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Conference Paper

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44th Congress of the European Regional Science Association: "Regions and Fiscal Federalism",
25th - 29th August 2004, Porto, Portugal

Provided in Cooperation with:

European Regional Science Association (ERSA)

Suggested Citation: Gil-Serrate, Ramiro; López-Laborda, Julio (2004) : Modelling tax decentralisation and regional growth, 44th Congress of the European Regional Science Association: "Regions and Fiscal Federalism", 25th - 29th August 2004, Porto, Portugal, European Regional Science Association (ERSA), Louvain-la-Neuve

This Version is available at:

<https://hdl.handle.net/10419/117039>

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MODELLING TAX DECENTRALISATION AND REGIONAL GROWTH

*Ramiro Gil-Serrate and Julio López-Laborda**

ABSTRACT: The aim of this paper is to determine a theoretical linkage between tax decentralisation and regional growth. For this purpose a two fiscal tiers growth model is specified. First, working on Zou (1996) analytical framework, which account for the potential effects of intergovernmental policies on regional growth, a tax decentralisation process is brought in. Next its original model is expanded taking into account such process. It is shown that the effect of tax decentralisation on regional growth depends on the existing relationship between private and regional public capital productivities ratio and their stocks ratio square root. Finally a hypothesis for the Spanish economy is obtained. It will be checked empirically in subsequent work.

Keywords: tax decentralisation; general equilibrium analysis; regional growth

JEL classification: H70; O40; R13

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I. INTRODUCTION

Studies of the possible relationship between fiscal decentralisation processes and economic growth opened up a new line of research in the latter half of the 1990's. This arose out of a much wider tradition concerned with the relationships between fiscal decentralisation and a series of economic and political goals, which was founded on the seminal work of Tiebout (1956), Stigler (1957), Musgrave (1959) and Oates (1972). In addition to economic growth *per se*, these goals included public spending efficiency, horizontal fiscal equity, controlling the government size, macroeconomic stability, fostering appropriate conditions in the markets and for government, and poverty reduction.

The main spur to the development of this new line of research has been the devolution process from central to lower tiers of government, a process that has taken place mainly in transitional and developing economies with the encouragement of various international bodies, particularly the World Bank. The intuition that these processes might not only affect the efficiency of public spending, horizontal fiscal equity and macroeconomic stability, comprising what might be called the traditional effects, but could also influence economic growth has led researchers at this and other international institutions to analyse this possible relationship.

The emergence or re-emergence of debate on the subject of fiscal decentralisation in numerous developed economies in recent decades has, meanwhile, motivated scholars to take up or continue this line of research. Consequently, the process holds a key place in the study of these economies with research focusing on the possible relationship with economic growth, one of the basic academic concerns of the 1990s.

A detailed review of the current state of research into the question of the relationship between fiscal decentralisation and economic growth is to be found in Martínez-Vázquez and McNab (2003). These scholars draw attention to the paucity of empirical work in this area, which contrasts sharply with the profusion of informal literature on the economic consequences of fiscal decentralisation. Moreover, they argue that a series of problems need to be overcome if we are to arrive at consistent

estimates of the relationship between fiscal decentralisation and economic growth and avoid accepting potentially erroneous results. At the same time, they highlight the need to develop the theoretical basis for the relationship further by answering the question of why we should expect fiscal decentralisation to have any effect on economic growth. The aim of this paper is precisely to contribute to this theoretical development.

Let us begin by clarifying the concept of fiscal decentralisation. We mean by this expression those processes by which policy is devolved from central to lower tiers of government, without specifying whether this refers to spending or revenue raising powers. Hence, when we wish to refer explicitly to the transfer of spending, we shall use the term “expenditure decentralisation”, and when devolution affects revenues either “revenue decentralisation” or “tax decentralisation”.

