GOVERNMENT DEFICIT SUSTAINABILITY, AND MONETARY VERSUS FISCAL DOMINANCE: THE CASE OF SPAIN, 1850-2000*

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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, emphasizing the role played by monetary and fiscal dominance in order to get fiscal solvency. 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. First, we analyze the relationship between primary surplus and debt, following the recent critique of Bohn (2007), and investigate the possibility of structural changes occurring along the period by means of the new approach of Kejriwal and Perron (2008, 2010). The analysis is complemented in two directions: (i) performing Granger-causality tests in order to distinguish properly between a fiscal dominant and a monetary dominant regime; and (ii) presenting the impulse-response functions of debt to innovations in the primary surplus, through the approach of Canzoneri, Cumby and Diba (2001).

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1. Introduction

The role of fiscal policy goes beyond the traditional stabilization function. Questions such as the balancing of budget deficits, the interactions between monetary and fiscal policies, and the fiscal discipline required in monetary unions, have been also intensively discussed in the last decades. In particular, one of the main problems concerning fiscal authorities is the sustainability of government deficits, which is related to the issue of long-run solvency. A fiscal policy is regarded as sustainable when, if maintained in the indefinite future, it does not violate the solvency constraint; and a government is said to be solvent if the present-value budget constraint, i.e., its intertemporal budget constraint (IBC) holds. In other words, the public deficit can be sustainable if the government can borrow. However, if the interest rate on the government debt exceeds the growth rate of the economy, debt dynamics would lead to an ever-increasing ratio of debt to GDP. The dynamics of debt accumulation could be stopped only if the ratio of the budget deficit to GDP would turn to be a surplus, or if seigniorage were allowed for.

As noticed before, the usual procedure in most of the empirical contributions on the long-run sustainability of budget deficits consists of testing the government's IBC; a non exhaustive list would include, among others, Hamilton and Flavin (1986), Trehan and Walsh (1988, 1991), Haug (1995), Quintos (1995), Martin (2000) or Bajo-Rubio, Díaz-Roldán and Esteve (2008, 2009). The results, however, are sometimes inconclusive due to differences in the econometric methodology, the particular specification of the transversality condition, and the sample period used. 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; an exception is Bajo-Rubio, Díaz-Roldán and Esteve (2010).

On the other hand, the traditional macroeconomic analysis assumes that the fiscal authority sets primary surpluses in order to assure fiscal solvency, for any path the price level could take. In this way, the monetary authority is expected to set the price level, without facing any constraint; whereas fiscal authority would adjust, so that the budget surplus path would be endogenous. This scenario is referred in the literature as the Ricardian or "monetary dominant" (MD) regime. However, a new approach has emerged in the 1990s, which assumes that fiscal authorities are able to set primary

surpluses that follow an arbitrary process, not necessarily compatible with solvency. In such a context, the budget surplus would be exogenous, and the endogenous adjustment of the price level would be required in order to achieve fiscal solvency. Hence, in this case the monetary authority could only control the timing of inflation. This is the so-called non-Ricardian or "fiscal dominant" (FD) regime, and the literature developed on these assumptions is referred as the Fiscal Theory of the Price Level (FTPL). The FTPL builds on the contributions of, among others, Leeper (1991), Sims (1994), Woodford (1994, 1995, 2001), and Cochrane (2001, 2005); a survey is provided in Carlstrom and Fuerst (2000), and some critical appraisals of the theory can be found, e.g., in McCallum (2001) or Buiter (2002). The empirical evidence regarding the FTPL, however, is not too abundant; see, e.g., Bajo-Rubio, Díaz-Roldán and Esteve (2009) and the references therein.

In this paper, we will try to explore the interactions between monetary and fiscal policies in order to get fiscal solvency, for the case of Spain over the period 1850-2000. The Spanish economy, characterized by chronic government deficits, seems to be an interesting case of study to investigate how budget deficits were financed, which will allow us to determine the prevailing policy regime along the period of analysis, i.e., MD or FD. In a companion paper (Bajo-Rubio, Díaz-Roldán and Esteve, 2010) we investigated this issue through the estimation of a cointegration relationship between government expenditures and revenues derived from the IBC, and then analyzed the possibility of non-linear behaviour of fiscal authorities through the estimation of a threshold cointegration model. In the present paper, however, we will first analyze if public finances are sustainable by examining instead the relationship between primary surplus and debt, and then investigate how this fiscal sustainability is achieved: i.e., through the endogenous adjustment of the primary budget surplus (in an MD regime), or through the endogenous adjustment of the price level (in an FD regime).

Regarding the empirical methodology, we will analyze the relationship between primary surplus and debt in the line of Bohn (1998), but incorporating the later critique to previous tests on sustainability using cointegration techniques, recently developed by this same author in Bohn (2007). Given the long-run span of the data, we will test for the eventual presence of structural breaks in the estimated relationship between primary surplus and debt, making use of the new approach of Kejriwal and Perron (2008, 2010)

to testing for multiple structural changes in cointegrated regression models. In addition, we will also perform Granger-causality tests between these two variables, since the above method might not be able to distinguish properly between an FD and an MD regime (see below). Finally, in order to check the robustness of our results, we will present the impulse-response functions of debt to innovations in the primary surplus, following the approach of Canzoneri, Cumby and Diba (2001).

