] EUROPEAN UNION. REGIONAL POLICY (2006), "A reformed Cohesion Policy for a changing Europe Regions, Cities and Border areas for Growth and Jobs ".

[83] EVERAERT, G. and HEYLEN, F. (2001), "Public Capital and Productivity Growth: Evidence from Belgium, 1953-1996 ", Economic Modelling, 18, 97-116.

[84] FAGERBERG, J. (1987), "A Technology gap approach to why growth rates differ " , Research Policy, 16 (4).

[85] FAGUET, J.P. (2002), "A model of Central versus Decentralized Government: Self-Interest and Mis-allocation in Bolivia", London School of Economics Working Paper 02-39.

[86] FAGUET, J.P. (2004), "Does Decentralization increase Government Responsiveness to Local Needs?: Evidence from Bolivia", Journal of Public Economics, 88.

[87] FALCH, T. and RATTSO, J. (1997), "Political Economy and Economic Determinants

od School Spending in Federal States: Theory and Time-Series Evidence", European Journal of Political Economy, 13.

[88] FAN, S., HAZELL, P. and THORAT, S. (2000), "Government Spending, Growth and Poverty in Rural India", American Journal of Agricultural Economics, 82 (4), 1038-1051.

[89] FELDSTEIN, M.S. (1975), "Wealth Neutrality and Local Choice in Public Education ", The American Economic Review, Vol. 65.

[90] FISHER, R.C. (1982), "Income and Grant Effects on Local Expenditure: The Flypaper Effect and Other Difficulties ", Journal of Urban Economics, Vol. 12.

[91] FISMAN, R. and GATTI, R. (2000), "Decentralization and Corruption: Evidence across Countries", World Bank, Washington,DC. Working paper no. 2290.

[92] GANELLY, G. and TERVALA, J. (2007), "Public Infrastructures, Public Consumption, and Welfare in a New-Open-Economy-Macro Model", IMF Working Paper no. 07/67.

[93] GERDTHAM, U.G., SOGAARD, J. JONSSON, F. and ANDERSSON, F. (1992), "An Econometric Analysis of Health Care Expenditure: a Cross Section of OEDC Countries", Journal of Health Economics, 11.

[94] GLOMM, G. and RAVIKUMAR, B. (1997), "Productive government expenditures and long-run growth ", Journal of Economic Dynamics and Control, 21, 183-204.

[95] GORDON, N. (2004), "Do Federal Grants Boost School Spending? Evidence from Title I", Journal of Public Economics, Vol. 88, No. 9-10.

[96] GRAMLICH, E. and GALPER, H. (1973) "State and Local Fiscal Behavior and Federal Grant Policy ", Brookings Papers on Economic Activity, vol. 1.

[97] GUPTA, S., CLEMENTS, B., BALDACCI, E. and MULAS-GRANADOS, C. (2005), "Fiscal Policy, Expenditure Composition and Growth in low-income Countries", Journal of International Money and Finance, 24, 441-463.

[98] HAMILTON, B.W. (1983), "The Flypaper Effect and Other Anomalies ", Journal of Public Economics, Vol, 22.

[99] HAMILTON, J.H. (1986), "The flypaper effect and the deadweight loss from taxation", Journal of Urban Economics, 19, 148–155.

[100] HANSSON, P. and HENREKSON, M. (1994), "A new framework for testing the effect of government spending on growth and productivity", Public Choice, 81 (4).

[101] HAUSMAN, J. (1978), "Specification Tests in Econometrics", Econometrica, 46 (6), 1251-71.

[102] HELMS, L.J. (1985), "The Effect of State and Local Taxes on Economic Growth: A Times Series-Cross Section Approach", The Review of Economics and Statistics, 67 (4), 574-582.

[103] HESTON, A., SUMMERS, R. and ATEN, B. (2002), Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP).

[104] HINES, J.R. and THALER, R.H. (1995), "Anomalies: The Flypaper Effect ", The Journal of Economic Perspectives, Vol. 9, No. 4.

[105] HISHOW, O.N. (2005), "Lessons from Lisbon, or Why Leisure Harms", Intereconomics, Volume 40 No. 2.

[106] HULTEN, C.R. (2000), "Total Factor Productivity: A Short Biography ", NBER Working Papers, no. 7471.

