

**ELASTICITIES OF REGIONAL AND LOCAL  
ADMINISTRATION EXPENDITURES  
THE PORTUGUESE CASE**  
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***Abstract.***

This work analyzes the evolution of real public expenditures of local and regional administrations (LRA), in Portugal, in the period after the Second World War. It also aims to estimate the elasticities associated to determinants, which explain the found growth. As most relevant results, it is focused that real public expenditures of LRA did not increase in a constant way – the most significant period of growth was between 1974 and 1990. A long-term relation was found among real public expenditures of LRA (as a proportion of real Gross National Product), the Number of Employees in Public Administration, the Number of Unemployed and Public Revenues. These results are consistent with modern versions of Wagner's Laws, with the role of lobbying groups and with the bureaucracy being a source of discouragement referring to the decentralized public expenditures.

JEL Codes: H50; H54; H72; C13

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**1. Introduction**

How did a decentralized public expenditure in Portugal develop after the Second World War? And why? These questions are the beginning of the following discussion. The study of the evolution of national public expenditures has received the focus from some researchers such as, for example, André and Delorme (1978), Beck

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(1981), Musgrave and Musgrave (1980), Trotman-Dickenson (1996), Rosen (1998), Demirbas (1999) or Jackson, Fethi and Fethi (1999). We can point Carreira (1989), Silva and Neves (1992), Afonso (2000) or Bronchi (2003) being some analysts for the Portuguese aggregates.

The major contribute of this work is to give evidence to the fact that a decentralized public outlay of Portugal – the real public expenditures of local and regional administrations (LRA) - had distinct phases of growth but, mainly, to show that determinants of this evolution can be explained. These determinants are the Number of Unemployed, the Number of Public Administration Employees and Public Revenues. For the study of the first suggestion (which consists in the heterogeneous development of real public expenditures of Portuguese LRA), I used a Markov Switching Model, which is a method used for identifying structural breaks in time series. For testing the long-term relation among the introduced determinants and real public expenditures of LRA, as a ratio of Portuguese real Gross National Product (GNP), I used the traditional framework of proceedings to evaluate the cointegration relation among economic variables. Via the Long Series of the Bank of Portugal data, observed between 1947 and 1995 and via the series of the Public Administration Sector Account, I intended to appreciate the evolution of the Portuguese real public expenditures of LRA and to find evidence favoring some determinants suggested by the Economic Literature. Some theories are introduced to explain the growth of public expenditures. We can report them in two groups: Theories of the growth of public expenditures because of movements on Demand or, alternatively, on Supply of the goods and services provided by the Government. For testing the significance of the long term relation among some economic variables pointed by the two groups of researchers, I appealed to a Model derived from Median Voter Theory, developed by Kirchgässner and Pommerehne (1997). This work is organized as the following: Section 2 is composed by a conceptual framework; Section 3 explains the application of the Markov Switching Model, introducing data and some results; Section 4 synthesizes the major theories which try to explain the growth of public expenditures; in Section 5 it will be inserted the discussion

influenced by the Median Voter Theory, describing data, the purposed Methodology and the returned estimations; Section 6 presents the conclusion.

## **2. A Conceptual framework**

In the last 50 years, many countries have been characterized by the phenomenon of the growth of their public expenditures. However, it is particularly necessary to define the phenomenon and to specify the object of this work. The phenomenon is restricted to an analysis on the evolution of the Portuguese real public expenditures of Local and Regional Administrations (LRA), between the years 1947 to 2002. These temporal limits focus on the period after the Second World War to nowadays (beginning of the Twenty-First century). The object of this study is identified with an economic aggregate – the real public expenditures of LRA– that can be described as the global amount of deflated expenditures spent by decentralized instances of Portuguese public administration. The Long Series of the Bank of Portugal and the Public Administration Sector Account provided data. Without intending to give an exhaustive list of authors, we can find some national studies on the growth of public expenditures, for example, by Trotman-Dickenson (1996) who gave attention to the English reality. Musgrave and Musgrave (1980), Rosen (1998) or Beck (1981) studied the Public Expenditures of the United States of America. Other European studies were developed by André and Delorme (1978), who analyzed the evolution of French Public Outlays, by Demirbas (1999), who observed the Turkish aggregates, or by Jackson *et al.* (1999) who studied the Northern Cyprian expenditures. In Portugal, we can cite Medina Carreira (1989), Silva and Neves (1992), Afonso (2000) or Bronchi (2003), among many others. Alternatively, for example, we can find Manasan (1985), who analyzed the public finances of Philippines. In general, only after 1985, different indicators assumed a stabilization of the growth of public expenditures.

Analyzing Figures A1, A2, A3 and A4, we find four representations that express the evolution of the logs of the following Portuguese public expenditures series: Total LRA Expenditures in

nominal terms, Total LRA Expenditures in real terms, percentual relation between nominal Total LRA expenditures and nominal Gross Nominal Product, and percentual relation between real Total LRA expenditures and real Gross Nominal Product. According to Musgrave and Musgrave (1980) and Beck (1981), Portuguese Public Expenditures were deflated by a calibrated average between Public Consumption Deflator Index and Private Consumption Deflator Index. As usually, its own index deflated nominal Gross Domestic Product. Due to the suggested development and according to Herber (1971), we are tempted to graphically recognize Wagner's Hypothesis: under pre or post industrialization efforts, the growth of public expenditures has slower rates than those related to periods characterized by vigorous industrialization. In these periods of strong industrialization, Government's expenditures try to follow efforts of the private sector. However, Wagner's Hypothesis, according to this suggestion, purposes an "S" curve. Watching the first figure (A1), it seems that, between 1947 and 1975 and between 1992 and 2002, the public expenditures aggregate has been defined by slower growth rates than those observed between 1975 and 1992. We can deparure this suggestion using the real public Expenditures of LRA whose representation highlights some inflexion points, associated to the observations of the middle of 1970, reported by the lectures on graphics A3 and A4 (percentual relation between nominal and real total public expenditure and, respectively, nominal and real gross nominal product). Annual average growth rates of the Portuguese LRA public expenditures, between 1947 and 2002, are: 13,09% (nominal series), 5,51% (real series), 1,74% (percentual relation between nominal LRA expenditures and nominal GDP) and 1,60% (percentual relation between real expenditures of LRA and real GDP).