As mentioned before, the empirical analysis will be performed for the case of Spain over the period 1850-2000. Recall that a common criticism to most tests of the IBC is that the econometric procedures used require a large number of observations. Accordingly, the longer than usual span of the data (i.e., 150 years) will allow us to obtain some more robust results than in most of previous analyses. On the other hand, 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 proved insufficient to finance even small amounts of public expenditures, so deficits became chronic, leading the government to a continuous resource to seigniorage.

In section 2, we describe the underlying theoretical framework. Next, in section 3 we introduce the empirical methodology, and discuss our dataset and the underlying economic background. We present the empirical results in section 4. Finally, the main conclusions are summarized in section 5.

2. Theoretical framework

As we have seen, according to the traditional analysis, prices would be determined by monetary policy. On the contrary, the FTPL develops the idea that sometimes, in order to guarantee fiscal solvency, monetary policy would be addressed to accommodate the path of expenditures and revenues chosen by the government, even at the cost of generating inflation. An antecedent of this claim can be found in Sargent and Wallace's (1981) contribution, where the interaction of fiscal and monetary variables in the financing of deficits, through taxes and seigniorage, was already analyzed. In this way, fiscal solvency can act as a restriction on the policy followed by a central bank.

In order to describe the two possible ways of achieving fiscal sustainability, we will make use of the government's IBC, written in terms of GDP shares:

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

where *b* and *s* denote, respectively, the public debt and primary surplus, both as ratios to GDP; *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. The condition for fiscal sustainability is:

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

i.e., the transversality condition; or, equivalently:

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

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

Notice that, in equilibrium, the fiscal solvency condition holds under both the MD and FD regimes; the difference between the two regimes lies in how solvency is achieved. According to the MD regime approach, the price level would be determined in the money market, following the quantity theory of money, and the primary surplus would adjust endogenously to satisfy the IBC. In terms of equation (3), *s* would be set to meet a given *b*, independently of the price level.

On the other hand, when the FD regime prevails, the primary surplus is set exogenously by the government, regardless of the level of public debt. In this framework, the price level would adjust in order to assure the fulfilment of the IBC. And the main implication for fiscal policy would be that government solvency turns to be a sufficient condition for price stability.

In terms of equation (3), we can write this latter equation as:

$$\frac{B_t}{P_t y_t} = \sum_{j=0}^{\infty}\left(\frac{1+x}{1+r}\right)^{j+1} E_t s_{t+j+1} \qquad (3')$$

where *B*, *P*, and *y* denote, respectively, the nominal value of public debt, the price level, and real GDP. Then, given *B*, *y*, and *s*, *P* would "jump" to satisfy (3'). In other words, if the market believes the government's commitment when setting *s*, a value of *P* will be set so that *B* was not excessive and (3') could be satisfied.

The underlying assumption of the FTPL is that there are interactions between monetary and fiscal policies. In this line, Carlstrom and Fuerst (2000) show the restrictions that the government's budget may place on monetary policy. If the policy regime can be qualified as an MD or as an FD regime, depends on the particular role played by either the monetary or the fiscal authority. So, whether monetary or fiscal policy determines prices involves an assumption about which policymaker will move first, i.e., the central bank or the fiscal authority. In terms of the game theory approach, the solution would be given by the leader-follower model but, in practice, this is an empirical question.

3. Empirical methodology, data, and economic background

As shown in Bajo-Rubio, Díaz-Roldán and Esteve (2009), the empirical literature has usually made use of two approaches to test for the prevalence of monetary dominance versus fiscal dominance:

(i) The *backward-looking* approach (e.g., Bohn, 1998), so that, in a Ricardian regime, an increase in the previous level of debt would result in a larger primary surplus today; i.e., $\Delta b_{t-1} \rightarrow \Delta s_t$.

(ii) The *forward-looking* approach (e.g., Canzoneri, Cumby and Diba, 2001), so that, in a Ricardian regime, a larger primary surplus today would lead to a reduction in the future level of debt; i.e., $\Delta s_t \rightarrow \nabla b_{t+1}$.

According to the first approach, one should estimate a cointegration relationship between the primary surplus and the (lagged) level of debt, both as ratios to GDP:

$$s_t = \alpha + \beta b_{t-1} + v_t \qquad (4)$$

where v_t denotes an error term. In this equation, a positive and significant estimate of β would be a sufficient condition for solvency, indicating that the government satisfies its present-value budget constraint; that is, in terms of the transversality condition, *s* would

be set to meet a given b, independently of the price level. Furthermore, in accordance with the backward-looking approach, an estimated $\beta > 0$ would indicate the prevalence of an MD regime, and an estimated $\beta \leq 0$ the prevalence of an FD regime.

Testing whether $\beta > 0$ from the estimation of (4) or, alternatively, whether $\beta' = 1$ from the estimation of a cointegration relationship such as:

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

where exp_t and rev_t denote the ratios of the government's total expenditures and revenues to GDP, and ε_t is an error term, are customary approaches to test for the sustainability of public finances. However, this kind of assessments of fiscal sustainability based on unit root and cointegration tests have been recently criticized by Bohn (2007), on the grounds that such tests are incapable of rejecting sustainability. Specifically, Bohn derives the following three propositions, related to the order of integration of debt, primary surplus, expenditures, and revenues, in order to verify under which conditions the transversality condition and the IBC hold (see Bohn (2007) for details):

(i) If b_t is integrated of order m, being m positive, then b_t satisfies the transversality condition, and b_t and s_t satisfy the IBC.

(ii) If exp_t and rev_t are integrated of order m_G and m_T, respectively, where $\Delta b_t = exp_t - rev_t$; then b_t is integrated of order m with $m \leq \max(m_G, m_T) + 1$, so the transversality condition and the IBC hold.

