

# **ON THE SUSTAINABILITY OF GOVERNMENT DEFICITS: SOME LONG- TERM EVIDENCE FOR SPAIN, 1850-2000<sup>(\*)</sup>**

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REFERENCES

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## **ABSTRACT**

In this paper, we provide a test of the sustainability of the Spanish government deficit over the period 1850-2000, from the estimation of a cointegration relationship between government expenditures and revenues derived from the intertemporal budget constraint. The longer than usual span of the data would allow us to obtain some more robust results on the fulfilling of the intertemporal budget constraint than in most of previous analyses. Two additional robustness checks of the results are also provided. First, we investigate the possibility of structural changes occurring along the period analyzed, using the new approach of Kejriwal and Perron (2008) to testing for multiple structural changes in cointegrated regression models. Second, we further investigate whether the behaviour of fiscal authorities had been non-linear, by means of the procedure of Hansen and Seo (2002) based on a threshold cointegration model. Our results show that (i) the government deficit would have been strongly sustainable in the long run, (ii) no evidence was found on any significant structural break throughout the whole period, and (iii) fiscal sustainability was attained due to the non-linear behaviour of fiscal authorities, so that actions on the budget deficit were taken only when it exceeded around 4.5% of GDP.



## I. INTRODUCTION

The sustainability of government deficits turns to be a crucial issue for economic policy. In principle, a deficit of the public sector can be sustainable in the short run provided that the government can borrow. However, if the interest rate on the government debt exceeds the growth rate of the economy, the resulting debt dynamics would lead to an ever-increasing ratio of debt to GDP. This dynamics of debt accumulation can only be stopped if the ratio of the budget deficit to GDP becomes a surplus; or, alternatively, through a sufficiently large revenue from money creation, i.e., if seigniorage is allowed for.

When assessing the long-run sustainability of fiscal policy, the usual procedure consists of testing the government's intertemporal budget constraint (IBC). In short, for the budget deficit being sustainable, the government must run future budget surpluses equal, in present-value terms, to the current value of its outstanding liabilities. There are several studies available on the sustainability of budget deficits; see, e.g., Hamilton and Flavin (1986), Trehan and Walsh (1988), Smith and Zin (1991), Haug (1995), Quintos (1995), Martin (2000) or Bajo-Rubio, Díaz-Roldán and Esteve (2008), to name a few. The results, though, seem to be still rather inconclusive due to differences in the econometric methodology, the particular specification of the transversality condition, and the sample period used. However, a common criticism to most of the available literature is that the econometric procedures used require a large number of observations, which is not usually the case in most tests of the IBC.

In this paper, we try to overcome this problem by using an extended data set covering 150 years, for the case of Spain. The Spanish case can be of interest given the permanent difficulties experienced when balancing the government budget across those years. For most of this period, and until the fiscal reform of 1978, public revenues were kept at a very low level in order to not being in conflict with the interests of the upper classes of the society. Accordingly, revenues turned to be insufficient to finance even small amounts of public expenditures, and deficits became chronic, leading the government to a continuous resource to seigniorage.

The aim of this paper will be to provide a test of the sustainability of the Spanish government deficit over the period 1850-2000, from the estimation of a cointegration relationship between government expenditures and revenues derived from the IBC. In this way, the longer than usual span of the data would allow us to obtain some more robust results on the fulfilling of the IBC than in most of previous analyses. In addition, we will provide two additional robustness checks of the estimated relationship between government expenditures and revenues. First, given the extended length of the sample, we investigate the possibility of structural changes occurring along the period analyzed. To this end, we will make use of the new approach of Kejriwal and Perron (2008a,b) to



testing for multiple structural changes in cointegrated regression models. Second, as an extension of this analysis, we further investigate whether the behaviour of fiscal authorities had been non-linear. We will do this by means of the procedure developed by Hansen and Seo (2002), based on a threshold cointegration model that considers the possibility of a non-linear relationship between government expenditures and revenues. In particular, provided that fiscal sustainability holds, we analyze if fiscal authorities would have adjusted the deficit only when the difference between expenditures and revenues exceeded a certain threshold, so ensuring the deficit sustainability in the long run.