### **3. Theories on the growth of Public Expenditure: a synthesis**

At this point, it is relevant to insert a question: What has been causing these movements? For answering, we can suggest a summary of some theories on the growth of Public Expenditures. These theories will be divided into two groups: the first group puts the pressure on demand side (and it accepts the hypothesis of decision-

makers who just react to exogenous factors) and the second group puts the pressure on supply side (and they are based on the hypothesis that public decision-makers collect expected effects from public expenditures management). The determinants, that immediately follow, belong to the group of the Demand-side ones: the social transformation between a society based on primary activities (as agriculture or fishery) and a society with the rising of the industrial sector; the higher income elasticities that can characterize public goods; the “Displacement Effects”; the redistribution processes; the “fiscal illusion”; and the role of lobbying groups. However, there remains a set of determinants related to the presupposition that the strongest focus on the public growth expenditures should be put on Supply-Side. A list of them is the following: the inelastic demand of public goods; the temporal distance between electoral moments; the economic cycle; the absence of precise knowledge of budget consequences; the bureaucratic preferences; the ideological differences (of “right” or “left” parties); the centralized public decisions; and the budgetary decision process. The complete justification for this presentation can be found in Mourão (2005).

#### **4. The behaviour of real public expenditure of LRA in Portugal: some evidence through a Markov-Switching Model.**

According to Peacock and Wiseman (1961), Public Expenditures can suffer structural shifts. Some political or socio-economic events can be behind these deep changes in the historical path of the series of public expenditures. But according to Wildavsky (1964), it is possible to identify phases in the growth rates of public outlays. This is so because decision-makers prefer to manage public expenditures with slow differences from one period to another. To test these theories, I will work with a Markov-Switching Model. The reasons that justify this choice are related to the statistical relevance of this method of analyzing time series; on the other side, the inclusion of *dummies* identifying periods of political prominence or structural breaks is only one example of alternative (and more adventurous) methods for this purpose.

The analysis of structural shifts in a time series context is due to authors like Quandt (1958), Goldfeld and Quandt (1973). According to Maddala and Kim (1998), Quandt

(1958) has begun with a dichotomic suggestion that was used to describe a time series. Goldfeld and Quandt (1973) purposed the introduction of constant transition probabilities between two different regimes, which could characterize a series, incorporating the concept of *markov chain*. However, this sort of *Markov switching regressions* became more popular after Hamilton's (1989) seminal work.

In Hamilton (1989), the phases ("regimes") of contraction or expansion are modeled as switching regimes of the inherent stochastic process:

$$\Delta y_t - \mathbf{m}(s_t) = \mathbf{a}_1(\Delta y_{t-1} - \mathbf{m}(s_{t-1})) + \dots + \mathbf{a}_2(\Delta y_{t-4} - \mathbf{m}(s_{t-4})) + u_t \quad (1)$$

In (1), these two regimes are defined by two different conditional distributions of the growth rate of real output ( $\Delta y_t$ ), where  $\mathbf{m}$ , the mean growth rate, is depending on the state  $s_t$ . So,  $\mathbf{m}_1$  is expected to be negative (contraction) and  $\mathbf{m}_2$  is expected to be positive (expansion). In his original work, Hamilton (1989) used a unique variance of the disturbance term, independently of the regimes,  $u_t \sim NID(0, \mathbf{S}^2)$ . An ergodic *Markov chain* generates the stochastic process. This ergodic Markov chain is defined by the transition probabilities (2):

$$p_{ij} = \Pr(s_{t+1} = j | s_t = i) \sum_{j=1}^M p_{iz} = 1 \quad \forall i, j \in \{1, \dots, M\} \quad (2)$$

With a two-regime business cycle, there are two transition probabilities:  $p_{12} = \Pr(\text{recession in } t | \text{expansion in } t-1)$   $p_{21} = \Pr(\text{expansion in } t | \text{recession in } t-1)$ . These transition probabilities should be estimated together with the parameters of equation (1), as stated by Krolzig (2001). For this aim, we can appeal to the Expectation-Maximization algorithm that was discussed by Hamilton (1990). To analyze the regimes that characterize the evolution of the Portuguese LRA real expenditures, between 1947 and 2002, firstly, I extracted the global data from the Long Series of the Bank of Portugal until 1995 and, after this period, from the Public Administration Sector Account in the Portuguese Estate Budget.

After the data collection, the (nominal) series were deflated, using the contribution of Musgrave and Musgrave (1980) and Beck (1981) where the global expenditures suffer the effect of a calibrated average between the deflators of public and private consumption. At last, the logs of real series were first-differenced to create a new series: the growth rate of Portuguese LRA real expenditures. To select the number of lags included in a *markov switching regression*, it is preferred to minimize the returned values by the Akaike Information Criteria (AIC), Hanna-Quinn Criteria (HQ) or Schwarz Bayesian Information Criteria (SC). The Table A1 synthesizes the results according to different number of lags (from 0 to 5). Observing Table A1, no lags will be included in the regression. To discuss the correct number of regimes, Ang and Beckaert's (1998) suggestion was followed. According to these authors, we can use the distribution  $\chi^2(q)$  to test the validity of some restrictions, where  $q$  is identified with the number of restrictions to be tested. Usually, the restrictions are formulated to test the equivalence between two means or between two variances, parameters associated to different regimes.

Testing two restrictions (equivalence between the means and between the variances of two states), I got a value of 8,85. According to this value, we can reject the null hypothesis of a single regime (the associated *p-value* is 1,19%). In the sequence of these tests, the series associated to the growth rates in the real public expenditures of LRA (DDTOTR) will be suggested by a *Markov Switching Model* with state-dependent mean and variance. This model has two regimes and no lags of the regressand are included as regressors:

$$DDTOTR_t - \mathbf{m}(s_t) = u_t \quad u_t \sim NID(0, \mathbf{d}_{s_t}^2) \quad (3)$$

The estimated parameters of the model (3) are shown in Table A2. The estimation of parameters and the figures A1 and A2 were brought in from MSVAR module, version 1.3, for Ox v.3.3. The regime-associated probabilities are referred in Figure A1 panels. The filtered probability can be understood as an optimal inference on the state variable (identifying a contraction or an expansion phase) at time  $t$  getting the information up to time  $t$ :  $Pr(s_t / y_1, \dots, y_t; \mathbf{q})$

The smoothed probability gives the optimal inference on the regime at time  $t$  considering the full sample information:  $Pr(s_t / y_1, \dots, y_T; \mathbf{q})$ . The set of population parameters,  $\mathbf{q}$ , is identified with:

$$\mathbf{q} = (\mathbf{m}_1, \mathbf{m}_2, \mathbf{s}_1, \mathbf{s}_2, p_{11}, p_{22})$$

However,  $\theta$  collects the information concerning the regimes: which means, standard deviations and persistence probabilities. From an integral lecture on Figure A1 and on data present in Table A2 we can suggest that the growth rates of the real public expenditures of Portuguese LRA, in the last 54 years, had two states. Regime 1 (low rates) was found between 1948 and 1972 and between 1989 and 2002. This phase has a mean growth rate of about 4,58%. Regime 2 (high rates) took place between 1973 and 1988 with a mean growth rate of 7,46%. The respective standard errors associated to states 1 and 2 are 0,053 and 0,115.

