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The sustainability of European external debt: What have we learned?

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Abstract

In this paper we aim to analyse the level of sustainability of external debt and, more importantly, how it has changed for a number of European economies. Given the severity of the crisis since 2008, we argue that the path of external debt burdens may have changed since the start of the crisis, given the concerns about debt accumulation in most countries. We follow the advice of Bohn (2007) and analyse the reaction of present debt accumulation to past debt stock, incorporating the possibility of endogenously determined structural breaks in this reaction function. We find that structural breaks happen in most cases after 2008, highlighting the importance of the policy measures taken by most governments.

Keywords: external debt, sustainability, crisis.

JEL classification: E31, E32, C22

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1. Introduction

In the wake of the recent financial crisis of 2007-2011, many countries have taken austerity measures in order to reduce debt levels, both sovereign and external. These policies have been motivated by high levels of debt accumulation and the need for some peripheral European countries to be bailed out by the European Union (EU) in a move to reduce their debt burdens and lower the risk premia of their bonds. Whether these increases in accumulated debt, both sovereign and external, are due to a more integrated market (Blanchard, 2007, and Blanchard and Giavazzi, 2002) or to over-optimism during the "Great Moderation" (Blanchard and Milesi-Ferretti, 2010, and Jaumotte and Sodsriwiboon, 2010), the need for action is justified.

These austerity measures have aroused a considerable degree of controversy, not only about whether or not they have had the desired effect but also about whether they are even effective at all. Austerity measures aiming to reduce sovereign debt by cutting expenditure and increasing taxes may arguably affect the current account and the stock of net foreign assets and external debt. In fact, there is some controversy regarding whether or not austerity measures have an impact on the current account, though lately Atoyan et al. (2012) have shown that austerity measures act as a break on capital inflows in Europe. Cuestas et al. (2014) have also analysed this issue but for the fiscal balance in Europe, finding strong evidence of structural breaks after the ignition of the crisis. In addition, Taylor (2013) argues that the current account matters for the ignition of the crisis, due fundamentally to the connection between capital inflows and credit expansion (see also Carvalho, 2014). This is because the contractionary fiscal policies being applied reduce aggregate demand and income, and hence consumption. If income drops, fewer products will be imported and fewer products will be produced to satisfy the demand of other countries. This point is particularly relevant, since these measures have also caused a contraction in the availability of credit, for instance for companies to keep producing, and so production has fallen and unemployment has risen.

This paper analyses the potential presence of structural breaks and changes in the degree of sustainability of the external debt in a selection of EU countries. More importantly, we are interested in spotting any changes in the time series properties of net foreign assets and external debt, in particular during the crisis. Hence, although our hypothesis is linked to the analysis of sustainability, our concern lies in analysing whether the persistence of shocks to external debt declined or increased after 2008. This is arguably both relevant and important, as we may be able to shed some light on the effects of policy measures on the international financial position of a given country. Although some countries have net credit positions (see Figures 1 and 2) it is interesting to analyse how past stocks feed into the growth rate of the variable. In Figure 1, where the net external debt is displayed as a percentage of GDP, we observe that in the cases of Germany, Ireland and Luxembourg there is an increased exposure to capital out flows and increased dependence on them. A similar picture arises from Figure 2, where net international investment positions as a percentage of GDP are presented. It is also a good exercise to compare the behaviour of the variables in countries with debt with countries with credit positions in order to gain some insights into the policy measures that can be applied or exported from one country to another. Hence, the focus of the paper is on analysing the evolution of the debt positions in Europe with a focus on the countries where debt positions keep rising. In order to test for this, we make use of a recent approach developed by Bohn (2007). Basically, Bohn (2007) questions the use of tests for the order of integration of the variables and cointegration tests. According to him, the transversality condition (TC) obtained from the intertemporal budget constraint (IBC), may hold for any order of integration of deficits. So although these tests may be of interest as they can provide an idea of the time series properties of deficits (see for instance, Holmes, 2004, Cunado et al., 2010, Cuestas, 2013, and Cuestas and Staehr, 2013 for European transition economies and Christopoulos and León-Ledesma, 2010, for the US), the interpretation in terms of sustainability of debt needs to be taken with a pinch of salt (Cuestas, 2013).

We test for the sustainability of external debt *á la B*ohn, and for structural changes in the persistence of shocks to the net international investment position and net external debt, by means of using unit root and fractional integration tests along with potential breaks, using quarterly data with enough observations pre and post-2007 to discover the effects of the crisis on the evolution of external debt burdens. The focus on fractional integration relies first on the fact that it allows a much higher degree of flexibility in the dynamic specification of the data. Moreover, it avoids the abrupt change observed in the AR-based unit root tests around the case of the AR coefficient equal to or higher than 1. In fact, one of the advantages of fractional integration is that it is rather smooth around the order of integration, which may be smaller than, equal to or higher than 1. On the other hand, fractional integration and structural breaks are issues which are intimately related with many authors suggesting that fractional integration might be an artificial artefact generated by the presence of breaks in the data that have not been taken into account (Diebold and Inoue, 2001; Granger and Hyung, 2004; etc.). Another innovation of the present paper is the variables which are analysed; while the earlier literature focuses on the net international investment position of the country or its net foreign assets, whose first differences are the current account plus valuation changes, we also look at the sustainability and the structural changes of the net external debt of the country. The latter only includes assets which generate a repayment obligation and excludes others such as foreign direct investment.