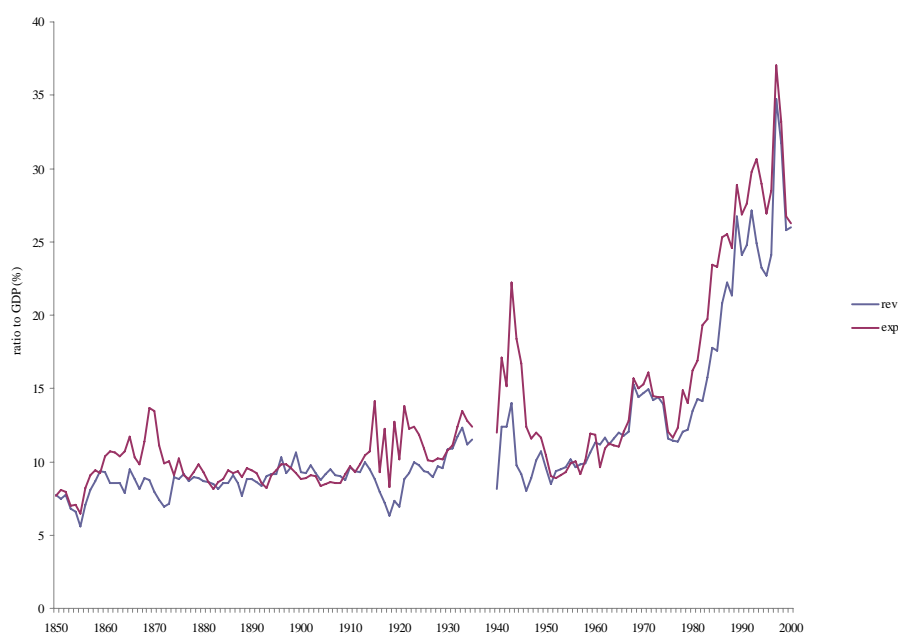
In section 2, we present and briefly discuss our data set. The results of the sustainability test are presented in section 3; and those of the tests on structural change and non-linearity in sections 4 and 5, respectively. Finally, section 6 concludes.

## 2. THE DATA

We use data on total (i.e., inclusive of debt interest) expenditures, and total revenues, both measured as ratios to GDP, for the Spanish central government (i.e., excluding the social security and local and regional governments). The data are taken from Comín and Díaz (2005), and cover the period 1850-2000. Notice that data on local governments are unavailable until 1958, whereas regional governments were just established after the approval of the current Constitution in 1978; also, social security only began to expand after 1966. The evolution of the two series appears in Figure 1.

**Figure 1**

### **SPANISH CENTRAL GOVERNMENT EXPENDITURES AND REVENUES, 1850-2000**



In general, the behaviour of the Spanish public sector has been characterized over most of this period by a high degree of protection and regulation, in order to favour some particular groups and sectors, rather than satisfying collective needs (such as infrastructures, or social expenditures). The insufficient levels of expenditure were dictated by the lack of revenues; and there were no revenues enough since governments were not willing to affect the interests of the upper classes of the society. Such a situation begins to change in the 1960s, but the process of liberalization was insufficient and soon partially reverted, so Spain had to wait until the restoration of democracy after 1977, and especially the integration in the now European Union (EU) in 1986, to enjoy a public sector comparable to that of the rest of Western Europe. The evolution of the Spanish public sector over this one-and-a-half-century period is discussed at length in Comín (1995, 1996).

Government expenditure was kept at a minimum over the 19th century, according to the principles of the liberal state. A greater role for the government involvement in the economy, especially regarding public works and social protection, appears between 1900 and 1935. Such a trend, however, finally arrived to a halt due to political instability and the lack of revenues. The increase in public expenditure after the end of the Spanish civil war was mainly due to the higher defence spending, and was soon reverted to lower levels than in the pre-war years. Government expenditure as a ratio to GDP only began to increase in the mid-1960s, following a higher spending on education, housing, or social security; however, a modern welfare state was not developed due to the lack of revenues. Finally, the process of modernization of the Spanish public sector, coupled with an increase in the functions performed by the state, can be dated at the end of the 1970s, in the aftermath of the economic crisis of that period, the restoration of democracy and, later on, the integration into the EU. Accordingly, the last years have contemplated an intense process of building a welfare state on European standards, and the development of modern and improved infrastructures. Even so, the ratio of government expenditure to GDP is still lower than the EU average.

On the other hand, government revenues proved to be clearly insufficient over most of the period, despite the fiscal reforms performed in 1845 (the first attempt to build a modern fiscal system), and 1900 (following the lost of the last Spanish colonies in Cuba and the Philippines). The inability of the governments to hinder the interests of the upper classes, coupled with the intense fiscal fraud, was at the root of this situation. Only after the fiscal reform of 1978, with the creation of a modern personal income tax, completed in 1986 with the introduction of the value added tax at the time of the integration into the EU, the Spanish fiscal system can be taken as comparable to that of the rest of Western Europe. In any case, budget deficits dominated over most of the

period, leading the government to a continuous resource to seigniorage until recent years, when a more orthodox financing of the deficits has been set up.

### 3. THE SUSTAINABILITY OF SPANISH BUDGET DEFICITS, 1850-2000

The customary framework used to test for the sustainability of budget deficits starts from the government's IBC that, in terms of GDP shares, becomes:

$$b_t = \sum_{j=0}^{\infty} \left( \frac{1+x}{1+r} \right)^{j+1} E_t s_{t+j+1} + \lim_{j \rightarrow \infty} \left( \frac{1+x}{1+r} \right)^{j+1} E_t b_{t+j+1} \quad (1)$$

where  $b$  and  $s$  denote, respectively, the total government liabilities (i.e., the sum of the stocks of public debt and base money) and the primary budget surplus (i.e., excluding interest payments), both as ratios to GDP. In addition,  $E$  is the expectations operator; and  $x$  and  $r$  stand, respectively, for the rate of growth of real GDP and the real interest rate, both assumed to be constant for simplicity.