Martínez-Vázquez and McNab (2003) draw a clear distinction between the direct and indirect relationships between fiscal decentralisation and economic growth, indicating that it is the latter which may be identified via the traditional effects of fiscal decentralisation. In this paper, however, we shall concentrate on the direct relationship, which is clearly described in Oates (1993)¹, who transposes the essence of his proposition concerning the positive impact of fiscal decentralisation on economic efficiency to the dynamic sphere of economic growth, though without formal analysis. The economic efficiency proposition was developed within a static framework in Oates’ (1972) Decentralisation Theorem and was further reinforced with the population mobility arguments put forward by Tiebout (1956). Thus, regional and national economic growth could be increased if decisions concerning investment in different types of capital were taken at lower tiers of government, because of the greater local knowledge existing at these levels. With some exceptions, this argument has been taken as the starting point for the empirical and theoretical research undertaken between the second half of the 1990s and the present to study the existence of possible fiscal decentralisation effects on economic growth. This series of studies includes eminently empirical work seeking to quantify the effect, such as Woller and Phillips (1998), Zhang and Zou (1998), Lin and Liu (2000), Akai and Sakata (2002), Rodríguez-Pose and Bwire (2003), and Thiessen (2003), and papers that not only attempt to quantify the

¹ Nevertheless, other scholars of fiscal federalism also describe positive effects on economic growth. See, for example, Bahl and Linn (1992), Rivlin (1992), Bird (1993) and Gramlich (1993).

effect but also to construct a simple analytical model reflecting the relationship existing between the two phenomena. These include papers by Davoodi and Zou (1998), Xie, Zou and Davoodi (1999), Zhang and Zou (2001), and Martínez-Vázquez and McNab (2002). Finally, there is the work of Zou (1996), Brueckner (1999) and Gong and Zou (2002 and 2003), who focus exclusively, and therefore in greater detail, on the construction of the analytic framework.

Our aim here is to add to the latter group of papers, which is to say those that seek to establish an analytical framework that would describe as fully as possible the relationships existing between the phenomena of fiscal decentralisation and economic growth, and for this reason we shall concentrate on the pioneering work of Zou (1996), whose work has been at the forefront in the field. In this paper, the author identifies long-term effects from taxes and transfers on the accumulation of private and public capital in a representative region and, therefore, on economic growth. However, we observe what we consider to be two significant limitations in Zou's model.

The first is the partial consideration of central or federal government, which is assumed not to invest or spend on its own behalf within the region, but to act simply as a tax collector and provider of funding through transfers².

The second limitation in Zou (1996) is that it fails specifically to include a process for tax decentralisation, on the basis of which we might identify its effects on economic growth in the representative region in order to propose any explanatory hypothesis. Let us note here, that in modelling the fiscal decentralisation process within the framework of endogenous growth models the literature has hitherto concentrated on expenditure decentralisation to arrive at growth-maximising expenditure shares among different levels of government³, while disregarding any consideration of the effects of tax decentralisation on economic growth. It is this limitation, specifically in Zou (1996) and generally in the literature on the subject, that we seek to resolve in this paper.

² Gong and Zou (2003) and Gil (2003) propose expanding the model in order to overcome this limitation.

³ See, inter alia, Davoodi and Zou (1998), Xie, Zou and Davoodi (1999), and Zhang and Zou (2001).

The rest of this paper is structured as follows. Firstly, we briefly present the model described in Zou (1996) and explain key results. We then go on to describe how tax decentralisation might be included in the model and propose a hypothesis to explain the manner in which this process affects growth in the Spanish economy. We end with our conclusions and an indication of possible avenues to extend this research.