(iii) If b_t and s_t follow an error-correction specification of the form $s_t - \rho b_{t-1} = z_t$, and z_t is integrated of order m for some $\rho < 0$ such that $|\rho| \in (0, 1+r]$ where r is a constant interest rate, then b_t satisfies the transversality condition and the IBC holds.

We use data on primary (i.e., excluding interest payments) budget surplus, and total gross debt, as well as on total revenues and expenditures, all of them as percentages of GDP, for the Spanish central government (i.e., excluding social security and local and regional governments) over the period 1850-2000. Notice that only data for the central government are available for the whole period; in particular, data on local governments are unavailable until 1958, regional governments were just established

after the approval of the current Constitution in 1978, and social security only began to expand after 1967.

The data on the public sector variables come from Comín and Díaz (2005), who provide a compilation of a large amount of government statistics for the period 1850-2000. As pointed out by these authors, the quantitative sources for the Spanish public sector are in general both abundant and reliable. From 1850 onwards, after the issuing of a law on public accountancy in that year, all the revenues and expenditures of the Spanish central government have been registered until 1957 into the *Estadísticas de las Cuentas Generales del Estado* (Statistics of General Accounts of the State). After 1958, these *Estadísticas* collect information about the activities of the general government (i.e., also including local and –since the 1980s– regional, governments, as well as the social security), and are available through the *Cuentas de las Administraciones Públicas* (Accounts of the General Government), published by the Ministry of Finance. Finally, the data on GDP have been taken from Prados de la Escosura (2003), who has constructed series for the main macroeconomic variables of the Spanish economy over the period 1850-2000.

The time evolution of the total and primary government surplus ($rev-exp$ and s, respectively) is shown in Figure 1, and that of the total gross debt (b) in Figure 2. In the rest of this section, we will briefly discuss the main developments of Spain's public finances between 1850 and 2000. A more detailed account of the evolution of the Spanish public sector over this one-and-a-half-century period can be found in Comín (1995, 1996); see also Comín (1994), more focused on its effects on economic growth.

In general, the traditional perception among economic historians on the role of the Spanish public sector since the beginning of industrialization in the early 19th century is rather negative. The continuous difficulties experienced by the Spanish public finances to balance the budget have been blamed of restricting the capital market for the industry, as well as distorting the allocation of resources (as shown, e.g., in the development of the railway network); see, for instance, Nadal (1975) or Tortella (1973). In fact, 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 end of the Old Regime in Spain was characterized by a deep crisis in public finances. The loss of most of the American colonial empire in the first decades of the 19th century led to a huge decrease in the remittances of the colonial administration as well as in custom tariffs. Accordingly, the large fall in revenues, coupled with high spending levels following years of wars and political instability, translated into a collapse of public finances.

The first attempt to build a modern tax system was the 1845 reform implemented by the minister of Finance Alejandro Mon, and mostly designed by Ramón Santillán. The Mon-Santillán reform "represents a fundamental milestone in the modernization of the Spanish Treasury" (Tortella, 2000, p. 175), and meant a clear improvement over the extremely complicated, and somewhat chaotic, tax system of the Old Regime. However, facing the pressure of wealthy social groups, the new system missed to satisfy the properties of equity, sufficiency, and flexibility to actually cover public expenditures.

The tax system that arises from the 1845 reform was built on French lines (the so called "Latin tax system"; see Fuentes-Quintana, 1978), and was based on the prevalence of indirect taxes, falling on specific consumption goods, and the setting of non-personal or product taxes, proportional and not progressive. The advantage of such a system was the simplicity of tax collection, but at the cost of an easy tax evasion. The tax system established by the Mon-Santillán reform was long lasting, despite some minor reforms, the most important being in 1900 (following the loss of the last Spanish colonies in Cuba and the Philippines) when the minister Raimundo Fernández-Villaverde introduced some new taxes on salaries, capital interest and business profits. Only after the fiscal reform of 1978, driven by the minister Francisco Fernández-Ordóñez, the Spanish fiscal system can be thought to be comparable to that of the rest of Western Europe. The main pillar of this reform was the creation of a modern personal income tax, together with a corporate income tax, which was completed in 1986 with the introduction of the value added tax at the time of the integration into the EU.

As stressed by Comín (1996), over most of the period analyzed the Spanish public sector was more concerned with providing 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). Government expenditure was kept at a minimum over the 19th century, according to the principles of the liberal state. During this time, most of the budget was assigned to the interest payments on the public debt (see below), as well as to paying for the salaries of the civil servants and the military.

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, in the context of World War II and the fears of the new political regime on keeping domestic peace; but it 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, due to higher spending on education, housing, and social security; however, a modern welfare state was not developed due to the lack of revenues. 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. As a result, the next years contemplated the building of a welfare state on European standards, and the development of modern and improved infrastructure. Even so, the ratio of government expenditure to GDP is still lower than the EU average.

Until here, we have examined the evolution of public revenues and expenditures. What about the budget balance?

A first point to notice is that, though both revenues and expenditures remained at low levels, the former were insufficient to finance even small amounts of the latter, so budget deficits dominated over most of the period. In the rest of this section, we will discuss how budget deficits were financed, which will allow us to explore the interactions between fiscal and monetary policies.