From here, the condition for fiscal sustainability is:

$$\lim_{j \rightarrow \infty} \left( \frac{1+x}{1+r} \right)^{j+1} E_t b_{t+j+1} = 0 \quad (2)$$

i.e., the government must run expected future budget surpluses equal, in present-value terms, to the current value of its outstanding liabilities.

The cointegration framework to test for the IBC follows once first differences are taken in (1):

$$\Delta b_t = \sum_{j=0}^{\infty} \left( \frac{1+x}{1+r} \right)^{j+1} E_t \Delta s_{t+j+1} + \lim_{j \rightarrow \infty} \left( \frac{1+x}{1+r} \right)^{j+1} E_t \Delta b_{t+j+1} \quad (3)$$

so that sustainability would require:

$$\lim_{j \rightarrow \infty} \left( \frac{1+x}{1+r} \right)^{j+1} E_t \Delta b_{t+j+1} = 0 \quad (4)$$

Under a no-Ponzi scheme rule, the right-hand side of equation (3) will be stationary as long as the budget surplus and the stock of government liabilities are all stationary in first differences. In order to test for condition (4), the usual procedure consists of testing for the stationarity of

$$\Delta b_t = \text{exp}_t - \text{rev}_t$$

where  $\text{exp}_t$  and  $\text{rev}_t$  denote the ratios of the government's total expenditures and revenues, respectively, to GDP; that is,  $\text{exp}_t - \text{rev}_t$  would be the total budget deficit (i.e., including interest payments) as a ratio to GDP. Provided that

both  $exp_t$  and  $rev_t$  are  $I(1)$  with a cointegration relationship  $(1,-1)$ , one should then test the linear restriction  $\beta = 1$  in a regression model of the form:

$$rev_t = \alpha + \beta exp_t + \varepsilon_t \quad (5)$$

where  $\varepsilon_t$  is an error term.

Now, we are in position of testing for the sustainability of the Spanish budget deficit over the period 1850-2000, using the data on government expenditures and revenues examined in the previous section. As a first step of the analysis, we test for the order of integration of the variables  $exp_t$  and  $rev_t$  using the tests of Ng and Perron (2001). These authors proposed using the tests statistics  $\overline{MZ}_\alpha^{GLS}$  and  $\overline{MZ}_t^{GLS}$ , which are modified versions of the  $Z_\alpha$  and  $Z_t$  Phillips-Perron tests; and  $ADF^{GLS}$ , a modified version of the Augmented Dickey-Fuller test. Such modifications improve the tests with regard to both size distortions and power. The results are shown in Table I, and the null hypothesis of no stationarity cannot be rejected, independently of the test, for the two series in levels; at the same time that the presence of two unit roots is clearly rejected at the 1% significance level. Accordingly, both series would be concluded to be  $I(1)$ .

**Table I**  
**NG-PERRON TESTS FOR UNIT ROOTS**

I(2) vs. I(1)

	$\overline{MZ}_\alpha^{GLS}$	$\overline{MZ}_t^{GLS}$	$ADF^{GLS}$
$\Delta rev_t$	-72.03*	-6.00*	-13.03*
$\Delta exp_t$	-62.46*	-5.58*	-8.54*

I(1) vs. I(0)

	$\overline{MZ}_\alpha^{GLS}$	$\overline{MZ}_t^{GLS}$	$ADF^{GLS}$
$rev_t$	-8.18	-1.82	-1.83
$exp_t$	-7.59	-1.85	-1.87

Notes: (i)\* Denotes significance at the 1% level. The critical values are taken from Ng and Perron (2001), Table I.

(ii) The autoregressive truncation lag has been selected using the modified Akaike information criterion, as proposed by Perron and Ng (1996).

Next, we perform a cointegration analysis of equation (5) over the whole sample. The estimation is made using the method of Dynamic Ordinary Least Squares (DOLS) of Stock and Watson (1993), following the methodology proposed by Shin (1994). This method has the advantage of providing a robust

correction to the possible presence of endogeneity in the explanatory variables, as well as of serial correlation in the error terms of the OLS estimation. Hence, we first estimate a long-run dynamic equation including leads and lags of the (first difference of the) explanatory variable in equation (5):

$$\text{rev}_t = \alpha + \beta \text{exp}_t + \sum_{j=-q}^q \phi_j \Delta \text{exp}_{t-1-j} + v_t \quad (6)$$

where  $v_t$  is an error term, and then perform Shin's (1994) test from the calculation of  $C_\mu$ , a LM statistic from the DOLS residuals which tests for deterministic cointegration (i.e., when no trend is present in the regression).

The results of the estimation of equation (6) appear in Table 2. First of all, the null hypothesis of deterministic cointegration between  $\text{rev}_t$  and  $\text{exp}_t$  is not rejected at the 1% level of significance. In addition, the estimate of  $\beta$  is 0.88, significantly different from zero at the 1% level; but not significantly different from one at the 1% level, according to a Wald test on the null hypothesis  $\hat{\beta} = 1$  against the alternative  $\hat{\beta} < 1$ , distributed as a  $\chi_1^2$  and denoted in the table by  $W_{\text{DOLS}}$ . Accordingly, the Spanish budget deficit would have been strongly sustainable, according to Quintos's (1995) terminology, over the whole period 1850-2000.