II. ZOU'S (1996) MODEL

In 1996, Heng-fu Zou, a World Bank researcher, published *Taxes, federal grants, local public spending, and growth*⁴. The paper considers a two-tier structure of local and federal government, each with their own income tax, a local consumption tax, intergovernmental transfers and balanced budgets. Based on this scenario, Zou describes a regional economic growth model for the accumulation of local private and public capital, allowing investigation of the manner in which changes in taxes and transfers affect the long-term equilibrium values for private consumption and the stock of private capital, as well as local public consumption and stock of capital. This analysis is based on two different preferences structures for a representative agent, the first including local public as well as private consumption as an argument in the utility function, and the second considering local public investment as well as public and private consumption. The latter structure was originally proposed by Arrow and Kurz (1970). The result is a dynamic system that assumes the federal government does not invest or consume on its own behalf in the region and therefore comprises four differential equations and the four endogenous variables reflecting local private and public consumption, and local private and public investment (c, E, k_p, k_s).

These equations are obtained on the basis of:

1. A utility function for the representative agent (productive family) in the representative region defined in accordance with the commonest preferences structure

⁴ This work was presented as the development and expansion of a previous paper, *Dynamic effects of federal grants on local spending*, published in 1994, which described a very partial dynamic analysis focusing on the effects of intergovernmental transfers on local public consumption and investment but assuming that tax revenues were constant and ignoring any effects on private sector's consumption and investment.

on the basis of private consumption (c) and local public consumption (E)⁵ such that intertemporal utility is given by:

$$\int_0^{\infty} [u(c) + v(E)] e^{-\rho t} dt, \text{ with } 0 < \rho < 1 \quad (1)$$

where ρ is a constant representing the intertemporal discount rate which, in the form it appears in the expression, reflects the preference for present as opposed to future consumption.

The utility function is increasing, concave and continuously differentiable, while its additive form simplifies the analysis but does not affect key results.

2. A production function for the representative agent, which is defined by two inputs, private capital (k_p) and local public capital (k_s):

$$y = y(k_p, k_s) \quad (2)$$

This is also an increasing, concave and continuously differentiable function, in which the two types of capital are complementary.

The production function also satisfies the Inada's conditions:

1. $y_i \rightarrow \infty$ as $k_i \rightarrow 0$
2. $y_i \rightarrow 0$ as $k_i \rightarrow \infty$

where y_i is the production function first derivative of k_i , with $i = p, s$.

These conditions guarantee that endogenous growth in the model is due to the existence of non decreasing returns on total capital.

⁵ As we have already explained, the author also considers a preferences structure including local public investment (k_s) as well as consumption in the utility function. However, he makes clear that this is not the most usual structure to be found in the literature and goes on to remark that this specification results in

In order to simplify subsequent analysis no capital depreciation is considered.

3. A federal government that collects an income tax from the private sector in the representative region at the rate τ_f in each period. Expenditures consist of two types of matching grants to the representative local government: a matching grant for local public investment (at the rate α , with $0 < \alpha < 1$) and a matching grant for local public consumption (at the rate β with $0 < \beta < 1$). The budget is balanced, such that:

$$\tau_f y = \alpha \dot{k}_s + \beta E \quad (3)$$

where \dot{k}_s is local public investment in the representative region for each period.

4. A representative local government that collects an income tax at the rate of τ_s on the private sector and a consumption tax at the rate τ_c on private consumption. Hence, total revenue of a typical local government will consist of these taxes plus the transfers received from the federal government, and its total expenditure will consist of local public consumption and local public investment. Once again, a balanced budget is assumed such that:

$$\tau_s y + \tau_c c + \alpha \dot{k}_s + \beta E = \dot{k}_s + E \quad (4)$$

Based on (3) and (4) Zou arrives at what he terms an integrated budget constraint for the local and federal governments, although this could in fact be defined simply as a local budget constraint in view of the structure of the model as regards the federal government:

$$\dot{k}_s = (\tau_s + \tau_f) y + \tau_c c - E \quad (5)$$

A budget constraint can now be defined for the representative agent, and this is given by the condition that the agent's income after tax is equal to total consumption and investment expenditures:

the disappearance of such desirable properties for the equilibrium of the resulting system as unity and stability.

$$(1 - \tau_f - \tau_s) y - \tau_c c = \dot{k}_p + c \quad (6)$$

where \dot{k}_p is private investment made by the representative agent in the period of time considered.