[107] HUTHER, J. and SHAH, A. (1998), "Applying a Simple Measure of Good Governance to the Debate on Fiscal Decentralization", World Bank, Washington, DC Policy research working paper 1894.

[108] IIMI, A. (2004), "Decentralization and Economic Growth Revisited: An Empirical Note", Japan Bank for International Cooperation Working Paper no. 17/2004.

[109] JIN, H., QIAN, Y. and WEINGAST, B.R. (2005), "Regional Decentralization and Fiscal Incentives: Federalism Chinese Style", Journal of Public Economics, vol. 89, 1719-1742.

[110] JONES, C. (1995)," Time Series Tests of Endogenous Growth Models", Quarterly Journal of Economics, 110 (2), 495-525.

[111] JONES, L.E., MANUELLI R.E. and ROSSI P.E. (1993), "Optimal Taxation in Models of Endogenous Growth," Journal of Political Economy, 101, 485-517.

[112] JONES, L.E. and MANUELLI R.E. (1993), "Growth and the Effects of Inflation" Journal of Economic Dynamics and Control, 19, 1405-1428.

[113] JONES, C.J. and WILLIAMS, J.C. (1998), "Measuring the Social Return to R&D", Quarterly Journal of Economics, November 1998.

[114] JUDSON, R.A. and OWEN, A.L. (1996), "Estimating Dynamic Panel Data Models: A Practical Guide for Macroeconomists", Federal Reserve Board of Governors, mimeo.

[115] KHAN, M.S and SENHADJI, A.S. (2001), "Threshold Effects in the Relationship between Inflation and Growth ", IMF staff papers, 48, 1-21.

[116] KING, D. (1984), "Fiscal Tiers: The Economics of Multilevel Government", George Allen and Unwin, London.

[117] KING, R., and REBELO, S. (1990) "Public Policy and Economic Growth: Developing Neoclassical Implications", Journal of Political Economy 98, 126-151.

[118] KNELLER, R., BLEANEY, M.F. and GEMMELL N. (1999) "Fiscal policy and growth: evidence from OECD countries", Journal of Public Economics 74, 171-190.

[119] KNIGHT, B. (2002), "Endogenous Federal Grants and Crowd-out of State Government Spending: Theory and Evidence from the Federal Highway Aid Program", The American Economic Review, Vol. 92, No. 1.

[120] KORMENDI , R. C. and MEGUIRE, P. G. (1985), "Macroeconomic Determinants of Growth: Cross-Country Evidence", Journal of Monetary Economics 16, 141-163.

[121] LEVINE, R. and RENELT, D. (1992), "A Sensisitive Analysis of Cross-country Growth Regressions", American Economic Review, 82 (4), 942-963.

[122] LOCKWOOD, B. (2002), "Distributive Politics and the Costs of Centralization", Review of Economic Studies, 69.

[123] MEHROTRA, A. and VALILA, T. (2006), "Public Investment in Europe: Evolution and Determinant in Perspective", Fiscal Studies, 27 (4), 443-471.

[124] MENDOZA, E.G. and TESAR, L.L. (1998), "The International Ramifications of Tax Reforms: Supply-Side Economics in a Global Economy ", The American Economic Review, 88 (1), 226-245.

[125] MARTINEZ VAZQUEZ, J. and MCNAB, R. (2003), "Fiscal Decentralization and Economic Growth", World Development, 31 (9).

[126] MARTINEZ VAZQUEZ, J. and MCNAB, R.M. (2005), "Fiscal Decentralization, Macrostability and Growth", International Studies Program Working Paper, 05-06.

[127] MELO, L. (2002), "The Flypaper Effect under Different Constitutional Contexts: The Colombian Case", Public Choice, Vol 111.

[128] MILLER, S.M. and RUSSEK, F.S. (1997), "Fiscal Structures and Economic Growth", Economic Inquiry, 35, 603-613.

[129] MITZE, T. (2007), "Dynamic simultaneous equation error component models applied to the analysis of regional equalization policies in a growth model framework for German states", Ruhr-University Bochum, mimeo

[130] MIZUTANI, F. and TANAKA, T. (2005), "Productivity Effects and Determinants of the Allocation of Public Infrastructure," ERSA conference papers ersa 05, 412, European Regional Science Association.