**Table 2**  
**ESTIMATION OF THE LONG-RUN RELATIONSHIP:**  
**STOCK-WATSON-SHIN COINTEGRATION TESTS**

$\alpha$	$\beta$	$C_\mu$	$W_{\text{DOLS}}$
0.19 (0.67)	0.88 (7.57)	0.144	1.20

Notes: (i)\*  $t$ -statistics in parentheses.

(ii)\* The  $C_\mu$  statistic is not significant at the conventional levels. The critical values are taken from Shin (1994), Table I, for  $m = 1$ .

(iii)\* The number of leads and lags selected was  $q = 5 \approx INT(T^{1/3})$ , as proposed in Stock and Watson (1993). The long-run variance of the cointegrating regression residuals has been estimated using the Bartlett window with  $l = 12 \approx INT(T^{1/2})$ , as proposed in Newey and West (1987).

#### 4. TESTING FOR STRUCTURAL CHANGE

Issues related to structural change have received a considerable amount of attention in the literature on statistics and econometrics; see Perron (2008) for

a recent and far-reaching account of the problem of testing for multiple structural changes in linear regression models. Accounting for parameter shifts is crucial in cointegration analysis as far as long spans of data are involved, as in this paper, since they are more likely to be affected by structural breaks.

Recently, Kejriwal and Perron (2008a,b) provide a comprehensive treatment of the problem of testing for multiple structural changes in cointegrated systems. Structural changes can manifest themselves through changes in the long-run relationship (6), either in the form of a change in the intercept, or in the slope of the cointegrating vector. In particular, the presence of structural changes affects the size of the residual-based test for the null hypothesis of cointegration by Shin (1994) when the true data generating process exhibits some type of structural breaks.

Accordingly, we test for the stability of equation (6) using the tests of Kejriwal and Perron (2008a,b). These authors propose three types of test statistics to test for multiple breaks in cointegrated regression models:

- a) First, a sup Wald test of the null hypothesis of no structural break ( $m = 0$ ) versus the alternative hypothesis that there are a fixed (arbitrary) number of breaks ( $m = k$ ):

$$\sup F_T^*(k) = \sup_{\lambda \in \Lambda_\varepsilon} \frac{SSR_0 - SSR_k}{\hat{\sigma}^2}$$

where  $SSR_0$  and  $SSR_k$  denote, respectively, the sums of squared residuals under the null hypothesis of no breaks, and under the alternative hypothesis of  $k$  breaks,  $\lambda = \{\lambda_1, \dots, \lambda_m\}$  is the vector of breaks fractions defined by  $\lambda_i = T_i/T$  for  $i = 1, \dots, m, T_i$ , and  $T_i$  are the break dates.

- b) Second, a test of the null hypothesis of no structural break ( $m = 0$ ) versus the alternative hypothesis that there is an unknown number of breaks given some upper bound  $M(1 \leq m \leq M)$ :

$$UD \max F_T^*(M) = \max_{1 \leq k \leq m} F_T^*(k)$$

- c) In addition to the tests above, Kejriwal and Perron also propose a sequential procedure that not only enables detection of parameter instability but also allows a consistent estimation of the number of breaks, i.e., a sequential test of the null hypothesis of  $k$  breaks versus the alternative hypothesis of  $k + 1$  breaks:

$$F_T(k + 1 | k) = \max_{1 \leq j \leq k+1} \sup_{\tau \in \Lambda_{j,\varepsilon}} T \{ SSR_T(\hat{T}_1, \dots, \hat{T}_k) \} - \{ SSR_T(\hat{T}_1, \dots, \hat{T}_{j-1}, \tau, \hat{T}_j, \dots, \hat{T}_k) \} / SSR_{k+1}$$

where  $\Lambda_{j,\varepsilon} = \{\tau; \hat{T}_{j-1} + (\hat{T}_j - \hat{T}_{j-1})\varepsilon \leq \tau \leq \hat{T}_j - (\hat{T}_j - \hat{T}_{j-1})\varepsilon\}$ , and the model with  $k$  breaks is obtained by a global minimization of the sum of squared residuals.



The results of applying the Kejriwal-Perron tests to the relationship between  $exp_t$  and  $rev_t$ , allowing up to three breaks, are shown in Table 3. Both the intercept and the slope are allowed to change across regimes, and the level of trimming used is 15%. As can be seen, none of the tests proves to be significant and the sequential procedure selects no break point, which would point to a stable cointegrating relationship between the two variables over the whole period.

**Table 3**  
**KEJRIWAL-PERRON TESTS FOR STRUCTURAL CHANGE**

<b>sup <math>F_T</math> (1)</b>	<b>sup <math>F_T</math> (2)</b>	<b>sup <math>F_T</math> (3)</b>	<b>UD max</b>	<b>Number of breaks selected</b>
9.18	5.80	4.69	9.18	0

Note: No test statistic is significant at the conventional levels. The critical values are taken from Kejriwal and Perron (2008a), Table 1.10, trending case.