In following periods, some political events marked the course of Portugal: 1) From 1961 until 1975, Portugal was involved in a military conflict, against independentist forces from the actual States of Angola, Mozambique, Guinea-Bissau, S. Tomé and Príncipe and Cabo Verde. These States were then recognized as Ultramarine Provinces. 2) The Economic Development Policy, during the decade of 1960, had a special vigour in the “Planos de Fomento”, macro programs organized for five years that were obligatory to the Public Sector and relating to the Private Sector, evolving the modernization of Central and Local Public Administrations and the building of some important infrastructures (roads, airports and hydroelectric centrals). 3) In 1974, a political revolution, started by a military coup on 25<sup>th</sup> April, substituted the II Republic, the Corporative, for the (actual) III Republic, the Democratic. 4) At the end of the 1970-decade, the International Monetary Fund acts on the Portuguese financial situation, imposing restrictions on the performance of the public finances. This fact marks the beginning of a period of slow growth rates in the aggregate of the public expenditures. 5) Since 1986, Portugal became part of the European Economic Community. This fact had accentuated the interdependence of public finances aggregates, as public expenditures, in an International context.



Since 1974, partisans disputing electoral moments have characterized the democratic experience. But the simple visualization on Figures A1, A2, A3 or A4 does not seem to suggest significant political influences on DDTOTR. We point this observation based on the absence of structural shifts in the series, caused by electoral moments, since 1980. A possible hypothesis of justification is found in the preferred classification of real public expenditures of LRA. Due to the economic classification, it is very difficult to identify shifts in the series. If functional or organic classifications were preferred we could expect different perceptions motivated by electoral moments (for example, we could verify if there is some revealed preference on public administration expenditures from one partisan). Combining the evidence, the period of higher growth of this series starts with the transition period between the two models of Republic Systems (1974-1976), and it was delayed until the end of the decade of 1980, where we can recognize the influence of the European integration, with other sources of challenges to national budgetary policies. The transition matrix ( $P_{ij}$ ) is given by

$$P_{ij} = \begin{bmatrix} 0,954 & 0,0461 \\ 0,107 & 0,893 \end{bmatrix}$$

So, we expect that State 1 has a prevalence of 22 years while State 2 remains, on average, during 9 years. This duration is calculated by  $1/(1-p_{ii})$ . According to these results, we confirm the influence of special moments in the growth rates of real public expenditures of LRA (as stated in the original contribution from Peacock and Wiseman (1961)). These special moments are mainly related to the political context that involved the period of transition between the two Republic Systems, period started in 1974. But we also find evidence supporting Wildavsky (1964) because we can identify phases in the growth rates. This opportunity leads us to recognize that political decision-makers prefer to introduce small changes in the volume of public expenditures of LRA, year after year. Observing the Figure A6, the desired statistical properties of the estimated residues can be induced. So, we confirm the absence of significant residual autocorrelation and the absence of residual non-normality.

## 5. The Model of Median Voter as a suggestion of the elasticities of real public expenditures of LRA

After these studies, two questions remain: 1) Is there a long-term relationship among real public expenditures of LRA and a set of explicative variables? 2) - And if there is, what are the estimated elasticities? In an Economic context, the notion of elasticity suggests the response of a variable to percentual changes in another variable, *coeteris paribus*. According to Greene (2003), the estimation is often purposed by log-linear models. To describe the behaviour associated to a political decision-maker, I will suggest a model related to the discussion involving the median voter, as stated by Kirchgässner and Pommerehne (1997). So that a political decision-maker – a government or the median voter – wants to maximize the utility associated to the following objective function:

$$U = U(x, q, Tr, T, D) \quad (3)$$

with  $x$  designating the private set of disposable goods and services,  $q$  the public acquirable basket of goods and services,  $Tr$  the Public Transfers to the private sector,  $T$  the Public Revenues and  $D$  the Public Deficit. The Marginal Utilities are positive for  $x$ ,  $q$  and  $Tr$ ;  $T$  and  $D$  have negative marginal utilities. We have to fulfill two restrictions. The first one synthesizes the Gross National Product ( $Y$ ):

$$Y = x * p_x + q * p_q \quad (4)$$

$p_x$  and  $p_q$  are, respectively, two variables associated to the private consumption price index and to the public consumption price series.

The second restriction is the popular budget constraint:

$$q * p_q + Tr * p_{Tr} - T * p_T - D * p_D = 0 \quad (5)$$

where  $p_{tr}$ ,  $p_t$ , and  $p_d$  are respectively identified with the valorizations given to the Transfers, to the Public Revenues and to the Budget value. In the median voter discussion it is usual to develop the model starting by an indirect utility function:

$$V = V(p_x, p_q, p_{Tr}, p_T, p_D, Y) \quad (6)$$

This indirect function has the following expected marginal utilities:

$$V_{p_x} < 0 \quad (7) \quad V_{p_q} < 0 \quad (8) \quad V_{p_{tr}} < 0 \quad (9)$$

$$V_{p_t} > 0 \quad (10) \quad V_{p_d} > 0 \quad (11) \quad V_y > 0 \quad (12)$$

The indirect utility function will be maximized according to (5) and respecting the transformed constraint (13):

$$q * \frac{P_q}{Y} + Tr * \frac{P_{Tr}}{Y} - T * \frac{P_T}{Y} - D * \frac{P_D}{Y} = 0 \quad (13)$$