The rest of the paper is organised as follows. The next section briefly summarises the literature. Section 3 explains the concept of sustainability of debt, taking into account Bohn's (2007) criticism. In Section 4, we summarise the econometric methods applied in the paper. In Section 5, we go through the results and provide a thorough discussion, while in Section 6 we draw some conclusions.

2. Brief literature review

A number of studies have analysed the sustainability of debt using Bohn's (2007) paper as a base model (see for instance Bajo-Rubio et al. 2014, and Durdu et al. 2013 and the references therein). However, these studies use annual observations and either neglect, in most cases, the effects of the financial crisis, or if the post 2007 years are included, they find no evidence of breaks in that period. In this context, Durdu et al. (2013) estimate panel error correction models for 50 countries, between net foreign assets and net exports (1970-2006), finding that weaker fundamentals tend to exacerbate the problem of external debt sustainability. On the other hand, Bajo-Rubio et al. (2014) estimate an error correction model between net foreign assets and net exports for a group of OECD countries using a time series dimension only, and finding less promising results for the European peripheral economies. To the best of our knowledge only Schoder et al. (2013) use quarterly observations until 2011, but no formal tests for breaks are performed.

Although the consideration of structural breaks has not been widely spread in the literature of debt sustainability, studies of debt crises, and especially the European debt crisis contagion since 2008, found a motivation in the sudden change in economic fundamentals after 2008. European sovereign debt crisis initially came as a surprise, including to policy makers, since economic activity, domestic and external debt were positive indicators in most of Europe previous to 2008. Unsustainability of external debt may prove to increase contagion. Beirne and Fratzscher (2013) followed a before and after 2008 approach for the period 1999-2011 in 31 countries to study changes in risk, and found that contagion was present in the European sovereign debt crisis. Gomez-Puig and

Sosvilla-Rivero (2013), employed a Granger-causality pair-wise analysis of bond yield rates using daily data in five European countries from 1999 to 2010, and identified the post 2008 global crisis period as highly relevant in debt crisis where contagion is an important characteristic.

Another line of the literature has focused on analysing the structural breaks in the long run relationship between interest rates, once again motivated by the occurrence of the financial crisis around 2008. Basse (2013) examined 10-year government bond yields in six European countries (1999-2011, monthly). His results based on unit root tests with a structural break indicate, as in Siklos and Wohar (1997), the existence of persistence in the time series; however, little evidence of structural breaks is found when analysing cointegrating relationships in the interest rates among pair-wised countries. On the other hand, Kunze and Gruppe (2014), looking at the relationship of professional forecast and observed interest rates, found a structural break, and the timing of the break in this relationship coincided with the beginning of the financial crisis in late 2008. Moreover, Sibbertsen et al. (2014) tested for a break in the persistence of government bond yield spreads between four large EU countries compared to Germany, finding evidence of a break (between 2006 and 2008) and also an increase in persistence. They use Sibbertsen and Kruse‘s (2009) test which departs from a fractional integration framework and allows for a more flexible order of integration than the traditional I(0)/I(1) dichotomy. On the contrary, the literature so far on external debt sustainability does not consider any change post-crisis.

3. The concept of sustainability of debt and structural change

Sustainability of debt is a concept which has attracted the attention of policy makers and economists alike in the last decade, particularly after the crisis that started in 2008.

Before Bohn’s (2007) seminal contribution, the use of integration and cointegration tests was popular as were tests for the order of integration of the variables to assess the sustainability of debt. This arose from the idea of Trehan and Walsh (1988, 1991) and Husted (1992) that a country is solvent, and therefore fulfils a necessary condition for sustainability, when its deficit is stationary.

However, Bohn (2007) explains and justifies why the TC may hold for any arbitrary order of integration of a deficit as a flow variable. The IBC implies that the current debt stock is equal to the present value of expected future deficits,

$$B_t = \sum_{i=1}^{\infty} \rho^i \, E_t(\Delta B_{t+i}), \quad (1)$$

where B_t is the external credit stock (a positive sign means a credit position) in t, and ρ is the discount factor, so this relation holds if,

$$\lim_{n\to\infty} \rho^n E_t(B_{t+n}) = 0. \quad (2)$$

Since $|\rho| < 1$, according to Bohn's (2007) proposition 1, Equation (2) holds for any order of integration of B_t. Even if the debt stock or the deficit is not covariance stationary, it cannot be concluded that we have a case of debt unsustainability. Rather, debt is sustainable, in the sense that the TC holds, when the debtor does not accumulate debt carelessly. Therefore, Bohn's third proposition, involves estimating the following reaction function,

$$\Delta B_t = \alpha B_{t-1} + \varepsilon_t, \quad (3)$$

and comparing the values of the estimated α with the interest rate. Note that ΔB_t is deficit or flow of debt. However, the crucial factor is to ascertain whether the TC holds, in order to assess whether the debt path is sustainable. According to Proposition 3 on pages 1844-45 in Bohn (2007), the TC holds for $\alpha \leq 0$, i.e. when B_t is not an explosive process. As a result, the TC can be assessed with a Dickey-Fuller test-like equation (Dickey and Fuller, 1979), see Equation (3). Basically, the parameter α is the one of interest in a Dickey-Fuller type regression. Note that even if the debt stock is a unit root process ($\alpha = 0$), the TC holds. Only when we have an explosive case should authorities worry about debt accumulation, and in the sense of Bohn (2007) they would accumulate debt obliviously. So strictly speaking, we are not interested in knowing if the variable is I(1) or I(0), but in knowing the value of α and its changes. This is because it is also meaningful to understand how the debt stock persistence changes after the ignition of the crises, and this justifies the use of methods which allow us to have an idea of the degree of persistence. At the end of the day, Equation (3) relates to how countries accumulate debt.[1]