Reordering the terms, Zou obtains:

$$\dot{k}_p = (1 - \tau_f - \tau_s) y - (1 + \tau_c) c \quad (6')$$

In the manner of Barro and Sala-i-Martin (1995), he then goes on to address dynamic optimisation by the private agent and the representative local government. Both seek to maximise the well-being of the agent, taking into account their respective budget constraints, based on the respective control variables (local private and public consumption) and state variables (local private and public investment), thereby obtaining the four equations referred to above:

$$\dot{k}_p = (1 - \tau_f - \tau_s) y - (1 + \tau_c) c \quad (6')$$

$$\dot{k}_s = (\tau_s + \tau_f) y + \tau_c c - E \quad (5)$$

$$\dot{c} = \frac{u'(c)}{-u''(c)} [(1 - \tau_f - \tau_s) y_p - \rho] \quad (7)$$

$$\dot{E} = \frac{v'(E)}{-v''(E)} [\tau_s (1 - \alpha)^{-1} y_s - \rho] \quad (8)$$

Finally, Zou proves that the dynamic system, composed of these four equations, has a unique perfect foresight equilibrium.

Table 1 summarises the main results obtained by Zou. It reflects the effects of changes in the exogenous variables (federal income tax (τ_f), local income tax (τ_s), local consumption tax (τ_c), investment matching grants to the representative local government (α), and matching grants to the representative local government for public consumption (β) on the long-term equilibrium values of the endogenous variables: stock of private capital (\bar{k}_p), stock of public capital (\bar{k}_s), private consumption (\bar{c}) and local public

consumption (\bar{E}). These effects are studied for the two types of preferences assumed, which are private and local public consumption as factors in utility function (A), and private consumption, local public consumption and local public investment as arguments in utility function (B).

Table 1. Long-term effects of taxes and transfers. Zou (1996)

Exogenous variables										
Endogenous variables	τ_f		τ_s		τ_c		α		β	
	A	B	A	B	A	B	A	B	A	B
\bar{k}_p	-	-	?	?	0	+	+	+	0	-
\bar{k}_s	-	-	?	?	0	+	+	+	0	-
\bar{c}	-	-	?	?	-	?	+	+	0	-
\bar{E}	?	?	?	?	+	+	+	+	0	-

Source: Zou (1996)

Applying Zou's (1996) model under the commonest preferences structure (A), it may thus be affirmed that any increase in federal taxation has negative effects on long-term capital accumulation and therefore on economic growth; that the effect of an increase on the local income tax is indeterminate; that an increase in local public investment transfers will stimulate long-term economic growth; and that economic growth is not affected by changes in transfers for local public consumption. The complementary nature of private and local public capital is a determining factor for these results.

This paper is the first to propose a general equilibrium framework to analyse the effects of changes in taxation and grants on local economic growth. However, it has nothing explicit to say regarding the effects of a fiscal decentralisation process. In subsequent research, Davoodi and Zou (1998), Xie, Zou and Davoodi (1999), and Zhang and Zou (2001), also within the framework of endogenous growth, consider the possible effects of expenditure decentralisation arriving as we have said at growth-maximising expenditure shares among different levels of government. These turn out to be the ratios of individual productivity over the aggregate productivity of spending by different levels of government. Hence, if expenditure allocations do not coincide with these ratios, a simple reallocation can lead to higher economic growth without altering

the total budget share in GDP⁶. The effects of tax decentralisation on growth have yet to be investigated, and we shall address this issue in the next section using Zou's (1996) model as the framework.

III. ZOU'S (1996) MODEL AND TAX DECENTRALISATION

Leaving aside the local consumption tax (τ_c) for the sake of simplicity, and given that the exclusion of this tax does not alter the results we are interested in, our basic aim is to incorporate a process of tax decentralisation into the model and identify its effects on economic growth in the representative region. This process of tax decentralisation may be viewed as a gain for the tax autonomy of the region, insofar as the percentage of total local government funding obtained through federal government transfers will decline accordingly or, to look at the other side of the coin, because the percentage of total funding raised through the local income tax will rise.