As a solution, a “system of demand functions” is returned, specifically, an *AIDS* (“Almost Ideal Demand System”), which has ratios assuming the variables:

$$s_i = a_i + b_i * \ln\left(\frac{Y}{P^*}\right) + \sum_{j=1}^4 g_{ij} * \ln\left(\frac{P_j}{P_5}\right) + \sum_{j=1}^k d_{ij} * z_j \quad (14)$$

where  $p_1=p_q$ ,  $p_2=p_{Tr}$ ,  $p_3=p_T$ ,  $p_4=p_D$  and  $p_5=p_x$ .  $P^*$  is assumed as the Gross National Product Price Index. The variables  $z_j$  are explicative variables of the decisions in public budget. Additionally, there are some restrictions in order to offer a solution to the *AIDS*:

$$a_1 + a_2 - a_3 - a_4 = 0 \quad (15)$$

$$b_1 + b_2 - b_3 - b_4 = 0 \quad (16)$$

$$g_{1j} + g_{2j} - g_{3j} - g_{4j} = 0, j = 1, \dots, 4 \quad (17)$$

$$d_{1j} + d_{2j} - d_{3j} - d_{4j} = 0, j = 1, \dots, k \quad (18)$$

$$a_1 + a_5 = 1 \quad b_1 + b_5 = 0 \quad (19) \quad (20)$$

$$g_{1j} + g_{5j} = 0, j = 2, \dots, 5 \quad (21)$$

$$d_{1j} + d_{5j} = 0, j = 1, \dots, k \quad (22)$$

According to the Demand Theory, the symmetry between the coefficients associated to the relative prices can be suggested as

$$g_{ij} = g_{ji}, i, j = 2, \dots, 5 \quad (23)$$

We can also conceive that the fluctuation of prices, concerning Transfers, Taxes and the Deficit, is equivalent:

$$p_i = p_j, i, j = 2, 3, 4 \quad (24)$$

However, as interesting prices in this *AIDS*, we have  $P^*$ ,  $p_q$  (public consumption price index) and  $p_x$  (private consumption price index). These equivalences (15-24) reduce the complexity in the system. Now, we are able to estimate the elasticities of the set of suggested exogenous variables in a model where real public expenditures of LRA of Portugal are the regressand. For this purpose, I focused on

some of the theories cited in the Section 3 (and relating to the frequency of testing in contexts of local and regional public administration). They are the Wagner's Laws (because the development process may be related to the growth of public expenditures of LRA), the Redistribution processes, the lobbying crowds and the bureaucracy as causes for the movement. The set of exogenous variables is composed by the following:

-*Real Gross National Product* (usually, this variable appears as exogenous in models in which Wagner's Hypotheses are tested; it is expected that the estimated coefficient returns positive values);

-*Number of Unemployed people* (this variable can be interpreted, simultaneously, as a target-group of redistributive public pretensions and as a lobbying crowd; it is not sure that the estimated coefficient is characterized by positive amounts, what could induce a complementary relation between real public expenditures of LRA and national current transfers (or a pro-cyclical behaviour of the regressand); if a negative signal characterizes the estimated coefficient, it can be due to an inherent relation of substitutability or to a counter-cyclical movement of public expenditures of LRA);

-*Number of Employees in Public Administration* (this variable is tested for analyzing the power of bureaucracy as an explanatory variable in the growth of expenditures; as verified with the Number of Unemployed people, there is not an unique direction of the predictable signal of the estimated coefficient);

-*Public Revenues* (According to Barbosa (1997), as another instrument of Budgetary Policy, this variable is used because it can induce positive effects on public expenditures, as suggested by the traditional short-term budget restriction; thus it is expected that the estimated coefficient has a positive signal).

Therefore, according to the specifications of the *AIDS*, in a first step it is intended to estimate the long-term relation among real public expenditures of LRA (*LDTOTR*), real GNP (*LPIBR*) and the  $z_j$  variables (Number of Unemployed, Number of Public Administration Employees and Public Revenues). Thus the following cointegration regression was estimated:

$$LDTOTR_t = a + \sum_{j=1}^k d_{ij} * z_j + g * LPIBR_t + u_t \quad (25)$$

However, some authors like Gupta (1967) and Musgrave (1969) purpose to test public expenditures as a ratio of production:

$$LDTOTR_t - LPIBR_t = \mathbf{a} + \sum_{j=1}^k \mathbf{d}_{ij} * z_j + u_t \quad (26)$$

A short appointment should be introduced here. It is related to the omission of political variables, like years of elections or periods characterized by the governance of a party. Using dummies variables for years of (legislative, municipal or presidential) elections, there was no statistical significance of the estimated parameters detected. A hypothesis for this apparent irrelevance of political explanations in the growth of Portuguese public expenditures is due to the preferred classification of public expenditures. If organic classification was chosen, which divides public expenditures according to outlays as Defense, Education, Health or Social Security (in the place of the preferred economic one), then it would be probable that a different lecture could have been done, as noted in Section 2. A second reason points out the unaltered regime felt for almost twenty years in Portugal, as Figure A2 expresses it.

**DATA:** The characterization of the logarithmized variables is the following: 1) LDTOTR is identified with the logs of the real public expenditures of LRA of Portugal, observed between 1947 and 2002. Its sources were the Long Series of the Bank of Portugal, between 1947 and 1995, edited by Pinheiro (1997), and between 1996 and 2002, the Public Administration Sector Account in the Portuguese Estate Budget. This variable is composed by all the expenditures that the Portuguese Government spends with the decentralized public administration. For the purpose of deflating the nominal series, I followed Musgrave and Musgrave (1980) and Beck (1981). The primary deflators were imported from the same sources of nominal public expenditures of LRA. 2) LPIBR represents the logs of real Gross National Product of Portugal, from 1947 to 2002. Its sources were Andrade (2000), between 1947 and 1955, Pinheiro (1997), between 1955 and 1995, and the official department of research of Portuguese Ministry of Finances, the “Gabinete de Estratégia e Planeamento (GEE)”, between 1996 and 2002. 3) LDESEMP corresponds to the logs of the Number of Unemployed, in Portugal,

during the observed period. The sources of this series were Pinheiro (1997), until 1995, and the GEE, after that observation. 4) LFUN symbolizes the logs of the Number of Public Administration Employees since 1947 to 2002. Its sources were Neves (1994), between 1947 and 1989, and the official Institute of Employment and Professional Training (“Instituto do Emprego e de Formação Profissional”, IEFP), between 1989 and 2002. 5) LREC signifies the logs of the Public Revenues, observed between 1947 and 2002. The sources of this series were the same that were used in the real public expenditures of LRA. There was no problem in the compatibility of the data, in spite of the diversity of the sources.