This context makes testing both easy and meaningful. Moreover, the model in Equation (3) can be made slightly more complicated by allowing for non-constant values

[1]See Phillips, Shi and Yu, 2014 for the appropriateness of ADF tests alike to detect explosive processes.

of α. This is of particular interest if important events have occurred and the path of debt accumulation may have changed. Hence, the autoregressive parameter can be written as,

$$\alpha_t = F(gdp_t, g_t, unem_t),$$

where F is simply a generic function of gdp_t, g_t and $unem_t$, which are the growth rates of GDP, government spending and the unemployment rate respectively. We argue that sudden changes in these macro-foundations may change the reaction function (3), and hence

$$\Delta B_t = \alpha_t B_{t-1} + \varepsilon_t.$$

In our context, many governments have been concerned about the amount of accumulated debt following the debt crisis which started in 2007 or 2008 depending on the country, and they have engaged in contractionary fiscal policies. Whether or not these austerity measures have had the desired effects is not only of academic interest, but also of policy and political interest, so it becomes interesting to estimate the following modification of Equation (3):

$$\Delta B_t = \alpha_1 I(t \leq Tb) B_{t-1} + \alpha_2 I(t > Tb) B_{t-1} + \varepsilon_{t\,,} \tag{4}$$

where I is an indicator function and T_b is the time of break. This approach is interesting provided that it is possible to observe how the autoregressive parameter increases or decreases after a given date. In our context, this would be an indication of the effect of certain measures or decisions on the evolution of debt burdens. Of course, this date does not need to be exogenously determined because the value of the autoregressive parameter would be expected to fall after austerity measures are applied for instance. But herein lies the controversy; not all countries have managed to apply the measures, as, for example, their unemployment rates are far too high.

As an alternative to the AR-setting in the context of unit root testing we also employ fractional integration or I(d) processes of the form:

$$(1 - L)^d B_t = \varepsilon_t\,, \tag{5}$$

where d can be any real value. Clearly, the unit root case (i.e., $\alpha = 0$ in (3)) corresponds now to d = 1 in (5). AR and fractional departures from (3) and (5) have very different long run implications. In (5), B_t is nonstationary but non-explosive for all $d \geq ½$. As d increases beyond ½ and through 1, B_t can be viewed as becoming "more nonstationary" , but it does so gradually, unlike in the case of (3) around $\alpha = 0$. The dramatic long run change in (3) around $\alpha = 0$ has the attractive implication that rejection of $\alpha = 0$ can be interpreted as evidence of either stationarity or explosivity, but rejections of the null does not necessarily warrant acceptance of any particular alternative. In this respect, fractional integration can be taken as an additional alternative in unit root testing approaches. In the next section, we provide a summary of the methods employed in the paper.

4. Methodology

As a preliminary analysis we use fractional integration techniques to analyse the degree of persistence of shocks. Fractional integration methods lend more flexibility to the analysis as the parameter *d* for the order of integration *I(d)*, is allowed to take any non-integer number. Note that this is an alternative way of measuring persistence, since in the *I(d)* framework, the higher the value of d is, the higher the level of association is between observations far apart in time. In fact, the main difference between the short-memory and the fractional frameworks is in the rate of decay of the autocorrelations, which are exponentially fast in the autoregressive case, but hyperbolically slow in the *I(d)* models. In our approach we estimate the order of integration for different samples so as to assess how the persistence, i.e. the way countries accumulate debt, changes after the crisis. Although in principle this is not exactly the idea of Bohn (2007), it can shed some light on the persistence of shocks and the evolution of that persistence. This would go in hand with the pre-Bohn (2007) literature on sustainability.

Two methodologies are employed for testing fractional integration. First, we use a parametric method based on the Whittle function in the frequency domain (Dahlhaus, 1989). In particular, we use first a model of the following form:

$$y_t = \alpha + \beta t + x_t; \quad (1 - L)^d x_t = u_t, \quad t = 1, 2, ..., \tag{6}$$

where y_t is the observed time series, α and β are the unknown coefficients corresponding to an intercept and a linear trend, and the resulting errors, x_t, are assumed to be white noise. Here we will consider the three standard cases examined in the literature, assuming a): no deterministic terms (i.e. α = β =0), b): an intercept (α unknown and β = 0), and c): an intercept with a linear time trend (α and β unknown).

A semi-parametric method will also be employed. This method is basically a local 'Whittle estimator' in the frequency domain, using a band of frequencies that degenerates to zero (see Robinson, 1995 for further details). As with the parametric case, the estimates of d were obtained from the first differenced data with 1 added to the resulting estimated values.[2]

However, the motivation for our analysis lies in the possibility of changes in the degree of sustainability, i.e. Equation (4). For this purpose, we make use of the method developed by Bai and Perron (2003). This approach allows us to test first for the existence of any structural changes, fixing a maximum number of breaks, to choose endogenously the break points, and to estimate all the parameters of the relationship of interest.

