



Testing for fiscal sustainability: New evidence from the G-7 and some European countries



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ABSTRACT

Whether or not a government deficit is sustainable has important implications for policy. If the debt of a nation is sustainable, then it implies that the government should have no incentive to default on its internal debt. In this article we examine whether or not the debt-GDP ratios of the G-7 and some European countries can be characterized by a unit root process with the non-linear trend and asymmetric adjustment. The econometric methodology allows us to determine whether the stationarity holds for the government's debt-GDP ratio after considering the non-linear trend. Among the main results, it is found that it is very likely that the debt-GDP ratios of Canada, Germany, the US and Italy are stationary after taking account of the non-linear trend in the long run. Nevertheless, it is model-dependent for the debt-GDP ratios of these countries to be asymmetrically adjusted after taking the non-linear trend into consideration.

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1. Introduction

The concept of fiscal deficit sustainability has long been a focus of research and policy debate in economics and public finance. In principle, a government will be able to sustain fiscal deficits as long as it can raise the necessary funds by borrowing. Although such a policy may be feasible in the short run, the ability of the government to service its debt by resorting to further borrowing is likely to be questioned once the deficits become persistent. Therefore, the government is required to balance its budget intertemporally by setting the current value of debt equal to the discounted sum of expected future surpluses. Violation of the intertemporal budget constraint (IBC) would indicate that the fiscal policy cannot be sustained forever because the value of debt will explode at a rate faster than the growth rate of the economy.

A myriad of studies have devoted many efforts to this issue. According to Hamilton and Falvin (1986) and Wilcox (1989),¹ early studies that examined the government's deficit sustainability used conventional unit root tests to investigate the mean-reverting behavior of the public deficit and debt (Feve and Henin, 2000; Getzner et al., 2001; Makrydakis et al., 1999; Uctum and Wickens, 2000). However, soon the cointegration approach either with or without a structural break become predominant (e.g., Afonso, 2005; Baharumshah and Lau, 2007; Bajo-Rubio et al., 2004; Gabriel and Sangduan, 2011; Goyal et al., 2004;

Kalyoncu, 2005; Lusinyan and Thornton, 2009; Martin, 2000; Quintos, 1995).² Motivated by the statistical power of the advances in panel unit root and panel cointegration tests (Maddala and Wu, 1999; Westerlund, 2006), an increasing number of authors have applied these new tools to test whether or not the government deficit is sustainable in the long run, for example, Westerlund and Prohl (2008), Afonso and Rault (2010) and Mahdavi and Westerlund (2011), to name a few.

An important feature of previous studies is that distinct results based on previous research are due to differences in methodology, approaches and samples and are subject to diverse interpretations, thus making it difficult to reach a corroborative position on the stationarity property of the government deficit. Another potential problem with previous studies is that if the government deficit is adjusted in an asymmetric or non-linear way, then conventional unit-root and cointegration tests suffer from a loss of power that may lead to the acceptance of non-stationarity when the government deficit is actually sustainable. Therefore, a growing body of research (see, for example, Arestis et al., 2004; Arghyrou and Luintel, 2007; Bajo-Rubio et al., 2006, 2010; Bohn, 1998; Cipollini, 2001; Davig, 2005; Payne et al., 2008; Sarno, 2001) has turned its attention to the adoption of more sophisticated non-linear models to test the government's ability to sustain its deficit. The empirical

² The univariate approach focuses on the stochastic properties of the stock of debt. The multivariate approach focuses on the long-run properties of the flow of expenditures and revenues, i.e., on the stochastic properties of the deficit. Therefore, sustainability through the debt implies sustainability through the deficit but the reverse is not true. Recently, Berenguer-Rico and Carrion-i-Silvestre (2011) have unified these approaches by testing for multicointegration in the flow-stock system. Escario et al. (2012) examine Spanish long-run fiscal sustainability by using the multicointegration methodology.

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¹ Trehan and Walsh (1988, 1991) show that the stationarity of the government deficit is a sufficient condition for the intertemporal budget constraint to hold.

Table 1
Studies adopt the univariate approach to test for the fiscal sustainability.

Studies	Countries and samples covered	Methodology	Sustainability
Makrydakis et al. (1999)	Greece debt–GDP ratio (1958–1995)	Zivot and Andrews' (1992) unit root test with structural break	Hold
Sarno (2001)	The US debt–GDP ratio (1916–1995)	Teräsvirta's (1994) smooth transition autoregressive (STAR) model	Non-linear stationarity and hold
Arestis et al. (2004)	The US deficit–GDP ratio (1947–2001)	Caner and Hansen's (2001) TAR unit root test	Non-linear stationarity and hold
Bajo-Rubio et al. (2004)	The Spanish deficit–GDP ratio (1964–2001)	Caner and Hansen's (2001) TAR unit root test	Non-linear stationarity and hold
Payne and Mohammadi (2006)	The US deficit–GDP ratio (1947–2003)	Perron's (1997) unit root test with structural break and Enders and Granger's (1998) TAR and MTAR unit root tests	Non-linear stationarity and hold

evidence from this line of research indicates that, by taking the non-linear property into account, the US and the European Monetary Union (EMU) countries are no longer in violation of the intertemporal budget constraint. For the benefit of readers, we summarize the recent contributions to the government deficit sustainability after 2000 in Tables 1–2.