## **5. WAS FISCAL POLICY NON-LINEAR?**

As showed before, the Spanish fiscal policy would have been strongly sustainable over the long run, along the period 1850-2000. In addition, we found no evidence on any significant structural break over the whole period. In this section, we explore whether sustainability was attained due to the non-linear behaviour of fiscal authorities. In such a case, the adjustment to the long run equilibrium would occur only when the deviation with respect to this equilibrium would exceed a certain threshold; unlike the traditional approach, where it was assumed that the long run equilibrium always existed. In particular, regarding the government deficit, if the behaviour of fiscal authorities were non-linear they would adjust the deficit only when the difference between expenditures and revenues would exceed a certain threshold, so ensuring the sustainability of the deficit in the long run. A theoretical justification of such behaviour is presented in Bertola and Drazen (1993) where, regarding the timing of fiscal actions, they argue that significant cuts in government spending take place only when the ratio of government spending to output hits a “trigger point”, which implies that abrupt changes in fiscal policy should not be observed frequently. In other words, these authors introduce a non-linearity in the reaction function of policymakers.

However, the empirical literature on fiscal sustainability has hardly incorporated the new developments on non-linearities in fiscal policy. A first attempt was Cipollini (2001), who introduced a regime shift in the adjustment

towards a linear long-run (cointegrating) relationship between total government revenues and expenditures for the UK, using a smooth transition error-correction model to test for non-linearities or asymmetries in the adjustment process. Bajo-Rubio, Díaz-Roldán and Esteve (2004) found strong evidence of non-linearities in the evolution of the Spanish budget deficit in terms of a threshold autoregressive model, so that the deficit dynamics would be different depending on whether the change in the deficit was below or above an endogenously estimated threshold. A similar analysis was applied to the US case by Arestis, Cipollini and Fattouh (2004). Later on, Bajo-Rubio, Díaz-Roldán and Esteve (2006) re-examine the long run sustainability of the budget deficit in the Spanish case, finding that non-linear effects would occur when the deficit is “big enough”, which would guarantee its long run sustainability. More recently, a non-linear analysis on fiscal sustainability, using smooth transition autoregressive models, has been also applied to some EMU countries by Arghyrou and Luintel (2007), who find that fiscal disequilibria adjust in a non-linear way to their long-run equilibrium in the countries analysed.

In this section, we will provide some additional evidence on the sustainability of budget deficits, when fiscal policy is conducted as a non-linear process. However, unlike the above papers, we will make use of a much longer sample period, extending over 150 years, which should provide some more robustness to our empirical results. In particular, we will try to quantify the “trigger point”; i.e., the precise moment in which the authorities would correct a deficit, so that a required fiscal adjustment is finally enforced to ensure the deficit sustainability in the long run. To that end, we will follow Bertola and Drazen’s (1993) theoretical contribution, making use of recent developments on threshold cointegration that consider the possibility of a non-linear relationship between government expenditures and revenues.

The concept of threshold cointegration was introduced by Balke and Fomby (1997) as a feasible way to combine non-linearity and cointegration. The traditional approach assumes that the error-correction model (ECM), characterizing systems in which variables are cointegrated, is present in every time period. On the contrary, Balke and Fomby (1997) show threshold cointegration as a possibility of a discrete adjustment, due to the presence of some adjustment costs on the side of economic agents. This type of discrete adjustment could be particularly useful to describe the behaviour of fiscal authorities, which would only cut budget deficits when they were “too large”, in order to meet the IBC. In this way, threshold cointegration would capture the possible non-linearity of fiscal policy in the sense that the error correction mechanism should be expected only when a certain threshold is reached.

When testing for threshold cointegration, Balke and Fomby (1997) proposed applying several univariate tests previously developed in the literature, to the known cointegrated residual (i.e., the error-correction term). More recently,

Hansen and Seo (2002) examine the case of an unknown cointegrating vector. In particular, these authors proposed a vector ECM (VECM) with one cointegrating vector and a threshold effect based on the error-correction term, and developed an LM test for the presence of a threshold effect. This will be the approach followed in this paper.

Hansen and Seo (2002) considered a two-regime threshold cointegration model, or a non-linear VECM of order  $1+1$ , such as:

$$\Delta x_t = \begin{cases} A_1' X_{t-1}(\beta) + u_t & \text{if } w_{t-1}(\beta) \leq \gamma \\ A_2' X_{t-1}(\beta) + u_t & \text{if } w_{t-1}(\beta) > \gamma \end{cases} \quad (7)$$

with

$$X_{t-1}(\beta) = \begin{pmatrix} 1 \\ w_{t-1}(\beta) \\ \Delta x_{t-1} \\ \Delta x_{t-2} \\ \vdots \\ \Delta x_{t-l} \end{pmatrix}$$

where  $x_t$  is a  $p$ -dimensional  $I(1)$  time series that is cointegrated with one  $p \times 1$  cointegrating vector  $\beta$ ,  $w_t(\beta) = \beta' x_t$  is the  $I(0)$  error-correction term,  $u_t$  is an error term,  $A_1$  and  $A_2$  are coefficient matrices, and  $\gamma$  is the threshold parameter. As can be seen, the threshold model (7) has two regimes, depending on whether deviations from the equilibrium (defined by the value of the error-correction term) are below or above the threshold, where  $A_1$  and  $A_2$  describe the dynamics in each of the regimes.