Bai and Perron (2003) propose the estimation of any relationship by OLS for different subsamples, and chose the breaks which minimise the sum of squared residuals (SSR). That is,

$$Y = X\beta + \bar{Z}\delta + U, \qquad (7)$$

where Y and X are vectors of variables in T, U is a vector of residuals, $\delta = (\delta_1', \delta_2', \ldots, \delta_{m+1}')'$ and $\bar{Z}$ is the matrix which diagonally partitions the full set of observations Z at $(T_1, \ldots, T_m)$, which are the break points. Hence, for each m-partition $(T_1, \ldots, T_m)$, the estimations of β and δ_i are obtained by minimising the SSR

$$S = (Y - X\beta - \bar{Z}\delta)'(Y - X\beta - \bar{Z}\delta). \qquad (8)$$

Once the estimates for the partitions are estimated as $\hat{\beta}(T_j)$and $\hat{\delta}(T_j)$, they are plugged into the objective function, equation (7), and the breaks are obtained such that $argmin_{T_{1,\ldots,}T_m} S_T(T_{1,\ldots,}T_m)$. The break points can be obtained by a grid search, which is very convenient for a small number of breaks, i.e. if there are two or fewer. In our case, the vector X does not contain any variables, and $\bar{Z}$ contains B_t. Finally, to match equation (7) with (4), the vector of parameters δcontains $\alpha_1$and α_2.

Bai and Perron (2003) also propose two types of test for the number of breaks. The first tests the null hypothesis of no breaks versus k breaks. The procedure involves defining

[2] Other "Whittle" semiparametric approaches that do not require first differences (Abadir et al., 2007) were also employed and produced essentially the same results as in Robinson (1995).

the partitions such that $T_i = T\gamma_i(i = 1, \dots, k)$. The authors propose the following matrix $(R\delta)' = (\delta_1' - \delta_2', \dots, \delta_k' - \delta_{k+1}')$, and define the following *F* statistic,

$$F_T(\gamma_1, \dots, \gamma_k; q) = \frac{1}{T}\left(\frac{T-kq-q-p}{kq}\right)\hat{\delta}'R'(R\hat{V}(\hat{\delta})R')^{-1}R\hat{\delta}, \qquad (9)$$

where $\widehat{V}(\hat{\delta})$ is an estimate of the variance covariance matrix of $\hat{\delta}$ robust to autocorrelation and heteroskedasticity and q is the number of regressors. Hence the test is $supF_T(k; q) = F_T(\hat{\gamma}_1, \dots, \hat{\gamma}_k; q)$ where $\hat{\gamma}_1, \dots, \hat{\gamma}_k$ minimise the global SSR. In addition Bai and Perron (1998) propose a test for *q* structural breaks vs *q+1,* which is a $supF_T(q+1|q)$.

The Bai and Perron (2003) method will give us a good indication of increases or reductions in the persistence of shocks, shown in the parameter α. However, we can go further and analyse whether there are changes in the order of integration from I(1) to I(0) and vice versa, particularly since the t-statistics may not be valid due to spurious relations, as the order of integration of the error term *U* is unknown. Within this approach we look at more abrupt changes, so we propose applying the Leybourne et al. (2007) approach. This method is based on a Dickey-Fuller type regression such as in Equation (3), where the H_0: $\alpha = 0$ all over the sample vs H_1: $\alpha_t < 0$for $t \in (T_1, T_2)$, i.e. the process is stationary for some subsample(s). This allows to test for changes in persistence from unit root to stationarity and vice versa. They base their analysis on a Dickey-Fuller test with a generalised least squares detrended series (such asin Elliot *et al.*, 1996), using a subsample of λT and τT to compute $\mathrm{DF_G}(\lambda, \tau)$, which is the t-ratio for the estimated α. The *M* statistic for a change in persistence is obtained as:

$$M = inf_{\lambda\in(0,1)} inf_{\tau\in(\lambda,1)} \mathrm{DF}_G(\lambda, \tau)\ . \qquad (10)$$

Critical values for this test are provided in Leybourne et al. (2007, p. 13) for different sample sizes. Alternatively, we could have employed the method suggested in Gil-Alana (2008), which is a generalisation of Bai and Perron’s (2003) method to the fractional case or the test proposed by Sibbersten and Kruse (2009). However, given that the break dates seem to occur in most of the cases at the extreme of the sample sizes, the applicability of these methods would be very limited, noting that fractional integration requires a long span of data. In addition, the latter test would analyse changes from nonstationary long memory process to I(1), which although interesting in macro data, would add very little in terms of economic intuition in our analysis.

5. Results

5.1 Data and stylised facts

Two variables are employed in this work, which are the Net International Investment Position (NIIP) and the Net External Debt (NED) as a percentage of GDP. The data consist of quarterly observations from the mid-1990s to the end of 2013, downloaded from Eurostat. The availability of data depends on the country. Our target countries are Austria, Bulgaria. Croatia, Estonia, Finland, Germany, Hungary, Ireland, Italy, Latvia, Luxembourg, the Netherlands, Poland, Portugal, Romania, Slovenia, Spain, Sweden and the UK. This is a large number of countries (19) compared to other studies. One of the main challenges is the low number of observations per country, with an average of 44 observations per country for NED and 50 for NIIP, which is a common limitation in studies of the sustainability of external debt imbalances. When working with annual data, most studies start from 1970, which implies time series of about 40 observations.[3] From among the large economies in the European Union, France is not included in the analysis because the number of observations is too low. More details are provided in the appendix.

As previously mentioned, NIIP represents the overall net foreign capital in the country, whereas NED is a subset of NIIP with only those assets which imply a repayment obligation. It could be argued that NED sustainability is a safer position for the country to target than NIIP, as it does not consider assets with a repayment obligation. For comparison purposes we use both. The data have not been seasonally adjusted, as preliminary tests of seasonality rejected the evidence of identifiable seasonality for most of the countries analysed. The data are displayed in Figures 1 and 2. When looking at the NED, we observe four groups of countries: a first group consisting of Bulgaria, Estonia, Hungary, Latvia, Lithuania, the Netherlands, Spain, Sweden and the UK with an increasing NED until 2008-2009; a second group of Croatia, Finland, Italy, Poland, Portugal, Romania and Slovenia, with an increasing or non-decreasing NED even after 2008; and a third group of Austria and Germany, with a falling NED since the start of the sample period. The forth group includes Ireland and Luxembourg, which have clear credit positions that increase during the examined period. The case of Finland is worthy of

[3]Even in the closely related literature on the sustainability of the current account, it is common to have a time series starting in 1960, meaning there are difficulties in moving much beyond 50 observations.

mention for the U-shaped behaviour of the NED, as is the case of Luxembourg with a similar U-shape closer to the central years of the crisis.