[131] MODIFI, A. and STONE, J. (1990), "Do State and Local Taxes affect Economic Growth?", Review of Economics and Statistics, 72 (4), 686-691.

[132] MOLERO, J.C (2001), "Analysis of the Decentralization of the Public Spending in Spain ", Public Finance and Management, 1 (4).

[133] MORENO, R., LÓPEZ-BAZO, E. and ARTÍS, M. (2003), "On the Effectiveness of Private and Public Capital", Applied Economics, 35 (6), 727–740.

[134] NIXON, J. (2000), "Convergence of Health Care Spending and Health Outcomes in the European Union, 1960-95", Centre for Health Economics, University of York, Discussion Paper no. 183.

[135] OATES, W. E. (1972), "Fiscal Federalism", New York: Harcourt, Brace, Jovanovich.

[136] OATES, W.E. (1993), "Fiscal decentralization and economic development", University of Maryland, Working Paper 93-4.

[137] OLMSTED, G.M., DENZAU, A.T. and ROBERTS, J.A. (1993), "We voted for this? : Institutions and educational spending ", Journal of Public Economics, Vol. 52, No. 3.

[138] ODEDOKUN, M.O (2001), "Public Finance and Economic Growth ", WIDER Discussion Paper, 72/2001.

[139] PALLESEN, T. (2006), "Flypaper II: The equivalent impact of matching and lump sum grants: Evidence from the change of grant regime in Danish local governments", Aarhus University, mimeo.

[140] PANIZZA, H. (1999), "On the Determinants of Fiscal Centralization: Theory and Evidence", Journal of Public Economics, 74.

[141] PAPKE, L.E. and WOOLDRIDGE, J.M. (1996), "Econometric Methods for Fractional Response Variables with an Application to 401 (K) Plan Participation Rates" , Journal of Applied Econometrics, vol. 11, no. 6, pp 619-632.

[142] PERCOCO, M. (2005), "The Impact of Structural Funds on Italian Mezzogiorno: 1994-1999", Région et Développement, 21, 141-153.

[143] PEROTTI, R. (1999), "Fiscal Policy in Good Times and Bad ", Quarterly Jounal of Economics, 114 (4), 1399-1436.

[144] PESHARAN, M.H., SHIN, Y. and SMITH, R. (1999), "Pooled Mean Group Estimators of Dynamic Heterogeneous Panels ", Journal of the Americal Statistical Association, 94, 621-634.

[145] RAM, R. (1986), "Government Size and Economic Growth: A new Framework and some Evidence from Cross-section and Time-series Data", American Economic Review, 76 (1), 191-203.

[146] RAMIREZ, M (1998), "Does Public Investment Enhance Labor Productivity Growth

in Chile? A Cointegration Analysis", North American Journal of Economics and Finance, 9 (1).

[147] RANDOLPH, S., BOGETIC, Z. and HEFLEY, D. (1996), "Determinants of public expenditure on Infrastructure. Transport and Communication", World Bank Policy Research Working Paper 1661.

[148] RODDEN, J. and WIBBELS, E. (2002), "Beyond the Fiction of Federalism: Macroeconomic Management in Multitiered Systems", World Politics, 54 (4).

[149] RODRIGUEZ-POSE, A.and FRATESI, U. (2004), "Between development and social policies: The impact of European structural funds in objective 1 regions ", Regional Studies 38(1), 97-113.

[150] ROMER, P. (1986) "Increasing Returns and Long-Run Growth", Journal of Political Economy, 94, 1002–1037.

[151] ROMER, T. and ROSENTHAL, H. (1980), "An Institutional Theory of the Effect of Intergovernmental Grants ", National Tax Journal 33, 451–458.

[152] ROMERO DE AVILA, D. and STRAUCH, R. (2003), "Public Finances and Long-Term Growth in Europe. Evidence from Panel Data Analysis ", ECB Working Paper no. 246.

[153] ROMP, W. and De HAAN, J. (2007), "Public Capital and Economic Growth: A Critical Survey", Perspektiven der Wirtschaftspolitik 8 (Special Issue), 6–52.

[154] ROUBINI, N. and SACHS, J. (1989), "Government Spending and Budget Deficits in the Industrial Countries ", Economic Policy, 8.

[155] RUBINCHIK-PESSACH, A. (2005), "Can Decentralization be Beneficial?", Journal of Public Economics, 89.