Next, Hansen and Seo (2002) proposed two heteroskedastic-consistent LM test statistics for the null hypothesis of linear cointegration (i.e., there is no threshold effect), against the alternative of threshold cointegration (i.e., model (7)). The first test would be used when the true cointegrating vector is known *a priori*, and is denoted as:

$$\sup LM^0 = \sup_{\gamma_L \leq \gamma \leq \gamma_U} LM(\beta_0, \gamma)$$

where  $\beta_0$  is the known value of  $\beta$  (in the case analyzed below,  $\beta_0 = 1$ ); whereas the second test would be used when the true cointegrating vector is unknown, and is denoted as:

$$\sup LM = \sup_{\gamma_L \leq \gamma \leq \gamma_U} LM(\tilde{\beta}, \gamma)$$

where  $\tilde{\beta}$  is the null estimate of  $\beta$ . In both tests,  $[\gamma_L, \gamma_U]$  is the search region set so that  $\gamma_L$  is the  $\pi_0$  percentile of  $\tilde{w}_{t-1}$  and  $\gamma_U$  is the  $(1 - \pi_0)$  percentile.

We have applied the tests  $\sup LM^0$  (for a given  $\beta = 1$ ) and  $\sup LM$  (for an estimated  $\beta$ ). In both cases, as proposed by Hansen and Seo (2002), the  $p$ -values are calculated using a parametric bootstrap method (with 5,000 simulation replications). To select the lag length of the VAR, we have used the Akaike and Bayesian information criteria, both of them leading to  $l = 2$ . The results are reported in Table 4. Threshold cointegration would appear at the 1% significance level when  $\beta$  is fixed at unity and when  $\beta$  is estimated rather than fixed, so that the null hypothesis of linear cointegration would be strongly rejected in both cases. According to the first test, the estimated threshold is  $\tilde{\gamma} = 4.38$ , with the error-correction term defined as  $w_t = \exp_t - rev_t$  (i.e., the budget deficit). The results from the second test are quite similar, with  $\beta$  estimated at 1.01 and an estimated threshold of  $\tilde{\gamma} = 4.52$ , or 4.64 in terms of the budget deficit (with  $rev_t$  computed at its average value over the sample period), where the error-correction term is now defined as  $w_t = \exp_t - 1.01rev_t$ . Hence, the first regime would occur when the government deficit as a ratio to GDP is above 4.38% or 4.64%, which would be the relatively unusual regime including around 11% of the observations (namely, the years 1869, 1870, 1915, 1917, 1919, 1921, 1941, 1943 to 1945, 1982, 1984 to 1986, and 1993 to 1994). In turn, the second or usual regime, which applies to the remaining 89% of the observations, would occur when the government deficit as a ratio to GDP is below 4.38% or 4.64%.

**Table 4**  
**HANSEN-SEO TESTS FOR THRESHOLD COINTEGRATION**

	<b>sup LM<sup>0</sup></b>	<b>sup LM</b>
Test statistic value	28.69	29.45
Calculated $p$ -values	0.004	0.001
Threshold parameter	4.38	4.52
Estimate of the cointegrating vector	1.00	1.01

The estimated two-regime threshold VAR (heteroskedasticity-consistent standard errors in parentheses) for the first case (i.e., for a given  $\beta = 1$ ; the results would be very similar for the second case, i.e., for an estimated  $\beta = 1.01$ ) is:

$$\Delta \exp_t = \begin{cases} 7.63 - 0.95 w_{t-1} - 1.00 \Delta \exp_{t-1} + 0.93 \Delta \exp_{t-2} - 0.34 \Delta rev_{t-1} \\ (0.24) \quad (0.15) \quad (0.20) \quad (0.22) \quad (0.19) \\ + 0.72 \Delta rev_{t-2} + u_{1t}, \quad w_{t-1} \geq 4.38 \\ (0.21) \\ -0.04 + 0.29 w_{t-1} + 0.22 \Delta \exp_{t-1} - 0.44 \Delta \exp_{t-2} + 0.11 \Delta rev_{t-1} \\ (0.11) \quad (0.075) \quad (0.10) \quad (0.10) \quad (0.09) \\ - 0.38 \Delta rev_{t-2} + u_{2t}, \quad w_{t-1} < 4.38 \\ (0.10) \end{cases}$$

