

**Public debt sustainability:
Evidence from EU countries under fiscal consolidation and non-linear unit
root tests**

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Abstract

This paper re-investigates public debt sustainability in the case of five European Union (EU) countries, i.e. Greece, Ireland, Italy, Portugal, and Spain, under bailout programmes or under fiscal consolidation measures, spanning the period 1980-2014. The empirical analysis makes use of methodologies in non-linear unit root testing and the results provide robust evidence in favour of public debt sustainability only for two countries, Ireland and Portugal. These findings suggest that the current austerity programmes implemented by these economies, especially the Greek government, is expected to trigger upward debt spirals, contributing to further fiscal unsustainability. Growth oriented policies should be the primary ingredient of a different programme for these countries to fiscally and economically survive.

Keywords: public debt ratio, sustainability, non-linear unit roots, five EU economies

JEL Classification Codes: H63, C10

1. Introduction

A number of Eurozone countries have been going through a substantially severe crisis in their public finances. The economies of countries like Greece, Ireland and Portugal have already required intervention by the European Commission, the European Central Bank (ECB), and the International Monetary Fund (IMF), following sharp increases in their sovereign bonds' yields, with financial investors also expressing increasing doubts about the ability of Spain and Italy to go on without a similar intervention. Given these unpleasant developments, there has been an increasing interest in the discussion about public debt sustainability, though sometimes increases in the sovereign debt as a proportion of GDP might be rationalised by faster adjustments of GDP vis-à-vis public debt (Reinhart and Rogoff, 2009a,b) or by expansionary

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fiscal policies implemented at the beginning of the financial crisis to stimulate real GDP (Dadush et al., 2010) or by real interest rate increases on sovereign bonds. Overall, such high increases in the public debt to GDP ratios tend to hurt the country's creditworthiness, leading to a vicious cycle between debt ratios and the capacity to serve this debt.

The macroeconomic literature has explored the likelihood that countries violate their intertemporal budget constraint. Neaime (2015) generates empirical findings that provide favourable evidence that in the cases of Ireland, Spain and Portugal, fiscal policies are sustainable, while Greece and perhaps Italy stand alone with unsustainable fiscal policies. A different strand in the literature focuses on the association between the public debt ratio and the primary surplus to GDP ratio. Bohn (2005) examines whether U.S. government policies are in line with fiscal solvency, in a sense that increases in public debt leads to increases in the government's primary fiscal balance. A positive conditional response of the primary surplus/GDP ratio to increases in the debt/GDP ratio implies that fiscal authorities react to positive changes in public debt by systematically raising the primary surplus. He documents that a positive association establishes that fiscal policy is sustainable, in a sense that satisfies the public intertemporal budget constraint.

The empirical literature has tested whether the deficit series is nonstationary, which indicates that it grows without bound over time, rendering fiscal policy unsustainable. The traditional approach in investigating the sustainability of fiscal policy is based on the intertemporal budget constraint of the government. Fiscal policy is considered sustainable if this constraint is expected to hold in present value terms, i.e. the no-Ponzi conditions must be satisfied whereby debt-holders expect the current debt to be offset by the sum of expected future discounted primary budget surpluses. Therefore, the methodology of unit roots investigates the null hypothesis of a unit root in the statistical process governing an appropriately discounted government debt series (Hamilton and Flavin, 1986; Wickens and Uctum, 1993). Moreover, linear unit root tests (i.e., those that do not consider the presence of any potential breaks) cannot identify correctly mean reversion (and, thus, sustainability) in the debt/income ratio, because this ratio is in practice bounced around by various shocks that occur at specified dates and make mean reversion difficult to detect (Ahmed and Rogers, 1995).

Trehan and Walsh (1991) check the stationarity of both the US public deficit and debt. Their results document that both series are stationary, supporting the debt sustainability hypothesis. Smith and Zin (1991) test the stationarity of the Canadian public debt and find that the association between real debt and real surpluses is not consistent with the intertemporal government budget constraint, rendering the public debt unsustainable. The main reason comes from the fact that the Canadian government systematically pays real returns to bond holders by issuing further debt. Baglioni and Cherubini (1993) find that debt is not sustainable in the Italian case, while Caporale (1995) finds that the Italian, Greek, Danish and German debts are not sustainable either.