[Insert Figures 1 and 2 about here]

From Figure 2, we get a slightly different picture. In most cases we observe a declining NIIP position, implying capital inflows and current account deficits. However, there are a few exceptions, namely Austria, Finland, Germany, the Netherlands and Sweden, which have stronger export sectors. Overall, it seems that the NIIP is worse for the peripheral countries, despite the austerity measures applied by most of the governments in these countries. Amongst other things this may be due to an increase in foreign direct investment.

5.2 Econometric results

First we estimate the fractional differencing parameter *d* for both the NED and the NIIP series, using parametric and semi-parametric methods, the latter for different bandwidths, for the whole sample and for the sample finishing in 2007:4 just before the start of the crisis. Comparing the results for both subsamples gives an idea of the potential changes in the degree of persistence after 2008.

For the NED series (Tables 1 and 2), the parameter *d* is relatively close to 1 in most cases, with no possibility of rejection of a unit root in nearly all of them. Using the parametric approach (in Table 1) we observe that there are some explosive cases such as Bulgaria, Estonia, Finland, Latvia, Poland, Romania, Slovenia, Spain and Sweden, implying unsustainable debt burdens. Similar results are found with the semi-parametric estimates reported in Table 2. We should compare these results with those in Tables 5 and 6 where the data end at the last quarter of 2007. In some cases there is a reduction in the degree of persistence of the shocks shown by a reduction in the estimated *d* for most specifications, but the picture does not hold for all of them. Overall, we can say that, in general, for the core EU countries the persistence of shocks seems to have declined after the crisis. However, the results seem to be less promising for the peripheral countries.

[Insert Tables 1 -8 about here]

The results for the NIIP series (Tables 3 and 4) seem to be slightly more promising as Table 3 shows that the data are not explosive for most countries. The exceptions are Bulgaria, Croatia, Estonia, Latvia, Romania and Slovenia, where shocks do seem to have explosive effects. Comparing Tables 3 and 4 with Tables 7 and 8, we get a similar conclusion as with the NED: there is a reduction in the estimated value of *d* for some countries, but this does not hold for all countries.

The results of the estimation for the autoregressive (AR) parameters in equations (3) and (4) are displayed in Tables 9 and 10, for the NED and NIIP respectively, along with the break dates in columns 2 to 5. Given that we are mainly interested in a potential break after the start of the crisis, and that the number of observations is quite limited for some countries, we allow for a maximum of one break. To test for just the existence of breaks, we have used the F-test and the information criteria proposed by Bai and Perron (2003).[4] When looking at the results for the NED in Table 9, we observe that the AR parameter is close to zero, and in most cases above zero, which reinforces the findings based on fractional integration. We also notice that the breaks occur well inside the post 2008 period, and in many cases we find that the AR parameter gets smaller after the break. These are the cases of Bulgaria, Estonia, Hungary, Latvia, Lithuania, Portugal, Slovenia, Spain and the UK. From this group Portugal and Spain were probably more severely affected by the sovereign debt crises, with high unemployment rates and bail outs from the EU. Hence measures to reduce the accumulation of debt may have had some positive effects for all these 9 countries. Focusing now on the results for the NIIP, it can be highlighted that the breaks seem to happen before those for the NED, and that a larger number of countries have benefitted from a reduction in the AR parameter; these are Austria, Bulgaria, Croatia, Estonia, Finland, Germany, Hungary, Latvia, Lithuania, Portugal, Romania, Slovenia, Spain and the UK. Interestingly no breaks are found for Italy, Luxembourg and Sweden, as was the case with the NED, and nor for Ireland or Poland. This means that for these latter countries nothing major seems to have happened in terms of debt accumulation. The case of Ireland is interesting; for its NED we observe an increase in the AR parameter, meaning that foreign credit accumulation increases after the crisis. Overall, it seems that the NIIP position enjoys a healthier position than the NED in most countries.

[4]Results not displayed but are available upon request to the authors.

[Insert Tables 9 and 10 about here]

Complementarily, in the last two columns of Tables 9 and 10, we display the results of the Leybourne et al. (2007) tests, which, as previously mentioned, allow us to examine more thoroughly the changes from I(1) to I(0) and vice versa. However, the results do not seem to be very promising; for the NED only the last few observations for Luxembourg seem to be stationary and mean reverting, whereas for the NIIP, Ireland, the Netherlands and Slovenia seem to have some periods where the unit root is rejected. Yet again, the case of Ireland attracts our attention; in 2005-2006 the data show reversion to the mean, probably indicating the end of the "Great moderation". Similar results are found for the Netherlands.

6. Conclusions

With the aim of shedding some light onto the issue of external debt sustainability and structural changes which are potentially due to the austerity measures taken after the ignition of the 2008 crisis, we have tested for structural breaks in the reaction function of past debt stocks on present deficits for a group of European countries.