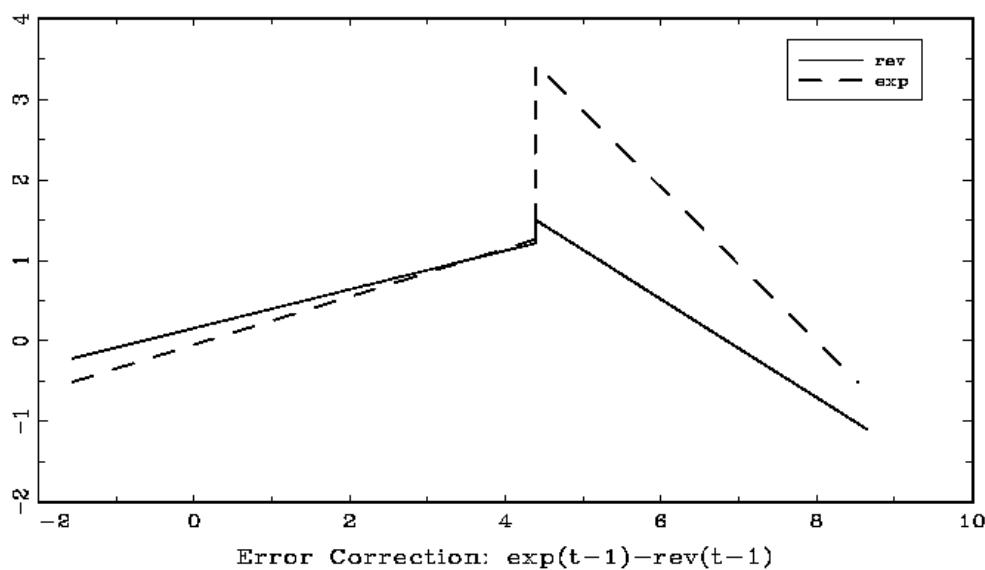
$$\Delta rev_t = \begin{cases} 4.17 - 0.61 w_{t-1} - 0.99 \Delta exp_{t-1} + 1.23 \Delta exp_{t-2} - 0.24 \Delta rev_{t-1} \\ (0.23) \quad (0.14) \quad (0.20) \quad (0.21) \quad (0.19) \\ + 1.13 \Delta rev_{t-2} + u_{1t}, \quad w_{t-1} \geq 4.38 \\ (0.20) \\ 0.15 + 0.24 w_{t-1} + 0.07 \Delta exp_{t-1} - 0.30 \Delta exp_{t-2} + 0.45 \Delta rev_{t-1} \\ (0.15) \quad (0.10) \quad (0.13) \quad (0.14) \quad (0.12) \\ - 0.62 \Delta rev_{t-2} + u_{2t}, \quad w_{t-1} < 4.38 \\ (0.13) \end{cases}$$

Significant error-correction effects appear in both regimes, but in the first regime the error-correction effects are larger in terms of significance and size of the estimated coefficients, i.e., when either government expenditures are well above revenues or government deficit is relatively high.

Figure 2 plots the error-correction effect, i.e., the estimated response of government expenditures and revenues to the discrepancy between them (i.e., to the size of the government deficit) in the previous period, holding the other variables constant. As can be seen, if the deficit were “large” (i.e., greater than 4.38% of GDP or rightwards of the threshold), both expenditures and revenues would decrease sharply with the size of the deficit; and, since the response of expenditures would be larger than that of the revenues, the government deficit would fall accordingly. However, for a “small” deficit (i.e., lower than 4.38% of GDP or leftwards of the threshold), the response of both expenditures and revenues is smaller.

**Figure 2**

**RESPONSE OF EXPENDITURES AND REVENUES TO ERROR CORRECTION**



Accordingly, the above evidence suggests that the Spanish fiscal policy would have shown significant non-linear effects. In particular, budget deficits would have shown a mean-reverting dynamic behaviour once the threshold was reached, which in turn would have assured their long-run sustainability.

## 6. CONCLUSIONS

In this paper, we have tried to provide some additional evidence on the long-run sustainability of the Spanish government deficit, using an extended data set covering 150 years. When assessing the long-run sustainability of fiscal policy, the econometric procedures usually employed require a large number of observations, which is not the case in most tests of the IBC. In order to overcome this problem we have made use of historical series for the period 1850-2000 so that, the longer than usual span of the data, should allow us to obtain some more robust results on the fulfilling of the IBC, than in most of previous analyses.

After estimating a cointegration relationship between government expenditures and revenues derived from the IBC, we have investigated the possible presence of structural changes following the new approach recently proposed by Kejriwal and Perron (2008a,b), and finally, we have checked the possible non-linear behaviour of fiscal authorities, using the procedure developed by Hansen and Seo (2002). The results show that the Spanish fiscal policy would have been strongly sustainable over the long run, along the period analysed. Moreover, no evidence has been found on any significant structural break throughout the whole period, which would point a stable cointegrating relationship between government expenditures and revenues. In addition, when exploring the possibility of a non-linear behaviour on the side of the fiscal authorities, we found that the Spanish fiscal policy would have shown significant non-linear effects. In particular, budget deficits would have shown a mean-reverting dynamic behaviour once their value exceeded around 4.5% of GDP, which in turn would have assured their long run sustainability.

To conclude, note that our result on the long-run sustainability of the Spanish government deficit says nothing on financing issues. As pointed out elsewhere, “(T)he history of the Spanish public debt until 1978 mirrors the main features of less developed countries, confirming the slow modernization of the Spanish Ministry of Finance” (Comín, 1995, p. 532), with frequent rescheduling of the government debt, and inflationary financing of the deficit. During the 19th century and the first years of the 20th century, deficits were monetized through the sales of government bonds to the Bank of Spain. The system changed after 1917, when government bonds were sold instead to private buyers, mostly private banks, but with the particular feature that these bonds could be automatically pledged at the Bank of Spain, so that its effect on the monetization of the deficit was not significantly different. Although this specific practice ended in the first 1960s, for most of the period government deficits were ultimately financed through seigniorage, leading to an inflationary trend; accordingly, monetary policy appeared to be subordinated to the needs of financing the budget deficit (Sabaté, Gadea and Escario, 2006). Only in recent years,



orthodox practices on deficit financing became prevalent, in particular after the Treaty of Maastricht entered into force in 1993, so that the financing of budget deficits by the central banks was explicitly ruled out. These issues of fiscal sustainability and deficit financing merit further investigation in order to properly characterize the behaviour of the Spanish fiscal policy in a long-term perspective.