The immediate consequence of budget deficits was a huge increase in public debt. The maximum levels of government debt can be found at the mid 1870s,

following a period of political instability after the so-called “Glorious Revolution”, when it amounted to more than 150% of GDP; and at the beginning of the 20th century, following the last wars in Cuba and the Philippines, reaching more than 125% of GDP. Later on, only at the end of the Spanish Civil War and in the mid 1990s (just before the fiscal consolidation that allowed Spain to join the European monetary union) the ratio debt-GDP reached significant, though lower, levels, of around 70% and 60%, respectively. As a by-product of the massive levels of public debt, their interest payments represented a substantial share of the budget, which can be seen, e.g., in the large difference between total and primary government surplus in Figure 1.

However, such huge amounts of public debt proved themselves impossible to repay, which led the Spanish governments of the 19th century to put into practice several reschedulings or “conversions”, the most important occurring in 1851, 1882, and 1899-1900. In a few words, a conversion consisted of issuing a new type of debt, and the holders of the old debt were offered to exchange those titles for the new ones. The terms of the deal were negotiated with debtors so that the government largely reduced the weight of the debt, under conditions agreed by most of the debt holders. While certainly lessening the levels of debt, conversions involved a change in the rules of the game that always proved harmful to the lenders. Therefore, the reputation of the Spanish government in international financial markets was severely harmed, which led to continuous increases in the interest rates required in future loans. In spite of this, conversions were worthwhile for some debt holders, such as important bankers or businessmen with good political connections, who obtained some favourable concessions (in mining, banking, railways...) in return; see Tortella (2000).

After 1850, once the initial effects of the Mon-Santillán reform came to an end, the growing public deficit was financed by debt issuing, which accumulated to that previously existing. This situation made worse from the last 1860s: the higher expenditures associated with the pro-independence rebellion in Cuba and the start of a new Carlist war coincided with a fall in revenues, due to the abolition of the consumption tax after the 1868 revolution. Accordingly, at the mid 1870s debt service amounted to nearly 40% of total public spending.

It is in this context that the granting to the Bank of Spain of a monopoly on the issuance of bank notes in March 1874 can be understood. In exchange of this monopoly, the Bank of Spain was compelled to finance the public Treasury through discounts and advances; and, as a counterpart to these assets, the Bank of Spain will issue bank notes. In other words, government debt was directly monetized. It is true that the government established some quantitative limits to note issuance, but these limits were revised upwards in the next years. This monopoly meant a great advantage to the Bank of Spain that (as in many other countries) was not yet a central bank, but a private institution competing with other banks.

The resort to the Bank of Spain in order to finance budget deficits was helped by the decision of not adopting the gold standard. An important monetary reform was implemented in 1868, with the creation of a new monetary unit, the peseta, and the adoption of a bimetallic system, based on gold and silver. However, in the next few years silver progressively replaced gold, which had become more expensive, and convertibility between gold and the peseta was suspended in 1883. Hence, Spain remained out of the gold standard, unlike the most advanced European countries that were at the same time her main trade partners. Some authors (e.g., Martín-Aceña, 1981) have argued that not joining the gold standard had quite negative effects for the Spanish economy, on reinforcing her isolation, which prevented her to participate on the benefits of international economic integration[1]. Conversely, on giving up the discipline associated with the gold standard, the Spanish authorities were able to develop an autonomous monetary policy, which allowed them to finance budget deficits in the following years.

It is true that, although the gold standard was never adopted in Spain, in the first years of the 20th century there were several attempts to do it. However, the chronic deficits in both the trade balance and the government budget would have led to massive losses of gold, rendering the system untenable in the long run. In fact, the well-known Report of the Commission on the Gold Standard (Comisión del Patrón Oro, 1929) stated that "the collapse of the exchange rate" was due to a monetary policy subordinated to

[1] The analysis of the relationship between external openness and economic growth has been the subject of frequent controversies; two recent contributions are Bajo-Rubio (2010) and Prados de la Escosura (2010).

the needs of a Treasury constantly in deficit. So, to the extent that those deficits were mostly financed via loans of the Bank of Spain to the government, the excessive quantity of money led to a tendency to depreciation of the exchange rate. Hence, according to the Commission, it was rather doubtful that the gold standard could be maintained in the long run if the government did not balance the budget; see Tortella (2000).

Therefore, granting the monopoly on the issuance of bank notes to the Bank of Spain in 1874, together with the suspension of convertibility between gold and the peseta in 1883, transformed the Spanish monetary system from a metallic standard into a fiduciary one, not linked to an automatic monetary discipline. Consequently, budget deficits were directly monetized through the sales of government bonds to the Bank of Spain.

A change in the way in which monetization of budget deficits took place happened in 1917. Even though the government budget showed a positive balance during the first decade of the 20th century, following the stabilizing measures of the minister Fernández-Villaverde, deficits resumed in the 1910s due to the increase in military spending triggered by the Moroccan war. The situation of the budget even worsened in the 1920s, after a large increase in infrastructure investment associated with the policy of public works followed by the Primo de Rivera government. Since a law issued in 1902 had banned the Treasury from selling bonds to the Bank of Spain, a new procedure of indirect monetization of budget deficits was established in 1917. According to the new system, 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 at a lower interest rate than the yield on these bonds paid to their owners. As a result, the effect of this procedure on the monetization of the deficit was not significantly different. All this, in turn, contributed to the higher inflation levels registered by the Spanish economy. The inflationary effects of these policies (except for some particular periods) were not particularly disturbing, however, given the absence of full employment along the period (with the only exception of the 1960s); see Comín (1994).