To do so, we have applied state-of-the-art time series econometrics in the form of fractional integration, and the Bai and Perron (2003) and Leybourne et al. (2007) methods. Unlike the previous literature, we find changes in the degree of persistence of shocks after the beginning of the crisis, in most cases implying a reduction in the way past debt burdens feed into debt accumulation in the present period, in particular for the net international investment position. This is of great satisfaction as it proves that most countries have managed to control the way they accumulate debt. However, there are some exceptions, such as the Netherlands for the net international investment position and Croatia, Finland, Germany, Ireland and Poland for the net external debt.

Appendix

Data availability

Country	NED	NIIP
Austria	2000:1-2013:3	1996:4-2013:3
Bulgaria	2003:4-2013:3	2003:4-2013:3
Croatia	2001:1-2013:3	2001:1-2013:3
Estonia	2003:4-2013:3	1996:1-2013:3
Finland	1996:1-2013:3	1994:4-2013:3
Germany	2003:4-2013:3	2003:4-2013:3
Hungary	2000:1-2013:3	1997:1-2013:3
Ireland	2003:4-2013:3	2003:4-2013:3
Italy	2003:4-2013:1	2003:4-2013:2
Latvia	2000:1-2013:3	1999:4-2013:4
Lithuania	2003:4-2013:3	1996:4-2013:3
Luxembourg	2003:4-2013:3	2003:4-2013:3
Netherlands	2003:2-2013:3	2003:2-2013:3
Poland	2003:4-2013:3	2003:4-2013:3
Portugal	2003:4-2013:3	2003:4-2013:3
Romania	2001:4-2013:3	2001:4-2013:3
Slovenia	2004:1-2013:3	2003:4-2013:3
Spain	2002:1-2013:3	1994:4-2013:3
Sweden	1998:4-2013:3	1998:4-2013:3
UK	1995:1-2013:3	1994:4-2013:3

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Table 1: Estimates of d (and 95% intervals) in the NED series

Country	No regressors	An intercept	An intercept and linear time trend
Austria	0.86 (0.66, 1.14)	0.54 (0.38, 0.77)	0.57 (0.42, 0.78)
Bulgaria	**1.23 (1.08, 1.45)**	**1.27 (1.14, 1.46)**	**1.27 (1.14, 1.45)**
Croatia	1.18 (0.63, 1.89)	0.79 (0.67, 1.33)	0.76 (0.47, 1.30)
Estonia	**1.28 (1.14, 1.49)**	**1.40 (1.26, 1.64)**	**1.40 (1.27, 1.63)**
Finland	0.99 (0.89, 1.16)	**1.14 (1.02, 1.33)**	**1.14 (1.02, 1.32)**
Germany	0.83 (0.63, 1.18)	0.99 (0.60, 1.43)	1.01 (0.79, 1.38)
Hungary	0.75 (0.56, 1.03)	0.97 (0.86, 1.16)	0.97 (0.83, 1.16)
Ireland	0.88 (0.82, 1.27)	1.13 (0.99, 1.35)	1.14 (0.99, 1.37)
Italy	0.85 (0.54, 1.19)	0.80 (0.67, 1.23)	0.61 (0.06, 1.22)
Latvia	**1.22 (1.10, 1.40)**	**1.35 (1.25, 1.49)**	**1.33 (1.23, 1.47)**
Lithuania	0.97 (0.73, 1.32)	1.16 (0.99, 1.40)	1.15 (0.99, 1.39)
Luxembourg	0.91 (0.69, 1.21)	0.94 (0.71, 1.26)	0.94 (0.71, 1.26)
Netherlands	0.61 (0.38, 1.08)	0.89 (0.72, 1.15)	0.89 (0.70, 1.15)
Poland	0.82 (0.58, 1.20)	**1.28 (1.07, 1.67)**	**1.29 (1.07, 1.66)**
Portugal	**0.75 (0.51, 1.08)**	0.99 (0.85, 1.31)	0.94 (0.65, 1.34)
Romania	1.15 (0.99, 1.39)	**1.26 (1.12, 1.47)**	**1.26 (1.13, 1.45)**
Slovenia	**1.26 (1.12, 1.46)**	**1.26 (1.13, 1.44)**	**1.24 (1.11, 1.41)**
Spain	0.81 (0.66, 1.11)	**1.32 (1.20, 1.50)**	**1.31 (1.18, 1.50)**
Sweden	0.43 (0.19, 0.74)	1.16 (0.83, 1.53)	1.16 (0.83, 1.57)
UK	0.83 (0.68, 1.02)	0.92 (0.79, 1.10)	0.92 (0.79, 1.10)

Note: Estimation of the *d* parameter in equation (5).In bold, evidence of explosive behaviour (d > 1) at the 5% level.

Table 2: Semi-parametric estimates for NED

Country/Bandwidth	5	6	7	8	9	10
Austria	1.013	0.904	0.779	0.808	0.734	0.717
Bulgaria	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**1.466**
Croatia	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
Estonia	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**1.419**
Finland	1.253	1.289	**1.388**	**1.472**	**1.425**	**1.336**
Germany	**1.427**	1.157	1.032	0.891	0.965	0.962
Hungary	**>1.500**	**>1.500**	**>1.500**	**>1.500**	1.193	1.038
Ireland	1.301	1.248	**1.398**	**1.342**	**1.421**	**1.490**
Italy	<0.500	<0.500	<0.500	<0.500	<0.500	0.542
Latvia	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**>1.500**
Lithuania	1.205	1.319	1.263	**1.341**	**1.388**	1.239
Luxembourg	1.052	1.072	1.197	1.217	1.039	1.080
Netherlands	**>1.500**	**1.465**	1.041	1.031	0.912	0.947
Poland	1.239	1.179	1.169	1.246	**1.313**	**1.403**
Portugal	1.039	1.090	0.982	1.131	**1.288**	1.119
Romania	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**1.465**
Slovenia	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**1.418**
Spain	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**1.495**
Sweden	0.824	1.018	1.273	**1.432**	**1.353**	1.158
UK	1.137	1.240	1.102	1.170	1.267	1.246
95% I(0)	-0.367 0.367	-0.335 0.335	-0.310 0.310	-0.290 0.290	-0.274 0.274	-0.260 0.260
95% I(1)	0.632 1.367	0.664 1.335	0.689 1.310	0.709 1.290	0.725 1.274	0.740 1.260