In the first place, we need to define a tax decentralisation indicator. Starting from the representative local government budget constraint in Zou's (1996) model:

$$\tau_s y + \alpha \dot{k}_s + \beta E = \dot{k}_s + E \quad (4')$$

Dividing both terms by total expenditure ($\dot{k}_s + E$) and reordering the expression, we may obtain an indicator of the proportion of total local expenditure funded by own taxes ($\tau_s y$):

$$\tau_s y / (\dot{k}_s + E) = 1 - (\alpha \dot{k}_s + \beta E) / (\dot{k}_s + E) \quad (9)$$

Let us call this indicator Φ .

If we consider that equal percentages are transferred for local public consumption and investment ($\alpha = \beta$), the tax decentralisation indicator would be reduced to the expression:

⁶This result was obtained using CES and Cobb-Douglas technologies.

$$\tau_s y / (\dot{k}_s + E) = 1 - \alpha \quad (9')$$

which is to say,

$$\Phi = 1 - \alpha \quad (9'')$$

Hence, if we wish to study the effects of a tax decentralisation process on Zou (1996), we need to consider a reduction in transfers from federal to local government (α). As a consequence, the federal government will reduce its tax rate (τ_f), assuming same level of income, because of the fall in the cost of transfers. If the local government wishes for its part to maintain its level of expenditure, it will need to respond with an increase in the tax rate (τ_s) to offset the decline in the funds transferred.

On the other hand, empirical studies described in a large literature following Gramlich (1977) suggest that in general one monetary unit received in the form of transfers results in an increase in regional public expenditure that is greater than the increase generated in such expenditure by an increase of one monetary unit in regional income due to a federal tax cut. This phenomenon has been labelled as the *flypaper effect* because, according to the studies cited, money tends to “stick” in the first sector (public or private) where it “lands”⁷.

In order to consider the *flypaper effect* in the model, let us denote τ to be total income tax rate when local public expenditure is financed exclusively through transfers. So, we have:

$$\tau_f = \tau \quad (10)$$

If local public expenditure is financed exclusively through local taxes we have, in turn:

$$\tau_s = \tau (1 - \varepsilon), \quad 0 \leq \varepsilon \leq 1 \quad (11)$$

⁷ Explanation of the *flypaper effect* is highly debated: see Bailey (1999), chapter 11.

where ε would be an indicator of the intensity of the *flypaper effect*. So, for a level of tax decentralization, Φ , we have:

$$\tau_f = \alpha \tau [1 - \varepsilon (1 - \alpha)] \quad (12)$$

$$\tau_s = (1 - \alpha) \tau [1 - \varepsilon (1 - \alpha)] \quad (13)$$

$$\tau_f + \tau_s = \tau [1 - \varepsilon (1 - \alpha)] \quad (14)$$

Incorporating the definition of a tax decentralisation indicator and the existence of the *flypaper effect* and excluding the local consumption tax, Zou's (1996) model could be reformulated as follows:

$$\int_0^{\infty} [u(c) + v(E)] e^{-\rho t} dt, \text{ with } 0 < \rho < 1 \quad (1)$$

$$y = y(k_p, k_s) \quad (2)$$

$$\tau_f y = \alpha (\dot{k}_s + E) \quad (3')$$

$$\tau_s y = (1 - \alpha) (\dot{k}_s + E) \quad (4'')$$

Hence, the regional government and individual constraints are:

$$\dot{k}_s = \tau [1 - \varepsilon (1 - \alpha)] y - E \quad (5')$$

$$\dot{k}_p = [1 - \tau [1 - \varepsilon (1 - \alpha)]] y - c \quad (6'')$$

Dynamic optimisation by the private agent and the representative local government is thus described by the following system of equations:

$$\dot{k}_p = [1 - \tau [1 - \varepsilon (1 - \alpha)]] y - c \quad (6'')$$

$$\dot{k}_s = \tau [1 - \varepsilon (1 - \alpha)] y - E \quad (5')$$

$$\dot{c} = \frac{u'(c)}{-u''(c)} [[1 - \tau [1 - \varepsilon (1 - \alpha)]] y_p - \rho] \quad (7')$$

$$\dot{E} = \frac{v'(E)}{-v''(E)} [\tau [1 - \varepsilon (1 - \alpha)] y_s - \rho] \quad (8')$$

It is clear that this system has a single equilibrium and following Buiter (1984), as Zou (1996) does, it can be shown that this equilibrium is stable.

Let us now go on to examine the equilibrium at the two extremes of tax decentralisation: there is no tax decentralisation (i.e. all local government funds are obtained through transfers), and complete tax decentralisation (i.e. all local government funds are obtained from local income tax). In order to compare the two scenarios and determine the effects of the tax decentralisation process on regional economic growth, we shall consider the Cobb-Douglas production technology. The result obtained is then generalized for any change in the level of tax decentralisation without the need to consider extreme situations.

A) Null tax decentralisation, $\Phi = 0$

In this situation, the system formed by equations (6''), (5') (7') and (8') is as follows:

$$\dot{k}_p = (1 - \tau) y - c \quad (15)$$

$$\dot{k}_s = \tau y - E \quad (16)$$

$$\dot{c} = \frac{u'(c)}{-u''(c)} [(1 - \tau) y_p - \rho] \quad (17)$$

$$\dot{E} = \frac{v'(E)}{-v''(E)} [\tau y_s - \rho] \quad (18)$$

with the following in the equilibrium:

$$(1 - \tau) y (\bar{k}_p, \bar{k}_s) - \bar{c} = 0 \quad (19)$$

$$\tau y (\bar{k}_p, \bar{k}_s) - \bar{E} = 0 \quad (20)$$

$$(1 - \tau) y_p (\bar{k}_p, \bar{k}_s) - \rho = 0 \quad (21)$$

$$\tau y_s (\bar{k}_p, \bar{k}_s) - \rho = 0 \quad (22)$$

where \bar{k}_p , \bar{k}_s , \bar{c} and \bar{E} denote steady state variable values and the exogenous variables are τ and ρ .

Considering that the production function takes a Cobb-Douglas form such that

$$y = A k_p^\gamma k_s^\eta \quad (23)$$

where $0 < \gamma < 1$, $0 < \eta < 1$, and $\gamma + \eta = 1$

the equilibrium (19) – (22) is as follows:

$$(1 - \tau) A \bar{k}_p^\gamma \bar{k}_s^\eta - \bar{c} = 0 \quad (19')$$

$$\tau A \bar{k}_p^\gamma \bar{k}_s^\eta - \bar{E} = 0 \quad (20')$$

$$(1 - \tau) \gamma y / \bar{k}_p - \rho = 0 \quad (21')$$

$$\tau \eta y / \bar{k}_s - \rho = 0 \quad (22')$$

Working out \bar{k}_p and \bar{k}_s from (21') and (22'), we obtain:

$$\bar{k}_p = (1 - \tau) \gamma y / \rho \quad (21'')$$

$$\bar{k}_s = \tau \eta y / \rho \quad (22'')$$

B) Full tax decentralisation, $\Phi = 1$

In this case, the system formed by equations (6''), (5') (7') and (8') is as follows:

$$\dot{k}_p = [1 - \tau (1 - \varepsilon)] y - c \quad (24)$$

$$\dot{k}_s = [\tau (1 - \varepsilon)] y - E \quad (25)$$

$$\dot{c} = \frac{u'(c)}{-u''(c)} [[1 - \tau (1 - \varepsilon)] y_p - \rho] \quad (26)$$