The situation did not change significantly until 1957, when the system of indirect monetization was abolished. Although budget deficits were not large after that year, the new way of financing the existing debt was introducing mandatory quotas (*coeficiente de inversión*) through which banks were obliged to invest in government bonds. That practice was more rational since the public sector pays its debt at the market rate; but it also tends to raise interest rates, which makes more expensive both the debt service and the cost of credit for the private sector. However, budget deficits reappeared during the period of transition to democracy after the mid 1970s, following the first attempts of building a modern welfare state, and the increase in social transfers addressed to alleviate the economic crisis of that period. As a result, rising budget deficits between 1977 and 1982 led to an ever-increasing indebtedness of the public sector, which was financed again via direct monetization by the Bank of Spain as before 1917.

Only after 1982, budget deficits were progressively financed in a more orthodox way, that is, through the issuing of public debt; and, despite the accumulation of debt along the 1980s, this did not prove to be too troublesome thanks to the remarkable economic growth experienced after joining the EU. Finally, from 1993 on government deficit financing by the central bank was explicitly forbidden according to the provisions of Article 104a of the Maastricht Treaty, which paved the way for the Economic and Monetary Union in the EU.

4. Empirical results

We have seen in the previous section how the budget deficits registered in the Spanish economy had been highly persistent. In addition, when looking into how these deficits were financed, the key role (whether directly or indirectly) played by the Bank of Spain could lead us to presume that monetary policy had been subordinated to the evolution of fiscal policy during most of the period of analysis; for a summary and discussion of this issue, see Comín (1996, pp. 157-158). In this section, we will provide a formal test of the sustainability of the Spanish government deficit over the period 1850-2000 following the methodology presented at the beginning of section 3; and, more importantly, we will analyze the role played by monetary and fiscal dominance in order to get fiscal solvency along the period.

In order to examine the three Bohn's propositions, we begin by testing for the order of integration of the variables b_t, exp_t, and rev_t, using the tests of Ng and Perron (2001). These authors proposed using the tests statistics MZ_α^{GLS} and MZ_t^{GLS}, which are modified versions of the Z_α 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. According to the results in Table 1, the null hypothesis of no stationarity cannot be rejected, independently of the test, for the three series in levels; and the presence of two unit roots is clearly rejected at the 1% significance level. Therefore, the three series would be concluded to be non-stationary, and the first two propositions of Bohn (2007) would hold.

Next, we estimate the error-correction specification analogue to (4):

$$\Delta s_t = \omega + \delta(L)\Delta b_{t-1} + \rho(s_{t-1} - \alpha - \beta b_{t-2}) + \gamma(L)\Delta s_t + \eta_t \qquad (6)$$

where η_t is an error term. The results are shown in Table 2 and, as can be seen, the error-correction coefficient is estimated at –0.21, and the long-run coefficient β at 0.02. The two estimates are significant at the 1% level. Accordingly, the third proposition of Bohn (2007) would hold, and public finances would have been sustainable over the long run. In particular, the adjustment of the primary surplus-GDP ratio to a given change in the debt-GDP ratio would have had an average half-life of about three years[2]. These results would confirm those found using the more traditional approach, i.e., from the estimation of a cointegration equation such as (5), in Bajo-Rubio, Díaz-Roldán and Esteve (2010).

Notice that, while it allows obtaining estimates that are more robust, using long spans of data increases the likelihood of finding instabilities in the estimated equations. Hence, we will test for the stability of equation (6) using the tests recently proposed by Kejriwal and Perron (2008, 2010), who provide a comprehensive treatment of issues related to testing for multiple structural changes, occurring at unknown dates, in cointegrated regression models. Their work builds on Bai and Perron (1998) who undertake a similar treatment in a stationary context. Since in our case all variables are

[2] Computed as $\log(0.5)/\log(1-|\hat{\rho}|)$, where $\hat{\rho}$ is the estimate of ρ in equation (6); in our case, –0.21.

non-stationary (see the results in Table 1), we will use the new tests of Kejriwal and Perron.

Specifically, these authors propose three types of test statistics to test for multiple breaks in cointegrated regression models:

a) First, sup $F_T(k)$, a test of the null hypothesis of no structural break versus the alternative hypothesis that there are a fixed (arbitrary) number of breaks, *k*.
b) Second, *UD* max, a test of the null hypothesis of no structural break versus the alternative hypothesis that there are an unknown number of breaks given some upper bound.
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.

The results of applying the Kejriwal-Perron tests to the relationship given by equation (6) are shown in Table 3, where up to three possible breaks have been allowed for (the results did not change if up to five breaks were allowed instead). 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 long-run relationship between the primary surplus and debt to GDP ratios over the whole period.

This result is consistent with that found in Bajo-Rubio, Díaz-Roldán and Esteve (2010), where no structural change was found in the relationship between total government expenditures and revenues over the same period. Notice that, as pointed out by Comín and Díaz (2005, p. 878), despite the fact that surpluses prevailed in only 29 years between 1850 and 2000, "in relative terms, however, the importance of the government deficit has not tended to increase" along the period. One might guess that the overall strategy of fiscal policy (i.e., small revenues, insufficient to keep up even small amount of expenditures; and pervasive budget deficits, ultimately financed by resorting to the Bank of Spain) did not change substantially along the period analyzed. The situation began to change only around the mid-1980s, when some more orthodox practices on deficit financing were implemented. However, these potential candidate

years for detecting a structural change are located at the very end of the sample period, leaving an insufficient number of observations available[3].