Note: Estimation of the *d* parameter in equation (6).In bold, evidence of explosive behaviour (d > 1) at the 5% level. Values of d greaterthan1.500 or less than 0.500 indicate that the proper estimate of the series may be higher or lower than this number since the estimation is restricted to the interval (-0.5, 0.5) in first differences.

Table 3: Estimates of d (and 95% intervals) in the NIIP series

Country	No regressors	An intercept	An intercept and linear time trend
Austria	0.79 (0.68, 0.97)	0.72 (0.60, 0.91)	0.69 (0.55, 0.90)
Bulgaria	**1.20 (1.03, 1.48)**	**1.48 (1.33, 1.71)**	**1.45 (1.31, 1.68)**
Croatia	0.95 (0.73, 1.29)	**1.24 (1.05, 1.54)**	**1.24 (1.04, 1.54)**
Estonia	**1.25 (1.10, 1.48)**	**1.26 (1.10, 1.47)**	**1.24 (1.09, 1.45)**
Finland	1.03 (0.89, 1.24)	1.03 (0.88, 1.24)	1.03 (0.88, 1.24)
Germany	1.12 (0.79, 1.52)	0.99 (0.53, 1.48)	1.02 (0.77, 1.41)
Hungary	0.91 (0.73, 1.14)	1.05 (0.93, 1.22)	1.05 (0.93, 1.22)
Ireland	0.93 (0.76, 1.19)	0.98 (0.83, 1.23)	0.97 (0.78, 1.24)
Italy	0.91 (0.67, 1.21)	0.67 (0.49, 1.03)	0.75 (0.57, 1.03)
Latvia	1.11 (0.92, 1.37)	**1.35 (1.21, 1.60)**	**1.32 (1.18, 1.60)**
Lithuania	0.99 (0.82, 1.21)	1.09 (0.93, 1.29)	1.08 (0.93, 1.28)
Luxembourg	0.74 (0.53, 1.05)	0.54 (0.25, 0.99)	0.54 (0.21, 0.99)
Netherlands	0.91 (0.82, 1.06)	0.93 (0.83, 1.08)	0.91 (0.78, 1.09)
Poland	0.91 (0.62, 1.27)	1.01 (0.83, 1.52)	1.02 (0.76, 1.51)
Portugal	0.89 (0.62, 1.19)	1.11 (0.91, 1.41)	1.11 (0.89, 1.42)
Romania	0.89 (0.67, 1.26)	**1.15 (1.02, 1.36)**	**1.15 (1.01, 1.37)**
Slovenia	1.03 (0.87, 1.24)	**1.18 (1.03, 1.37)**	**1.17 (1.02, 1.36)**
Spain	0.89 (0.79, 1.09)	0.96 (0.88, 1.08)	0.95 (0.85, 1.09)
Sweden	0.76 (0.59, 1.07)	0.57 (0.44, 0.93)	0.55 (0.31, 0.94)
UK	0.93 (0.78, 1.14)	0.92 (0.78, 1.14)	0.92 (0.78, 1.14)

Note: Estimation of the *d* parameter in equation (5).In bold, evidence of explosive behaviour ($d > 1$) at the 5% level.

Table 4: Semi-parametric estimates for NIIP

Country/Bandwidth	5	6	7	8	9	10
Austria	1.283	0.801	0.708	0.617	0.656	0.731
Bulgaria	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**1.465**
Croatia	1.264	1.161	1.194	**1.305**	**1.377**	**1.289**
Estonia	1.182	**1.365**	1.042	1.177	1.208	**1.284**
Finland	0.692	0.741	0.842	0.874	0.967	0.894
Germany	1.223	1.247	0.948	0.967	1.017	0.966
Hungary	1.252	**>1.500**	**>1.500**	1.235	1.271	**1.355**
Ireland	1.286	1.284	1.307	**1.467**	**>1.500**	1.142
Italy	0.684	0.794	0.878	0.985	1.086	1.081
Latvia	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**>1.500**
Lithuania	**>1.500**	**1.458**	0.994	0.898	0.980	1.079
Luxembourg	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
Netherlands	**>1.500**	1.147	1.211	1.179	1.212	1.110
Poland	0.837	0.659	0.764	0.864	0.953	0.944
Portugal	1.341	1.187	**1.355**	**1.413**	1.356	1.326
Romania	**>1.500**	1.219	1.187	1.269	**1.347**	**1.309**
Slovenia	**1.434**	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**1.389**
Spain	**>1.500**	**1.341**	**1.353**	1.238	1.110	1.064
Sweden	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
UK	0.685	0.859	0.694	0.771	0.818	0.851
95% I(0)	-0.367 0.367	-0.335 0.335	-0.310 0.310	-0.290 0.290	-0.274 0.274	-0.260 0.260
95% I(1)	0.632 1.367	0.664 1.335	0.689 1.310	0.709 1.290	0.725 1.274	0.740 1.260

Note: Estimation of the *d* parameter in equation (6).In bold, evidence of explosive behaviour (d > 1) at the 5% level. Values of d greaterthan1.500 or less than 0.500 indicate that the proper estimate of the series may be higher or lower than this number since the estimation is restricted to the interval (-0.5, 0.5) in first differences.