[156] SANZ, I. and VELAZQUEZ, F.J. (2002), "Determinants of the Composition of Government Expenditure by Functions", European Economy Group Working Paper, 13/2002.

[157] SAPIR, A. (ed.) (2003), "An Agenda for a Growing Europe: Making the EU Economic System Deliver ", Brussels, European Commission.

[158] SAREL, M. (1996), "Nonlinear Effects of Inflation on Economic Growth ", IMF staff papers, 43, 199-215.

[159] STOKEY, N.L. and REBELO, S. (1995), "Growth effects of flat-rate taxes", Journal of Political Economy, 103 (3), 519-550.

[160] STRUMPF, K.S. (1998), "A Predictive Index for the Flypaper Effect", Journal of Public Economics, Vol 69.

[161] STURM, J.E. (1998), "Public Capital Expenditure in OECD Countries. The causes and consequences of decline in Public Capital Spending ", Edward Elgar, Chelthenham.

[162] STURM, J.E. (2001), "Determinants of Public Capital Spending in less-developed Countries ", CESinfo, Munich.

[163] SUHRCKEA, M., McKEEB, M., STUCKLERC, D., SAUTO ARCED, R., TSOLOVAD, S. and MORTENSEND, J.(2006), "The contribution of health to the economy in the European Union", Public Health120, 994–1001.

[164] SWAN, T.W. (1956), "Economic Growth and Capital Accumulation", Economic Record, 32, 334-361.

[165] THIESSEN, U. (2003), "Fiscal Decentralization and Economic Growth in High-Income OECD Countries", Fiscal Studies, 24 (3).

[166] TOBIN,J. (1965), "Money and Economic Growth", Econometrica, 33 (4), 671-684.

[167] TOMLJANOVICH, M. (2004), "The Role of State Fiscal Policy in State Economic Growth", Contemporary Economic Policy, 22 (3), 318-330.

[168] TREISMAN, D (2000), "Decentralization and Inflation: Commitment, Collective Action or Continuity", American Political Science Review, 94 (4).

[169] TURNOVSKI, S.J. (1999), "Optimal Tax, Debt, and Expenditure Policies in a Growing Economy ", Journal of Public Economics, vol. 60, 21-44.

[170] VAN DER PLOEG, R. (2006), "Rolling Back the Public Sector: Differential Effects on Employment, Investment and Growth ", Oxford Economic Papers, vol. 58, no. 1.

[171] VAN DER PLOEG, F. and BOVENBERG, L. (1994), "Environmental Policy, Public Goods and The Marginal Cost of Public Funds", The Economic Journal, vol. 104, pp. 444-454.

[172] VOLDEN, C. (2007), "Intergovernmental Grants: A Formal Model of Interrelated National and Subnational Political Decisions ", The Journal of Federalism 37(2), 209-243.

[173] VON HAGEN, J. and STRAUCH, R. (2001), "Fiscal Consolidations: Quality, Economic Conditions, and Sucess", Public Choice, 109, 327-346.

[174] WEICHER, J.C. (1972), "Aid, Expenditures and Local Government Structure", National Tax Journal, Vol. 25.

[175] WEINGAST, B.R. (1995), "The Economic Role of Political Institutions: Market-preserving Federalism and Economic Development", Journal of Law, Economics and Organizations, 11 (1).

[176] WERNING, I. (2007), "Optimal Fiscal Policy with Redistribution ", Quarterly Journal of Economics, forthcoming.

[177] WINER, S.L. (1983), "Some evidence on the effect of the separation of spending and tax decisions ", Journal of Political Economy, 91, 126–140.

[178] WOLLER, G. M. and PHILLIPS, K. (1998), "Fiscal decentralization and LDC economic growth: an empirical investigation", Journal of Development Studies, 34 (4).

[179] WOOLDRIDGE, J.M. (2002), Econometric Analysis of Cross Section and Panel Data, MIT press, Cambridge, MA.

[180] XIE, D., ZOU, H. and DAVOODI, H. (1999), "Fiscal decentralization and economic growth in the United States", Journal of Urban Economics, 45.

[181] ZHANG, T. and ZOU, H.F. (1998), "Fiscal Decentralization, Public Spending and Economic Growth in China", Journal of Public Economics, vol 67, 221-240.