In relation to this, notice that the simulation analysis conducted in Bai and Perron (2006) demonstrates that the size and power of these tests can be significantly distorted by two factors: (i) a small break size, and (ii) a small segment size (i.e., the length of the new regime after the break). In fact, when we looked at the residuals of equation (6), the adjustment of the equation begins to worsen after the mid-1980s and, especially, for the mid-1990s. On the other hand, the sequential procedure of Bai and Perron (1998), also used in the tests of Kejriwal and Perron (2010), excludes some observations (in our case, 15%) at the beginning and at the end of the sample. Therefore, to the extent that the most likely break points would be located at the very end of the sample, and since the last observations have been excluded on implementing the procedure, this might explain why the tests are unable to reject the null of no structural change.

Recall that, in addition to implying fiscal solvency, a positive estimate of β in equation (6) would indicate, according to the *backward-looking* approach, the prevalence of an MD regime. However, there is a possible ambiguity here, since a positive estimate of β is strictly compatible with the presence of both an MD and an FD regime. That is, in an MD regime we would observe that an increase in debt in period *t* would lead to a larger primary surplus *ex-post*; i.e.: $\Delta b_t \rightarrow \Delta s_{t+1}$, which implies an estimated $\beta > 0$. Yet, in an FD regime, a decrease in the expected primary surplus would lead to a fall in the current debt ratio, through a price increase; i.e.: $\nabla E_t s_{t+1} \rightarrow \nabla b_t$, which also implies an estimated $\beta > 0$. For that reason, we will complement the above analysis with Granger-causality tests between the primary surplus and debt to GDP ratios.

[3] Notice that some previous analyses of the sustainability of the Spanish government deficit, using data from 1964 to the second half of the 1990s, found a structural change in the relationship between government expenditures and revenues. A common result to these papers is that the break was always located around 1986-1988; see Camarero, Esteve and Tamarit (1998), de Castro and Hernández de Cos (2002), or Escario (2005).

In particular, according to Sims, Stock and Watson (1990), if two I(1) series X_t and Y_t are cointegrated, the relevant regression is the following:

$$X_t = \alpha_0 + \delta_1 X_{t-1} + \gamma_1 \left(X_{t-1} - \beta Y_{t-1} \right) + \sum_{i=1}^{m} \alpha_{1i} \Delta X_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta Y_{t-i} + \zeta_t \qquad (7)$$

with an analogous representation holding for Y_t as dependent variable. Then, to testing for Granger-causality, the null hypotheses would be: (i) $\gamma_1 = 0$, for the absence of long-run causality; and (ii) $\alpha_{2i} = 0$, for the absence of short-run causality. And the standard *F* test can be used to test for Granger-causality in the short and in the long run.

The results of the Granger-causality test for the variables primary budget surplus and government gross debt are presented in Table 4. We report *F* statistics on the null hypotheses $\gamma_1 = 0$ and $\alpha_{2i} = 0$, from the estimation of equation (7) with s_t and b_{t-1} alternatively as dependent variables. Up to three lags of the first difference of each of these variables have been included, and the number of lags has been chosen using the Akaike information criterion. The results in Table 4 indicate the presence of both long-run and short-run Granger-causality from primary surplus to debt, which would point to the prevalence of an FD regime over the period of analysis.

Finally, in order to offer a more complete picture, we present the results from applying the so-called *forward-looking* approach, following Canzoneri, Cumby and Diba (2001). According to these authors, in an MD regime a positive innovation in the primary surplus pays off some of the debt, so the future level of debt would fall. In turn, in an FD regime a positive innovation in the primary surplus should lead to a higher future level of debt, via a lower price level. Notice, however, that a possible ambiguity can also emerge here since, even if a positive innovation in the primary surplus leads to a reduction in the future level of debt, this could be compatible with an FD regime. In particular, if innovations in the primary surplus were negatively correlated with future surpluses, the future level of debt would fall through a rise in the price level; and such a case could be justified since a higher surplus today might reduce the need of future surpluses.

The impulse-response function of the debt-GDP ratio to innovations in the primary surplus-GDP ratio, from an estimated VAR in these two variables, is shown in

Figure 3 together with ±2 standard errors, over a 10-year horizon. The VAR was estimated with one lag and a constant; up to five lags were tested, and the optimal lag order was selected using the Akaike information criterion. As can be seen in the figure, the debt-GDP ratio exhibits a small, but positive, response following an innovation in the surplus-GDP ratio, and then decreases to move gradually toward zero. Accordingly, this approach would also indicate that an FD regime would have prevailed over the period of analysis.

5. Conclusions

In this paper, we have tried to provide some additional empirical evidence on the sustainability of government deficits, and, more importantly, on the role played by monetary and fiscal dominance in order to get fiscal solvency, for the case of Spain over the period 1850-2000. More specifically, once we found that public finances were sustainable, we investigated how this fiscal sustainability was achieved: i.e., through the endogenous adjustment of the primary budget surplus (in an MD regime), or through the endogenous adjustment of the price level (in an FD regime). An important point to be stressed is that our dataset extends over 150 years, which should allow us to obtain some more robust results as compared to other previous analyses.