**METHODOLOGY** To study the long-term relation among variables, econometricians have been purposing the analysis on the possibility of cointegration regressions, since the seminal works of Sargan (1964), Davidson, Hendry, Srba and Yeo (1978) or Engle and Granger (1987). If two variables  $x_t$  and  $y_t$  are integrated by the first order, i.e., they are  $I(1)$ , and if they can generate a third one,  $z_t$ , in a way that

$$z_t = y_t - bx_t \quad z_t \sim I(0) \quad (27)$$

then, we will identify  $x_t$  and  $y_t$  as cointegrated. Generally, after recognizing that  $y_t \sim I(d)$   $x_t \sim I(b)$  we will identify  $x_t$  and  $y_t$  as cointegrated if  $z_t$  can be characterized as

$$z_t = y_t - bx_t \quad z_t \sim I(d-b) \quad (28)$$

with  $b$  positive, necessarily. If  $b$  is null then  $z_t \sim I(d)$  and the relation found between  $x_t$  and  $y_t$  is called ‘spurious’ according to Granger and Newbold(1974). To test the null hypothesis of non-cointegration relation, as stated by Phillips and Loretan (1991), Hamilton (1994) or Haldrup (1994), it is previously necessary to analyze the stationarity of each series involved in the observed relationship. There is a considerable set of tests on stationarity. However, I used the following Augmented Dickey-Fuller (ADF), the Dickey-Fuller Generalized Least Squares (DF-GLS) as stated by Elliott, Rothenberg and Stock (1996), the Leybourne and McCabe (1994) and Dickey and Pantula (1987) tests. I began with the popular Augmented Dickey-Fuller (ADF) test. The null hypothesis of the ADF identifies the presence of a unit root in the series  $Y_t$  (so,  $Y_t$  is not stationary).

According to this purpose, the significance of  $\mathbf{d}$  in the regression (29) is observed according to critical values present in Phillips (1987) or in MacKinnon (1991).

$$\Delta Y_t = \mathbf{b}_1 + \mathbf{b}_2 t + \mathbf{d} Y_{t-1} + \mathbf{a}_i \sum_{i=1}^m \Delta Y_{t-1} + \mathbf{e}_t \quad (29)$$

In (29),  $\Delta Y_t$  identifies the series of first-differences of  $Y_t$  and  $t$  indicates the eventual temporal trend. As an answer to the need of identifying the length of lags ( $p$ ) to be included in the test regressions, the cited Information Criteria – Akaike Information Criteria,  $AIC(p)$ , Schwarz Information Criteria,  $SC(p)$  or Hannan and Quinn,  $HQ(p)$ , are frequently used. Elliott, Rothenberg and Stock (1996) also developed a test with the null hypothesis identified with the assumption of the non-stationarity of a series. According to King (1980), they searched optimizing properties of the test for small samples. Identifying  $y_t^d$  with the detrended series of  $y_t$ , the null hypothesis assumes the absence of significance of the coefficient of  $\mathbf{a}_0$  in the following regression (30):

$$\Delta y_t^d = \mathbf{a}_0 y_{t-1}^d + \mathbf{a}_1 \Delta y_{t-1}^d + \dots + \mathbf{a}_p \Delta y_{t-1}^d + e_t \quad (30)$$

As stated by Ng and Perron (2001), I also preferred the Modified Akaike Information Criteria (MAIC), for the choice of the lag length to include in the test. Although these tests (ADF and DF-GLS) returned convergent results, I also used the Leybourne and McCabe (1994) test. Contrary to the priors, Leybourne and McCabe (1994) test has the null hypothesis assuming the stationarity of a series.

Their structural model is assumed as the following ( $\mathbf{f}(L)y_t$  is identified with a lag operator of  $y_t$ ):

$$\mathbf{f}(L)y_t = \mathbf{a}_t + \mathbf{b}_t + \mathbf{e} \quad (31)$$

$$\mathbf{a}_t = \mathbf{a}_{t-1} + \mathbf{h} \quad (32)$$

$$\mathbf{a}_0 = \mathbf{a} \quad (33)$$

$t=1,2,\dots,T$ ,  $\mathbf{e}_t \sim iid(0, \mathbf{s}_e^2)$   $\mathbf{h}_t \sim iid(0, \mathbf{s}_h^2)$   $\mathbf{e}_t$  and  $\mathbf{h}_t$  are independent.

The results in Table A3 confirmed the presence of double unit-roots in the series LDTOT, LPIB, LREC, LDPIB (logs of GNP deflator) and LDDESP (logs of the deflator of real public expenditures of

LRA) while LDTOTR, LPIBR, LDESEMP and LFUN can be characterized as I(1). To strengthen the evidence of the accused double unit-roots, I used Dickey and Pantula (1987) test. It starts from an AR(3) model as (34):

$$x_t = \mathbf{q}_1 y_{t-1} + \mathbf{q}_2 z_{t-1} + \mathbf{q}_3 w_{t-1} + \mathbf{e}_t \quad (34)$$

$$z_t = y_t - y_{t-1} \quad (35)$$

$$w_t = z_t - z_{t-1} \quad (36)$$

$$x_t = w_t - w_{t-1} \quad (37)$$

This test tries to evaluate the presence of a diminishing number of unit roots, descending from 3 ( $H_3$ ) to 0 ( $H_0$ ). After recognizing that the estimated coefficient for  $\mathbf{q}_3$  in (38) is not null, according to a  $t$ -test in the regression

$$x_t = \mathbf{q}_3 w_{t-1} + \mathbf{e}_t \quad (38)$$

the null hypothesis of 2 ( $H_2$ ) unit roots against only one can be tested using the regression

$$x_t = \mathbf{q}_2 z_{t-1} + \mathbf{q}_3 w_{t-1} + \mathbf{e}_t \quad (39)$$

The null hypothesis of  $H_2$  is not rejected if there is evidence in the sense that  $\mathbf{q}_2$  is not significant. The Table A4 confirms the prior observations: LDTOT, LPIB, LREC, LDPIB and LDDESP are I(2) while LPIBR, LDTOTR, LDESEMP and LFUN are I(1).