In a different methodological framework, other studies make use of cointegration techniques to test the association between public expenditures and revenues. In the case of the U.S., Ahmed and Rogers (1995) find that debt is sustainable, while Payne (1997) finds that debt is sustainable in Germany (i.e., out of the G7 economies). Papadopoulos and Sidiropoulos (1999) make use of EU data and highlight that debt is unsustainable in the cases of Spain, Belgium, Greece, Italy and Portugal. Finally, Neaime (2012) studies the sustainability of public debt in the Middle East and North Africa (MENA) countries after the recent financial crisis. Her empirical results illustrate the presence of sustainability of fiscal policies only in the case of Tunisia.

However, the above studies have used methodologies that ignore the presence of potential non-linearities and their effect on the validity of the sustainability hypothesis. Therefore, the goal of this paper is to infer the sustainability of the public debt ratio for five EU countries that

are currently experiencing fiscal problems, i.e. Greece, Ireland, Italy, Portugal, and Spain, through non-linear unit root tests that explicitly consider the potential role of breaks in their testing approach. These countries are either under an austerity/bailout programme (Greece, Ireland and Portugal) or they have explicitly introduced by themselves austerity measures (Italy and Spain) to curb high debt ratios.

2. Data and empirical analysis

The study makes use of quarterly data on public debt and GDP for a sample of five EU countries, namely, Greece, Ireland, Italy, Portugal, and Spain, spanning the period 1980-2014. Data were sourced from Eurostat (2000-2014) and the statistical services of those countries (1980-1999). Although data were obtained from two different sources, they have been adjusted to reflect the same base year and to follow the same definitions.

We apply three unit root tests with structural breaks onto our public debt ratios. The first two unit root tests are the Lee and Strazicich (2003) Lagrange Multiplier (LM) test and the Narayan and Popp (2010) test. These tests have been shown to provide better results in terms of power and size. While they allow for two structural breaks, neither accommodates heteroskedasticity, which is particularly problematic with frequency higher than annual data. To illustrate the problem, we also apply a third test, the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) unit root test with two structural breaks, proposed by Narayan and Liu (2013). Its main advantage is that the unit root hypothesis is tested with the ML t-ratio with a heteroskedastic-consistent covariance matrix.

The LM test is applied with two breaks in the intercept (Model AA) and two breaks in the intercept and trend (Model CC), while the latter test is a ADF-type unit root test for innovation-outliners, where the problem of spurious rejection could be avoided by formulating a data generating process (DGP) as an unobserved components model. Breaks occur under both the null and alternative hypotheses. Narayan and Popp (2010) use two different specifications for the deterministic component: one allows for two breaks in the level, Model 1 (M1), and the other allows for two breaks in the level as well as in the slope of the deterministic trend component, Model 2 (M2). Table 1 presents the results of the Lee and Strazicich (2003) LM unit root test with two breaks in the intercept (Model AA) and two breaks in the intercept and trend (Model CC). In both cases, the test fails to reject the unit root null only for the case of Greece, implying the rejection of the sustainability hypothesis for this particular economy. The break dates are closely related to the Maastricht Treaty event that fundamentally imposed certain restrictions on the way the fiscal policy is implemented as well as to the European sovereign debt crisis event that deteriorated the sustainability of public debt.

Table 1. Lee and Strazicich (2003) LM unit root test results with two structural breaks.

Country	Break in intercept			Break in intercept and trend		
	Test statistic	TB1	TB2	Test statistic	TB1	TB2
Greece	-2.67	1989:3	2007:3	-4.55	1990:1	2009:4
Ireland	-5.88	1990:2	2009:3	-5.14	1991:2	2010:1
Italy	-4.62	1991:4	2008:4	-4.80	1992:3	2009:3
Portugal	-4.75	1992:2	2008:4	-4.96	1993:4	2009:2
Spain	-4.69	1990:1	2009:3	-4.72	1991:4	2009:4

Critical values for Model AA = -4.54, -3.84, -3.50 at 1%, 5%, 10%, respectively. Critical values for Model CC = -6.16, -5.59, -5.27 at 1%, 5%, 10%, respectively. TB1 and TB2 are the dates of the structural breaks.