First, we have analyzed the sustainability of government deficits by examining the relationship between primary surplus and debt, following the recent critique of Bohn (2007) to previous tests on sustainability using cointegration techniques. We found that the debt-to-GDP ratio was integrated of order one, as they were the ratios of total government expenditures and revenues to GDP too. In addition, we estimated an error-correction relationship between primary surplus and debt (both as ratios to GDP), finding a significant error-correction coefficient, and a long-run coefficient positive and also significantly different from zero at the 1% level. Accordingly, the three propositions derived by Bohn (2007) would hold, and public finances would have been sustainable over the long run, with an estimated adjustment of the primary surplus-GDP ratio to a given change in the debt-GDP ratio with an average half-life of about three years. Given the long-run span of the data, we also tested for the eventual presence of structural breaks in the estimated relationship between primary surplus and debt, following the new approach recently proposed by Kejriwal and Perron (2008, 2010), but

the results pointed to a stable long-run relationship between the primary surplus and debt to GDP ratios over the whole period.

Even though these results could be taken *prima facie* as evidence in favour of the prevalence of an MD regime, in fact the above method might not be able to distinguish properly between an FD and an MD regime. That is, in equilibrium, the fiscal solvency condition holds under both the MD and FD regimes, and the difference between them would come from how fiscal sustainability is achieved, i.e., through the adjustment of either the primary surplus or the price level in the MD and the FD case, respectively. For that reason, in order to distinguish between the two regimes, we next performed Granger-causality tests between primary surplus and debt. The results showed the presence of both long-run and short-run Granger-causality from primary surplus to debt, which would point to the prevalence of an FD regime over the period of analysis.

Finally, we also presented the impulse-response function of debt to innovations in the primary surplus, following the approach of Canzoneri, Cumby and Diba (2001). Again, since the debt-GDP ratio showed a small, but positive, response following an innovation in the surplus-GDP ratio, to decrease later gradually toward zero, this approach would also indicate that an FD regime would have prevailed along the period analyzed.

The results of this paper would agree and confirm for a longer period extending from 1850 to 2000, those previously obtained by Sabaté, Gadea and Escario (2006). Using a different approach (in particular, from the estimation of a stationary VAR model), these authors also found the prevalence of an FD regime in the Spanish case for the period 1874-1935.

Summarizing our findings, the Spanish government deficit would have been sustainable along the period 1850-2000, since the condition of fiscal solvency was fulfilled. In addition, the relationship between primary deficit and debt was found to be stable over the long run, and the whole period can be characterized as one of fiscal dominance. In other words, fiscal authorities would have set budget deficits exogenously, and the endogenous adjustment of the price level was required in order to

achieve fiscal solvency, so that monetary policy was subordinated to the needs of financing the budget deficit. Nevertheless, as shown in Bajo-Rubio, Díaz-Roldán and Esteve (2010), if the deficit was above a certain threshold (estimated at around 4.5% of GDP), budget deficits would have been cut in order to assure their long-run sustainability.

Our results would also confirm the informal evidence provided by economic historians; see, e.g., Tortella (2000) or Comín (1995, 1996). The Spanish case seems to be an example of how an FD regime is compatible with a sustainable fiscal policy; or, from a different point of view, we might conclude that an independent monetary policy (or, equivalently, an MD regime) is not a necessary condition for achieving fiscal sustainability.

Overall, the picture that emerges would be typical of a less developed country, with a rather undisciplined public sector, unable to collect revenues enough to finance even small amounts of expenditure, and compelled to engage in inflationary financing of the deficit (Comín, 1995). This was the case of Spain over most of this period, since the development of a public sector comparable to that of the rest of Western Europe can be dated only following the restoration of democracy after 1977, and especially after joining the EU in 1986. On the other hand, the more orthodox practices on deficit financing set around the mid-1980s, ending in the explicit ban on financing by the central bank after 1993, seem to be located at the very end of the sample. Accordingly, this would leave an insufficient number of observations available to detect any structural change, or to modify the results on fiscal dominance; put in other words, for most of the period analyzed there was no major change in the way the deficit was financed.

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Figure 1
Total and primary government surplus: Spain, 1850-2000