*The cointegration among I(2) variables:* With the presence of I(2) variables in the cointegration regression, some considerations remain. According to Haldrup (1998), there are three kinds of cointegration in this context:

$$\mathbf{b}_1' X_{2t} \sim I(0) \quad (40)$$

$$\mathbf{b}_1' X_{2t} \sim I(1) \quad (41)$$

$$\mathbf{b}_3' X_{2t} + \mathbf{b}_4' X_{1t} + \mathbf{b}_5' \Delta X_{2t} \sim I(0) \quad (42)$$

In this formalization,  $\mathbf{b}_i, i=1, \dots, 5$  refers to the estimated cointegration vectors while the subscript  $i$  ( $i=1$  or  $i=2$ ), associated to  $X_t$  variables, indicates the inherent order of integration. As stated by Granger and Lee (1989), in (40) the variables are multicointegrated



because they are cointegrated by levels and by their differences. In (41) the I(2) variables are only cointegrated by their differences (if they are in logs, only their growth rates are cointegrated). In (42), we are facing polynomial cointegration (cointegration among I(2) variables, I(1) variables and the first differences of I(2) variables). Haldrup (1994) recognizes that when the residual series of a cointegration regression,  $u_t$ , is I(1) or I(2), the F-test of any hypothesis diverges to  $\infty$  with the order  $O_p(T)$  even if the null is true. Whilst,  $R^2$  converges to 1 and the Durbin-Watson statistic converges to 0. The estimated coefficients for  $X_{1t}$  converge with a rate of  $O_p(T^{d-1})$  and for  $X_{2t}$  with a rate of  $O_p(T^{d-2})$ . With this sequence, Haldrup (1994) developed a set of tests for the null hypothesis of the non-cointegration based in the observation in the residuals from the regression of cointegration. The null hypothesis is not rejected if some evidence favoring the presence of an I(1) or an I(2) series is found. Haldrup (1994) revealed critical values for rejecting the null in function of  $m_1$  (the number of I(1) regressors) and of  $m_2$  (the number of I(2) regressors).

*Efficient estimation:* As suggested by Stock and Watson (1993), the estimated results by *Static Ordinary Least Squares* (SOLS) may not be the most efficient, although, in a cointegration relation, they are super-consistent (for a definition of the concepts of efficiency and consistency, it is purposed a lecture on Hamilton (1994)). This may eventually be due to the small sample (56 observations). In order to get more efficient estimators, I added to the SOLS estimations the results from the computation by Dynamic OLS (DOLS), firstly suggested by Saikonnen (1991) and preferred in Stock and Watson (1993), and by Non Linear Squares (NLS), according to Phillips and Loretan (1991). The DOLS method purposes the efficient estimation by adding lags and leads of the first-differences of the exogenous series (or second-differences if these exogenous series are I(2)) to the cointegration regression. The NLS method substitutes the set of lags and leads of the DOLS method by lags of the exogenous variables and by lags of the residuals obtained from the cointegration regression.

*Estimation. Results obtained by SOLS, DOLS and NLS:* Table A5 synthesizes the results from the estimation by SOLS, according to (25). Considering it, and according to ADF test statistic on the residuals from cointegration regression (see Haldrup, 1994), we can reject the hypothesis of cointegration among LDTOTR (regressand), LPIBR, LREC, LDESEMP and LFUN. However, I also tested the hypothesis of cointegration among a new related regressand (percentual relation between real public expenditures of LRA and real GNP) and the set of exogenous variables (LREC, LDESEMP and LFUN), according to regression (26). According to Haldrup (1994) and observing the respective series of residuals from this cointegration regression, we reject the null hypothesis of a non-cointegration relation among LDTOTR-LPIBR, the log of real public expenditures of LRA as a ratio of real GNP, and LFUN, the log of the Number of Public Administration Employees, LREC, the log of Public Revenues, and LDESEMP, the log of the Number of Unemployed, with a significance level of 10%. Thus, it is expected that there is a long-term relationship among these variables. From a first lecture, the estimated coefficient for LFUN (-0,678) may be interpreted as confirming a relation of substitutability between the regressand and the public expenditures destined to Public Administration Employees (correlationated with LFUN). There are significant and positive elasticities associated to public revenues (0,180) and to the Number of Unemployed (0,228). Being essentially constituted by Taxes as an instrument of financing public budget deficit, as stated by Barbosa (1997), public revenues offer a reason for increasing the proportion of real public expenditures of LRA in GNP. The number of Unemployed increases the proportion between the observed expenditures and the real GNP. This fact induces that increasing unemployment amplifies real public expenditures of LRA, especially, its outlay that is concerned to decentralized support (for example, current transfers). But we can also interpret this signal as related to an attempt of regional and local decision-makers to minimize the harmful effects of economic contractions (though, real public of LRA are counter-cyclical variables). These values are related to the observations from Brennan and Buchanan (1980), Lijeron (1996) and Barro and Sala-i-Martin (1990). So, they are consistent with modern versions of Wagner's Laws, with the

perception of LRA expenditures as luxury (because they are specially influenced by public revenues), with the role of lobbying groups and with the bureaucracy being a source of discouragement referring to the decentralized public expenditures (the so-called Leviathan effect). Table A6 shows the estimated coefficients for the cointegration relations tested in (26), following the SOLS, DOLS and NLS methods. As it can be verified, the returned estimations by these three methods do not give back substantially different values. Thus, it can be expected that LREC remains in an interval between 0,16 and 0,18, LDESEMP has its estimated elasticities between 0,23 and 0,26 and LFUN preserves its estimations between -0,68 and -0,61.

## **6. Conclusion**

This document reports a progressing work developed to test the distinction of regimes in the evolution of real public expenditures of local and regional administration (LRA) of Portugal, post World War II (1947-2002). Its main contribution focuses on Portuguese public finances, specially, on the aggregate of decentralized expenditures devoted to local and regional structures. A second aim of this research was to find a long-term relation, according to various theories of the growth of public expenditures, among real public expenditures of LRA and a set of exogenous variables as real GNP, the Number of Public Administration Employees, the Number of Unemployed and the Public Revenues. The strongest results confirm that real public expenditures of LRA can be characterized, between 1947 and 2002, by two states. The state associated to higher rates of annual growth of real public expenditures of LRA happened between 1974 and 1990. Since 1988, it is highly probable that the reality is characterized by the other state (low rates of growth). After recognizing the homogeneity between the analyzed expenditures and the real output, the possibility of cointegration remains among the real public expenditures of LRA as a percentage of real GNP and the Number of Public Administration Employees, the Number of Unemployed and Public Revenues. Interestingly, there is a relation of substitutability between the observed ratio and the Number of Public Administration Employees (the estimated coefficient is -0,678). But the estimated coefficients for the Number of Employees (0,228) and

for Public Revenues (0,180) indicate that, firstly, real public expenditures of LRA are used to attenuate the harmful of unemployment (these public expenditures are counter-cyclical variables), and, secondly, that growing public revenues may increase the analyzed decentralized expenditures in Portugal.