Table 2. Narayan and Popp (2010) unit root test results with two structural breaks.

Country	Break in intercept			Break in intercept and trend		
	Test statistic	TB1	TB2	Test statistic	TB1	TB2
Greece	-2.42	1990:1	2008:4	-3.62	1991:1	2008:2
Ireland	-4.81	1991:2	2008:4	-5.46	1990:4	2009:1
Italy	-4.77	1992:1	2008:3	-5.31	1991:2	2007:2
Portugal	-4.85	1993:1	2009:2	-5.64	1993:4	2009:3
Spain	-4.73	1993:2	2009:4	-5.70	1993:3	2009:3

Critical values for Model M1 = -4.67, -4.08, -3.77 at 1%, 5%, 10%, respectively. Critical values for Model M2 = -5.29, -4.69, -4.40 at 1%, 5%, 10%, respectively. TB1 and TB2 are the dates of the structural breaks.

Table 3. Narayan and Liu (2013) GARCH unit root test results with two structural breaks in the intercept.

Country	Break in intercept		
	Test statistic	TB1	TB2
Greece	-2.28	1992:3	2008:3
Ireland	-3.89	1992:4	2008:3
Italy	-3.71	1992:3	2008:3
Portugal	-4.16	1992:4	2009:1
Spain	-3.78	1992:4	2009:2

Critical value for N=150, the range of GARCH parameters [0.05, 0.90] and break points 1992:3 and 1992:4 = -3.8362, 2008:3, 2009:1 and 2009:2 = -3.8276 at 5%. TB1 and TB2 are the dates of the structural breaks.

Table 2 presents the results of the Narayan and Popp (2010) test with two structural breaks. Once again, in both cases the test fails to reject the unit root null only for the case of Greece, while the break dates are close to those identified previously.

Finally, Table 3 reports the results of the Narayan and Liu (2013) GARCH unit root test with two breaks in the intercept. In contrast to the findings from the Lee and Strazicich (2003) and Narayan and Popp (2010) unit root tests, the new findings indicate that in the cases of Ireland and Portugal the null hypothesis of a unit root is rejected, which implies sustainability. By contrast, in the cases of Greece, Italy and Spain, the null hypothesis cannot be rejected, implying nonstationarity and the absence of mean reversion, and, therefore, non-sustainability.

Overall, the results illustrate that Greece, Italy and Spain display evidence against the sustainability hypothesis. Given the superiority of the Narayan and Liu (2013) estimates, we also argue that in relevance to the break dates, they occurred close to the 1992 Maastricht even (TB1) as well as close to the 2010 sovereign debt crisis event. Both events seem to have contributed to making the burden of the public debt non-sustainable across these three economies. Ireland and Portugal also experienced stressful events with their public debt finances, but their austerity programmes seemed to have delivered positive results.

3. Conclusions and policy implications

The empirical findings from non-linear unit root testing documented that in five EU countries, i.e. Greece, Ireland, Italy, Portugal, and Spain, under fiscal consolidation/austerity programmes, in the cases of Greece, Italy and Spain, the hypothesis of public debt sustainability was rejected. It seems that the recent global financial crisis has significantly contributed to the deterioration of the countries' fiscal performance.

The introduced fiscal adjustment measures are expected to keep their economy at low performance, which will further worsen the existing debt burden and hamper any future efforts to grow out of the accumulated public debt through higher growth rates.

Nevertheless, it should be noted that the accumulated national debt is the result of political/institutional factors as well (especially in the case of Greece). Therefore, austerity fiscal measures alone may not resolve the current fiscal problem, but should be accompanied with other political/institutional corrective measures. But this deserves explicit research to be established.

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