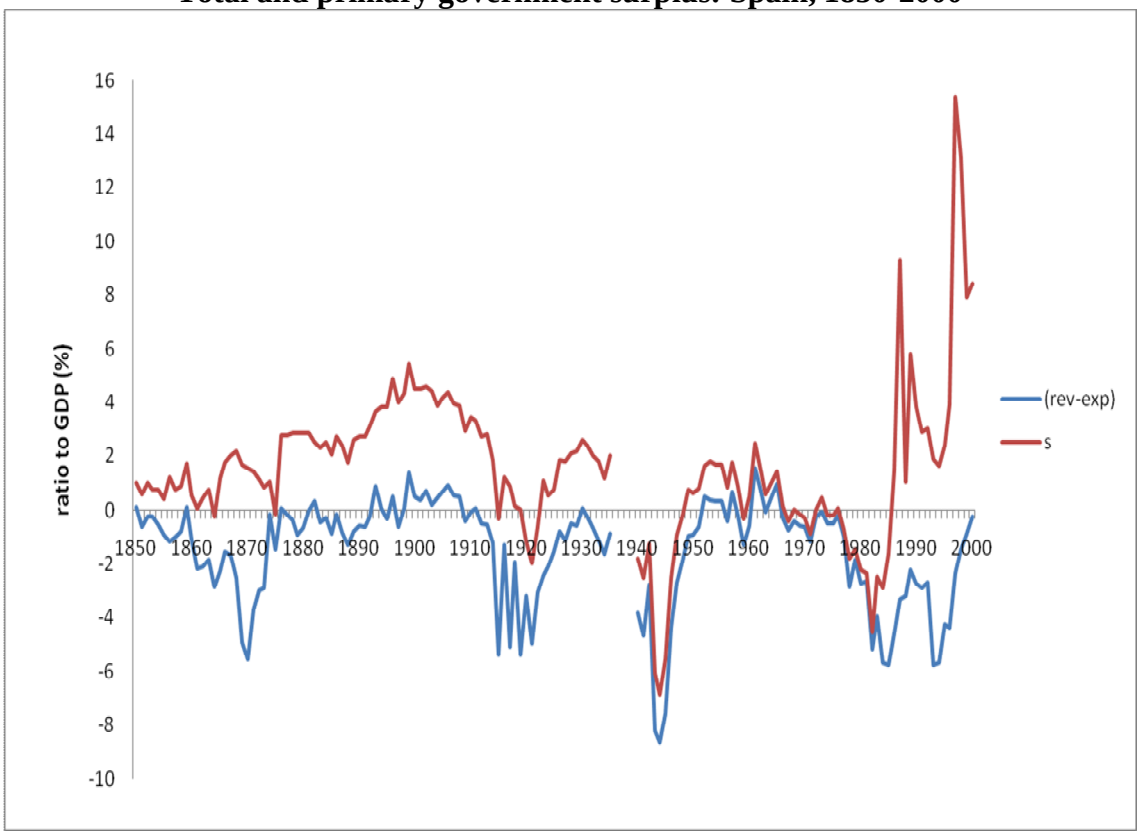

Figure 2
Total gross debt: Spain, 1850-2000

Figure 3
Response of debt/GDP to primary surplus/GDP from an estimated VAR

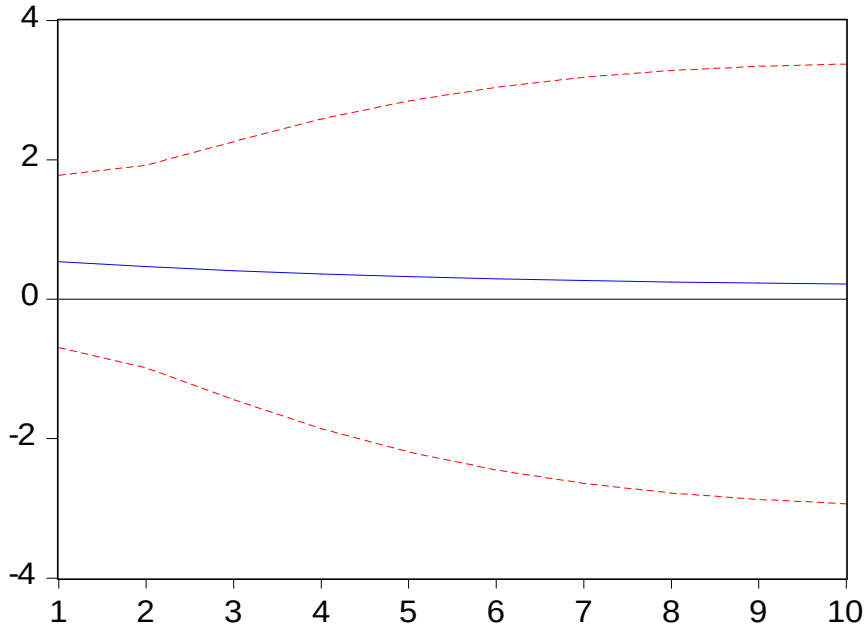

Table 1
Ng-Perron tests for unit roots

I(2) vs. I(1)

	MZ_{α}^{GLS}	MZ_{t}^{GLS}	ADF^{GLS}
Δb_t	–32.66*	–4.03*	–4.58*
Δexp_t	–62.46*	–5.58*	–8.54*
Δrev_t	–72.03*	–6.00*	–13.03*

I(1) vs. I(0)

	MZ_{α}^{GLS}	MZ_{t}^{GLS}	ADF^{GLS}
b_t	–11.62	–2.37	–2.40
exp_t	–7.59	–1.85	–1.87
rev_t	–8.18	–1.82	–1.83

Notes:
(i) * denotes significance at the 1% level. The critical values are taken from Ng and Perron (2001), Table 1.
(ii) The autoregressive truncation lag has been selected using the modified Akaike information criterion, as proposed by Perron and Ng (1996).

Table 2
Estimation of a long-run nonlinear relationship between s_t and b_{t-1}

Error-correction coefficient	-0.21^{*} (–3.84)
Long-run coefficient	0.02^{*} (2.75)

Notes:
(i) *t*-statistics in parentheses.
(ii) * denotes significance at the 1% level.

Table 3
Kejriwal-Perron tests for structural change

sup $F_T(1)$	sup $F_T(2)$	sup $F_T(3)$	*UD* max	Number of breaks selected
6.62	5.33	4.19	6.62	0

Note: No test statistic is significant at the conventional levels. The critical values are taken from Kejriwal and Perron (2010), Table 1.10, trending case.

Table 4
Sims-Stock-Watson tests for Granger-causality

H_0	$s_t \rightarrow b_{t-1}$	$b_{t-1} \rightarrow s_t$
$\gamma_1 = 0$	77.46^{*}	1.45
$\alpha_{2i} = 0$	3.26^{**}	1.13

Notes:
(i) The reported values are *F*-statistics on the null hypotheses $\gamma_1 = 0$ and $\alpha_{2i} = 0$, from the estimation of equation (7) in the text using s_t and b_{t-1} alternatively as dependent variables.
(ii) * and ** denote significance at the 1% and 5% levels, respectively.