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## Annexes: Figures and Tables

Fig. A1. Nominal Public Expenditures of Ira (logs), 1947-2002

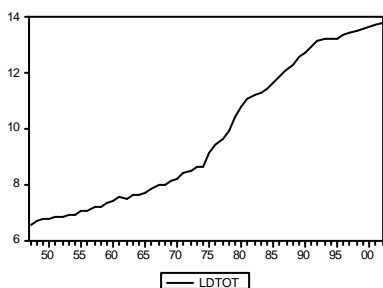


Fig. A2. Real public Expenditures of Ira (logs), 1947-2002

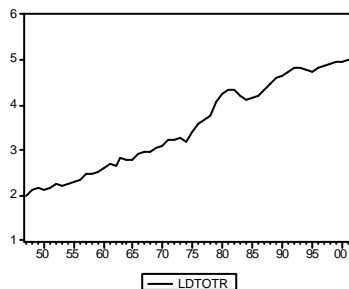


Fig.A3.Relation between nominal public expenditures of Ira and gnp(logs)

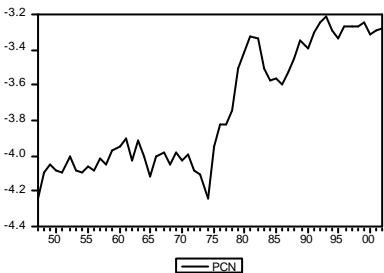


Fig.A4.Relation between real expenditures of Ira and gnp(logs)

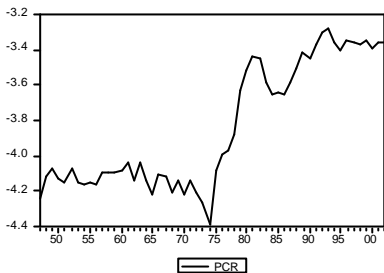


Figure A5 – Filtered, Smoothed and Predicted Probabilities of Regime 1 and 2 associated to the growth rates of real public expenditures of Portuguese LRA (series “DDTOTR”), 1948-2002

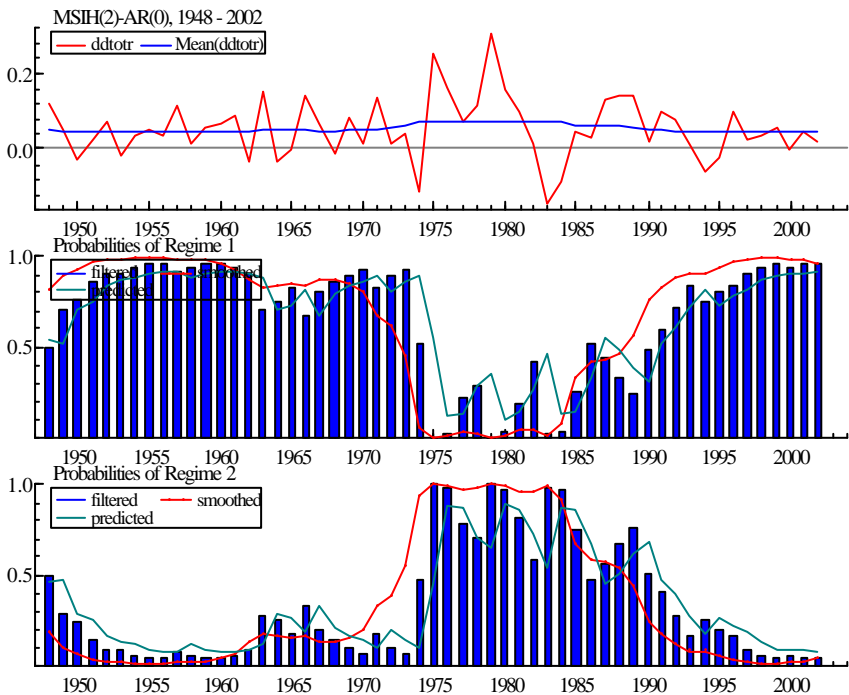
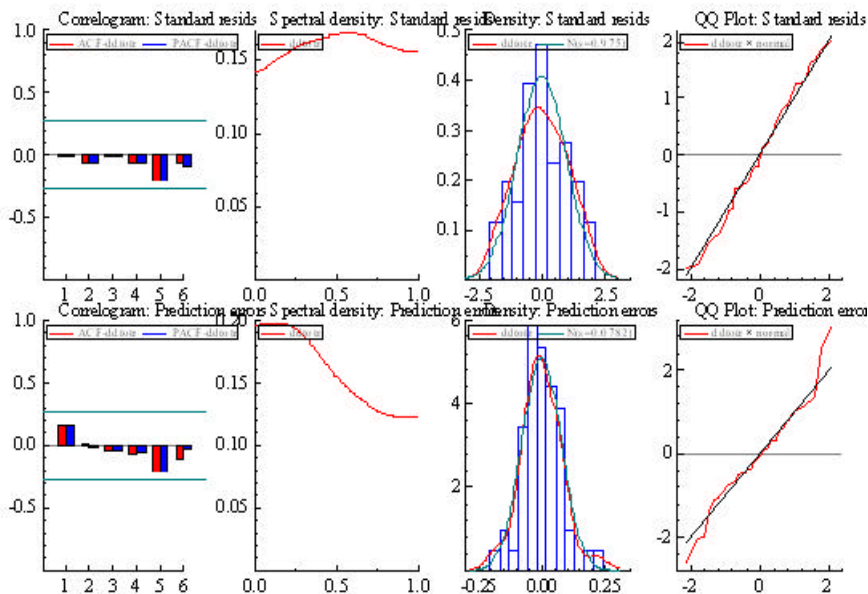




Figure A6 – Residual analysis

Table A1. Selection of the number of lags ( $r$ ) to be included in an Autoregression of the growth rates of real public expenditures of Portuguese LRA, 1948-2002

$r$	0	1	2	3	4	5
AIC	-2,185	-2,176	-2,118	-2,080	-2,021	-2,072
HQ	-2,080	-2,031	-1,947	-1,880	-1,826	-2,066
SC	-2,149	-2,102	-2,007	-1,930	-1,832	-1,843

Table A2 – Estimates for the parameters of a Markov-Switching Model of growth rates of real public expenditures of Portuguese LRA, 1948-2002

	Coefficient	Standard Error	t-value
Constant			
State 1 (slow growth)	0,045818	0,010024	4,5710
State 2 (high growth)	0,074616	0,029201	2,5552

Table A3 – Statistical values obtained from ADF, DF-GLS and L-MC (Leybourne and McCabe(1994)) Tests