$$\dot{E} = \frac{v'(E)}{-v''(E)} [[\tau (1 - \varepsilon)] y_s - \rho] \quad (27)$$

with the following in the equilibrium:

$$[1 - \tau (1 - \varepsilon)] y (\bar{k}_p, \bar{k}_s) - \bar{c} = 0 \quad (28)$$

$$[\tau (1 - \varepsilon)] y (\bar{k}_s + \bar{E}) - \bar{E} = 0 \quad (29)$$

$$[1 - \tau (1 - \varepsilon)] y_p (\bar{k}_p, \bar{k}_s) - \rho = 0 \quad (30)$$

$$[\tau (1 - \varepsilon)] y_s (\bar{k}_p, \bar{k}_s) - \rho = 0 \quad (31)$$

where \bar{k}_p , \bar{k}_s , \bar{c} and \bar{E} denote steady state values and the exogenous variables are τ , ε and ρ .

Since the production function takes the specific Cobb-Douglas form reflected in (23), the equilibrium (28) – (31) is as follows:

$$[1 - \tau (1 - \varepsilon)] A \bar{k}_p^\gamma \bar{k}_s^\eta - \bar{c} = 0 \quad (28')$$

$$[\tau (1 - \varepsilon)] A \bar{k}_p^\gamma \bar{k}_s^\eta - \bar{E} = 0 \quad (29')$$

$$[1 - \tau (1 - \varepsilon)] \gamma y / \bar{k}_p - \rho = 0 \quad (30')$$

$$[\tau (1 - \varepsilon)] \eta y / \bar{k}_s - \rho = 0 \quad (31')$$

Working out \bar{k}_p and \bar{k}_s from (30') and (31'), we obtain:

$$\bar{k}_p = [1 - \tau (1 - \varepsilon)] \gamma y / \rho \quad (30'')$$

$$\bar{k}_s = [\tau (1 - \varepsilon)] \eta y / \rho \quad (31'')$$

C) Comparison of the scenarios

Given Zou's (1996) model, the results we have obtained for the equilibrium values of the two types of capital for a Cobb Douglas technology considering the two extremes of tax decentralisation are as follows:

$$\underline{\Phi = 0}$$

$$\bar{k}_{pN} = (1 - \tau) \gamma y / \rho$$

$$\bar{k}_{sN} = \tau \eta y / \rho$$

$$\underline{\Phi = 1}$$

$$\bar{k}_{pF} = [1 - \tau (1 - \varepsilon)] \gamma y / \rho$$

$$\bar{k}_{sF} = [\tau (1 - \varepsilon)] \eta y / \rho$$

It may be observed that the stocks of equilibrium for the two types of capital (\bar{k}_p, \bar{k}_s) are different. Specifically, if we move from a situation of null tax decentralisation ($\Phi = 0$) to full tax decentralisation ($\Phi = 1$), the long-term equilibrium values for private and local public capital undergo the following changes:

$$dk_p = \gamma \tau y \varepsilon / \rho \quad dk_s = -\eta \tau y \varepsilon / \rho \quad (32)$$

since

$$dy / dk_p = y_p = \gamma y / k_p \quad \text{and} \quad dy / dk_s = y_s = \eta y / k_s$$

we have

$$dy_{kp} = (\gamma y / k_p) dk_p = (\gamma y)^2 \tau \varepsilon / k_p \rho$$

$$dy_{ks} = (\eta y / k_s) dk_s = -(\eta y)^2 \tau \varepsilon / k_s \rho$$

Considering both expressions together, we obtain:

$$dy = [y^2 \tau \varepsilon / \rho] [(\gamma^2 / k_p) - (\eta^2 / k_s)] \quad (33)$$