There are at least two channels that make the budget deficit series become a non-linear process. The first rationale for incorporating possible asymmetry in the adjustment of the budget deficit stems in part from fiscal policy-makers that respond differently to a deviation of the deficit and/or surplus from its long-run trend. One would expect, for example, that the response would be more aggressive if the deficit is above its long-run trend than when it is below it (Bertola and Drazen, 1993). Second, the available empirical evidence suggests that various business cycle indicators exhibit asymmetric behavior (see, for example, Enders and Siklos, 2001). Given that the budget deficit is influenced by business cycle movements via automatic fiscal stabilizers and discretionary fiscal measures, it is reasonable to assume that the business cycle asymmetries could possibly translate into the budget deficit (Payne and Mohammadi, 2006).

The aim of this study is to re-examine whether or not the government debt of the G-7 and some European countries is sustainable. An important implication of the standard unit root tests is the implicit assumption that the adjustment process is symmetric. Indeed, if the true adjustment process is asymmetric, then the restrictive symmetric adjustment implicitly assumed is indicative of model misspecification. In order to take account of the possibility of an asymmetric adjustment of the government deficits, in line with the literature, we adopt the threshold autoregressive (hereafter TAR) and the momentum threshold autoregressive (hereafter MTAR) unit root tests, proposed by Enders and Granger (1998), in this study. In addition, in order to take the possibility of non-linear trends into consideration, we also use the logistic smooth transition threshold autoregressive (hereafter LSTR-TAR) and the logistic smooth transition momentum threshold autoregressive (hereafter LSTR-MTAR) unit root tests, championed by Sollis (2004) and Cook and Vougas (2009), in this paper. These approaches permit structural breaks to occur gradually over time instead of instantaneously.³ The reason for adopting the LSTR-TAR and LSTR-MTAR models in this study is that non-linearity may occur in the form of *structural changes* in the deterministic components as emphasized by Bierens (1997) and Leybourne et al. (1998). In this study, we find that the debt–GDP ratios of the G-7 and European countries display smooth shifts in trend rather than sudden changes (see Figs. 1–11 for the details).

As compared to the literature, the contributions of this study are threefold. First, the application of the threshold model overcomes the

³ In the context of economic time series this has considerable intuitive appeal. Generally speaking, changes in economic aggregates are influenced by the changes in behavior of a very large number of agents. It is highly unlikely that all individual agents will react simultaneously to a given economic stimulus; while some may be able to (and want to) react instantaneously, others will be prone to different degrees of institutional inertia (dependent, for instance, on the efficiency of the markets in which they have to operate) and so will adjust with different time lags (Leybourne and Mizen, 1999, p 804).

weakness of the traditional linear unit root test in detecting the fiscal sustainability. It allows us to draw conclusions about the validity of the government intertemporal budget constraint in the long run. Furthermore, investigating the short-run dynamics of the threshold model provides a test concerning the importance of asymmetric adjustment in the government debt. Second, previous studies (e.g., Bajo-Rubio et al., 2010; Berenguer-Rico and Carrion-i-Silvestre, 2011) have shed light on the importance of recognizing the possibility of a structural shift in testing for the null hypothesis of a unit root for the debt–GDP ratio. We take this possibility into consideration by employing the Sollis (2004) and Cook and Vougas (2009) approaches. They combine the ideas of Enders and Granger (1998) and Leybourne et al. (1998) and develop a test for the null hypothesis of a unit root that under the alternative hypothesis allows for stationary asymmetric adjustment around a smooth transition between deterministic linear trends. Third, as compared with previous studies where the sample ends in the early 2000s (e.g., Bajo-Rubio et al., 2004; Sarno, 2001), our period of analysis is extended to 2012, including the most recent developments in terms of the financial tsunami and the European sovereign debt crisis.

The major findings from this study are as follows. First, by using standard unit root tests we find that the debt–GDP ratios of the G-7 and some European countries are non-stationary processes, implying that the fiscal sustainability does not hold. Second, the evidence from the TAR and MTAR unit root regressions suggests that the debt–GDP ratios are stationary series with asymmetric adjustment, indicating that the government intertemporal budget constraint is likely to be on a sustainable path in the long run. Third, the results from the LSTR-TAR or LSTR-MTAR models show that the debt–GDP ratios of Canada, Germany, the US and Italy are stationary after taking into account the non-linear trend. Nevertheless, it is model-dependent for the debt–GDP ratios of these countries to be asymmetrically adjusted after taking the non-linear trend into consideration.

The remainder of this paper is organized as follows. Section 2 reviews the theoretical foundation of fiscal sustainability. Section 3 outlines the statistical methods used for testing non-linearity and the unit roots. Section 4 discusses the data used and the empirical results and compares our results with those of the extant literature. Finally, Section 5 concludes.

2. Fiscal sustainability

Tests of fiscal sustainability are commonly based on the present value of the government's intertemporal budget constraint.⁴ Consider the following one-period government budget constraint:

$$\Delta B_t = G_t - R_t, \quad (1)$$

where B_t is the real market value of government debt, G_t is real government expenditure inclusive of interest payments, R_t represents real tax

⁴ The content of this section draws heavily from Berenguer-Rico and Carrion-i-Silvestre (2011).

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