$y_t$	$\Delta^d y_t$	ADF		DF-GLS	L-MC	
		C	C, T		C	C,T
Lpib	d=0	-1.78(3)	-2.28(3)	-1.68(1)	4.10(1) ***	0.41(1) ***
	d=1	-1.73(1)	-1.55(1)	-1.14(2)	2.09(2) ***	0.71(2) ***
	d=2	- 7.62(1)** *	-9.35(1) ***	-6.68(2) ***	0.09(2)	0.08(2)
Ldtot	d=0	0.24(1)	0.23(1)	-0.59(1)	3.83(1) ***	0.71(1) ***
	d=1	-2.48(1)	-2.67(1)	-2.48(1)	2.60(1) ***	0.51(1) ***
	d=2	-7.17(1) ***	-7.70(1) ***	-5.73(1) ***	0.34*(1)	0.11(1)*
Lddesp	d=0	-0.67(1)	-1.81(1)	-2.07(2)	5.26(2) ***	0.63(2) ***
	d=1	-1.35(1) ***	-1.03(1)	-1.07(4)	1.97(4) ***	0.88(4) ***
	d=2	-4.48(2)	-4.56(2) ***	-3.82(2) ***	0.48(2)**	0.20(2)**
Ldpib	d=0	-1.04(2)	-2.55(2)	-1.54(3)	4.95(3) ***	0.58(3) ***
	d=1	-1.30(1)	-1.54(1)	-1.22(1)	2.03(1) ***	0.87(1) ***
	d=2	-11.31(1) ***	-11.36(1) ***	-4.51(2) ***	0.43(2)*	0.18(2)**
Lrec	d=0	0.06(3)	0.72(3)	-0.05(3)	4.19(3) ***	0.74(3) ***
	d=1	-1.87(2)	-1.54(2)	-1.95(2)	3.15(2) ***	0.57(2) ***
	d=2	-9.47(2) ***	-10.46(2) ***	-9.40(2) ***	0.09(2)	0.08(2)
Ldese mp	d=0	-1.58(2)	-1.20(2)	-1.67(2)	3.31(2) ***	0.59(2) ***
	d=1	-5.19(1) ***	-5.44(1) ***	-5.20(1) ***	0.13(1)	0.12(1)*

	d=2	-7.47(3) ***	-8.11(3) ***	-7.44(3) ***	0.016(3)	0.08(3)
Lfun	d=0	-0.63(3)	-0.09(3)	-0.74(3)	3.82(3) ***	0.68(3) ***
	d=1	-4.43(3)	-4.54(3) ***	-4.46(3)	0.07(3)	0.003(3)
	d=2	-6.22(1) ***	-6.64(1) ***	-6.21(1) ***	0.008(1)	0.002(1)
Lpibr= Lpib- Ldpib	d=0	-1.53(2)	-1.66(2)	-1.82(2)	3.03(2) ***	0.58(2) ***
	d=1	-4.33(1) ***	-4.66(1) ***	-3.76*** (3)	0.66(3)**	0.13(3)*
	d=2	-8.86(3) ***	-9.51(3***)	-6.91*** (3)	0.03(3)	0.03(3)
Ldtotr Ldtot- Lddesp	d=0	-0.35(3)	-0.40(3)	-1.00(2)	3.56(2) ***	0.67(2) ***
	d=1	-4.53(2) ***	-4.87(2) ***	-3.90(1) ***	0.67(1)**	0.135(1)*
	d=2	-7.84(2) ***	-8.41(2) ***	- 6.20(1)***	0.18(1)	0.111(1)
Ldtotr- Lpibr	d=0	-0.52(3) ***	-0.58(3)	-1.12(2)	3.48(2) ***	0.65(2) ***
	d=1	-5.05(2)	-5.43(2) ***	-4.26(1) ***	0.44(1)*	0.13(1)*
	d=2	-8.82(1) ***	-9.47(1)***	-6.88(1) ***	0.02(1)	0.03(1)

Note: \*, \*\*, \*\*\* identify the significance level when the null is rejected by, respectively, a level of 10%, 5% and 1%. C means intercept, and T means trend. The 1<sup>st</sup> column of identifies the order of differencing in each series ( $y_t$ ) from 0 (levels of the series) to 2 (second-differences of  $y_t$ ). Between parentheses “(...)” the number of preferred lags appears according to the Bayesian Schwarz Criteria, in the columns of the ADF test. The preferred lag length, in DF-GLS and Leybourne and McCabe (1994) tests, was chosen respecting the MAIC as stated by Ng and Perron (2001).

TABLE A4 – Statistic values obtained from Dickey-Pantula (1987) test

Series ( $y_t$ )	$\hat{q}_1 / \hat{s}_{q_1}$	$\hat{q}_2 / \hat{s}_{q_2}$
LPIB	...	-0.643
LDTOT	...	-1.456
LDDESP	...	-0.886
LDPIB	...	-0.841
LMREC	...	-0.998
LMDESEMP	0.574	-5.175***
LMFUN	-2.459*	-3.498***
LMPIBR	-1.878*	-3.358***
LMDTOTR	-2.573*	-3.228***
LMDTOTR-LMPIBR	-1.133	-4.929***

Note: \*, \*\*, \*\*\* identify the significance level when the null is rejected by, respectively, a level of 10%, 5% and 1%.

TABLE A5 – SOLS Estimation of the cointegration regression (25)

	C	Lpibr	Lrec	Ldesemp	Lfun	ADF
Ldtotr	-4.018* (2.27)	0.626*** (0.116)	0.199*** (0.024)	0.121** (0.053)	-0.008 (0.263)	-3.924

Note: Below the estimated coefficients, between parentheses, the respective standard errors are evidenced. significance levels - 10%: \*, 5%: \*\*, 1%: \*\*\*

TABLE A6 .SOLS, DOLS and NLS Estimations of the regression (26)

	SOLS	DOLS	NLS
C	1.048 (1.773)	0.370 (5.934)	0.889 (2.580)
LMREC	0.180*** (0.025)	0.156* (0.083)	0.176*** (0.037)
LMDESEMP	0.228*** (0.045)	0.261** (0.101)	0.246*** (0.059)
LMFUN	-0.678*** (0.174)	-0.609 (0.594)	-0.668*** (0.254)
ADF	-4.063*	...	...

Note: Dependent variable Ldtotr-lpibr. Below the estimated coefficients, between parentheses, the respective standard errors are evidenced. significance levels - 10%: \*, 5%: \*\*, 1%: \*\*\*