Since the first of the expressions in square brackets in this equation is positive, we may conclude that in Zou's (1996) model a tax decentralisation process represented by the switch from $\Phi = 0$ to $\Phi = 1$ would generate economic growth provided that:

$$[(\gamma^2 / k_p) - (\eta^2 / k_s)] > 0$$

or that

$$\gamma / \eta > \sqrt{k_p / k_s} \quad (34)$$

D) Generalization of the result

Let us now assume that our starting point is a given level of tax decentralisation measured by $\Phi_1 = 1 - \alpha_1$ and we wish to reach a level of $\Phi_2 = 1 - \alpha_2$, such that $\Phi_1 < \Phi_2$ or $\alpha_1 > \alpha_2$, which is the same thing. Proceeding in the same manner as for the extreme scenarios, we may obtain the expression:

$$dy = [y^2 \tau \varepsilon (\alpha_1 - \alpha_2) / \rho] [(\gamma^2 / k_p) - (\eta^2 / k_s)] \quad (35)$$

where the magnitude of the first term in square brackets, which remains positive, depends on the intensity of the process of tax decentralisation. This magnitude will reach its maximum for the greatest possible progress, which is reflected in the case of the switch from null tax decentralisation ($\Phi_1 = 0$ or $\alpha_1 = 1$) to total tax decentralisation ($\Phi_2 = 1$ or $\alpha_2 = 0$) considered above, from which we have obtained expression (33).

The term in the second set of square brackets remains the same as in (34), which confirms the idea that a process of tax decentralisation would generate long-term economic growth if the private and regional public capital productivities ratio exceeds the radicand of the coefficient between the stock of private capital and the stock of local public capital.

Let us turn now to study the case of the Spanish economy on the basis of data obtained from Fundación Banco Bilbao Vizcaya Argentaria (FBBVA) and Instituto

Valenciano de Investigaciones Económicas (IVIE) for the stock of non residential private capital and the stock of public capital (used to approximate the stock of local public capital, because this is the only type of public capital existing in the structure of the model since central government does not make any investments of its own in the region) and Instituto Nacional de Estadística (INE) data for the remaining variables. This provides average values for the stock of non residential private capital per head and the stock of public capital per head over the period 1971 – 1997. Let us now perform simple estimations of the productivity of these types of capital for the period in accordance with the specification of the production function, as a result of which we obtain the following results (base year 1986)⁸:

$$k_p = \text{€}12,537 \quad k_s = \text{€}2,386 \quad \gamma = 0.79 \quad \eta = 0.21$$

Hence, per (34) we have

$$\gamma / \eta = 3.76 > \sqrt{\frac{k_p}{k_s}} = 2.29$$

Hence, our hypothesis based on the model proposed in this paper is that going deeply into the process of tax decentralisation in the Spanish economy would produce long-term growth. Our next objective is to verify this hypothesis empirically.

IV. CONCLUSIONS

Taking as our starting point the analysis of Zou (1996), one of the leading scholars to study the existence of a direct relationship between fiscal decentralisation and economic growth, we have identified two limitations in the model, which we have sought to resolve in order to contribute to the examination of the relationship. Having addressed the first of these limitations in an earlier paper, this paper concentrates on the need to incorporate a tax decentralisation process and examine its effects on economic growth in a representative region. By including this process in Zou's (1996) model, we have been able to define a relationship that determines the effect of tax decentralisation on regional economic growth. We have evaluated this relationship for the Spanish

⁸ We acknowledge Jaime Sanaú Villarroya for providing these estimations.

economy as a whole, as a result of which we have arrived at a hypothesis in line with our proposal that progress in tax decentralisation does in fact contribute to long-term growth in the Spanish economy.

After modelling not only expenditure decentralisation (Davoodi and Zou (1998), Xie, Zou and Davoodi (1999), and Zhang and Zou (2001)) but also tax decentralisation, one possible avenue for the expansion of this research with regard to the further development of the theoretical basis for the relationship between fiscal decentralisation and economic growth would be to combine both phenomena in a single model. From an empirical standpoint, further research will be required to verify our hypothesis in relation to the Spanish economy.

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