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## SÍNTESIS

### PRINCIPALES IMPLICACIONES DE POLÍTICA ECONÓMICA

La sostenibilidad del déficit público constituye un aspecto crucial para la política económica. En principio, un déficit del sector público puede ser sostenible en el corto plazo siempre que el gobierno pueda tomar prestado. Sin embargo, si el tipo de interés de la deuda pública es mayor que la tasa de crecimiento de la economía, la dinámica de la deuda resultante llevaría a una proporción entre la deuda y el PIB que crecería indefinidamente. Esta dinámica de acumulación de la deuda solamente podrá detenerse si la proporción entre el déficit presupuestario y el PIB se convierte en un superávit; o, alternativamente, mediante unos ingresos suficientemente grandes derivados de la creación de dinero, es decir, si se permite el señoreaje.

A la hora de evaluar la sostenibilidad a largo plazo de la política fiscal, el procedimiento habitual consiste en el contraste de la restricción presupuestaria intertemporal del gobierno. En pocas palabras, para que un déficit presupuestario sea sostenible, el gobierno debe generar unos superávits presupuestarios futuros iguales, en términos de valor presente, al valor actual de sus pasivos. Existen diversos estudios empíricos acerca de la sostenibilidad del déficit presupuestario, si bien los resultados no suelen ser demasiado concluyentes debido a diferencias en la metodología econométrica, la especificación particular de la condición de transversalidad, o el periodo muestral utilizado. Sin embargo, una crítica común a la mayor parte de la literatura disponible se basa en el hecho de que los procedimientos econométricos utilizados requieren un gran número de observaciones, lo que no suele ser el caso en la mayor parte de los contrastes realizados sobre la restricción presupuestaria intertemporal del gobierno.

En el presente trabajo intentamos superar este problema mediante la utilización de una base de datos que cubre 150 años, para el caso de España. El caso español puede ser de particular interés dadas las permanentes dificultades experimentadas a la hora de equilibrar el presupuesto del gobierno a lo largo de estos años. Durante la mayor parte de este periodo, y hasta la reforma fiscal de 1978, los ingresos públicos se mantuvieron a niveles muy bajos para no entrar en conflicto con los intereses de las clases dominantes. Así pues, los ingresos resultaban insuficientes para financiar incluso pequeñas cantidades de gasto público, y los déficits se hicieron crónicos, lo que hizo que los gobiernos recurrieran continuamente al señoreaje.

El objetivo de este trabajo es ofrecer un contraste de la sostenibilidad del déficit público español para el periodo 1850-2000, a partir de la estimación de una relación de cointegración entre gastos e ingresos públicos, derivada de la restricción presupuestaria intertemporal del gobierno. De esta manera, la longitud, mayor que la habitual, de la base de datos, nos permitiría obtener unas conclusiones más robustas acerca del cumplimiento de la restricción presupuestaria intertemporal del gobierno que en la mayoría de los trabajos anteriores. Asimismo, ofrecemos dos contrastes adicionales de robustez de la relación estimada entre gastos e ingresos públicos. En

primer lugar, dada la longitud de la muestra, investigamos la posibilidad de que ocurrieran cambios estructurales a lo largo del periodo analizado. Para ello utilizaremos el nuevo enfoque de Kejriwal y Perron (2008), que permite contrastar la existencia de cambios estructurales múltiples en modelos de regresión cointegrados. En segundo lugar, como una extensión de este análisis, analizamos además si el comportamiento de las autoridades fiscales habría sido no lineal. Para ello utilizaremos el procedimiento desarrollado por Hansen y Seo (2002), basado en un modelo de cointegración de umbral que considera la posibilidad de una relación no lineal entre gastos e ingresos públicos. En particular, si se verifica la sostenibilidad fiscal, analizamos si las autoridades fiscales habrían ajustado el déficit solamente cuando la diferencia entre gastos e ingresos superara un cierto umbral, asegurando así la sostenibilidad del déficit en el largo plazo.

Los resultados obtenidos muestran que la política fiscal española habría sido fuertemente sostenible en el largo plazo, durante el periodo analizado. Asimismo, no se encontró evidencia de cambio estructural significativo a lo largo del periodo completo, lo que indicaría que la relación de cointegración entre gastos e ingresos públicos habría sido estable. Finalmente, cuando analizamos la posibilidad de un comportamiento no lineal por parte de las autoridades fiscales, obtuvimos que la política fiscal española habría mostrado significativos efectos no lineales. En particular, los déficit presupuestarios habrían mostrado un comportamiento dinámico de reversión a la media cuando su valor superaba alrededor de un 4,5% del PIB, lo que a su vez habría asegurado su sostenibilidad a largo plazo.

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