Table 5: Estimates of d (and 95% intervals) in the NED series. Data ending in 2007q4

Country	No regressors	An intercept	An intercept and linear time trend
Austria	0.92 (0.69, 1.24)	0.60 (0.48, 0.83)	0.47 (0.22, 0.81)
Bulgaria	1.01 (0.59, 1.53)	0.75 (0.36, 1.19)	0.81 (0.43, 1.27)
Croatia	0.54 (0.38, 1.23)	1.02 (0.80, 1.44)	1.01 (0.57, 1.44)
Estonia	0.82 (0.61, 1.21)	0.97 (0.55, 1.29)	0.97 (0.70, 1.37)
Finland	0.95 (0.79, 1.22)	0.83 (0.70, 1.10)	0.82 (0.65, 1.08)
Germany	0.93 (0.58, 1.43)	0.99 (0.79, 1.49)	0.74 (-0.11, 1.47)
Hungary	0.92 (0.70, 1.25)	1.02 (0.87, 1.36)	1.03 (0.83, 1.41)
Ireland	0.76 (0.31, 1.32)	0.59 (0.19, 1.18)	0.59 (0.19, 1.18)
Italy	0.61 (0.22, 1.15)	1.06 (0.65, 2.03)	0.97 (0.03, 2.00)
Latvia	0.82 (0.73, 0.99)	1.02 (0.89, 1.29)	0.97 (0.76, 1.35)
Lithuania	0.95 (0.66, 1.45)	1.03 (0.67, 1.36)	1.08 (0.79, 1.44)
Luxembourg	0.72 (0.22, 1.30)	0.51 (0.23, 1.25)	0.13 (-0.38, 1.20)
Netherlands	0.74 (0.35, 1.33)	0.47 (0.19, 0.96)	0.44 (0.04, 0.96)
Poland	0.76 (0.39, 1.28)	**1.56 (1.29, 1.95)**	**1.50 (1.28, 1.90)**
Portugal	0.78 (0.38, 1.37)	0.89 (0.55, 1.54)	0.94 (0.47, 1.64)
Romania	**1.35 (1.12, 1.66)**	**1.39 (1.08, 1.73)**	**1.38 (1.11, 1.71)**
Slovenia	0.80 (0.47, 1.18)	0.77 (0.46, 1.13)	0.78 (0.41, 1.27)
Spain	0.81 (0.66, 1.16)	**1.15 (1.04, 1.34)**	**1.22 (1.03, 1.47)**
Sweden	0.11 (0.05, 0.70)	0.97 (0.31, 1.45)	1.00 (0.14, 1.45)
UK	0.79 (0.63, 1.08)	0.88 (0.27, 1.09)	0.85 (0.68, 1.10)

Note: Estimation of the *d* parameter in equation (5).In bold, evidence of explosive behaviour (d > 1) at the 5% level.

Table 6: Semi-parametric estimates for NED.Data ending in 2007q4

Country/Bandwidth	5	6	7	8	9	10
Austria	1.003	0.966	0.852	0.893	0.838	0.710
Bulgaria	1.252	**1.416**	**>1.500**	1.066	1.026	---
Croatia	1.346	**1.404**	0.891	0.909	0.959	1.039
Estonia	**>1.500**	1.194	1.311	1.173	1.103	---
Finland	1.121	1.001	0.679	0.756	0.820	0.841
Germany	1.118	1.044	1.132	1.200	---	---
Hungary	**>1.500**	1.223	0.917	0.857	0.907	0.955
Ireland	0.929	1.100	0.801	0.823	---	---
Italy	<0.500	1.090	1.236	**>1.500**	**1.402**	---
Latvia	0.970	1.143	1.362	0.996	0.978	1.041
Lithuania	**>1.500**	**1.467**	**>1.500**	**1.305**	1.174	---
Luxembourg	<0.500	<0.500	<0.500	<0.500	0.522	---
Netherlands	<0.500	<0.500	<0.500	<0.500	0.551	---
Poland	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**>1.500**	---
Portugal	0.995	1.241	**>1.500**	1.226	---	---
Romania	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**1.378**	**1.342**
Slovenia	**>1.500**	0.558	0.753	0.934	0.984	---
Spain	**1.397**	**1.435**	**>1.500**	**>1.500**	**1.284**	1.255
Sweden	1.241	1.237	1.189	1.225	**1.330**	**1.289**
UK	0.705	0.815	0.961	1.118	1.145	1.232
95% I(0)	-0.367 0.367	-0.335 0.335	-0.310 0.310	-0.290 0.290	-0.274 0.274	-0.260 0.260
95% I(1)	0.632 1.367	0.664 1.335	0.689 1.310	0.709 1.290	0.725 1.274	0.740 1.260

Note: Estimation of the *d* parameter in equation (6).In bold, evidence of explosive behaviour (d > 1) at the 5% level. Values of d greaterthan1.500 or less than 0.500 indicate that the proper estimate of the series may be higher or lower than this number since the estimation is restricted to the interval (-0.5, 0.5) in first differences.

Table 7: Estimates of d (and 95% intervals) in the NIIP series. Data ending in 2007q4

Country	No regressors	An intercept	An intercept and linear time trend
Austria	0.68 (0.45, 1.00)	0.47 (0.19, 0.91)	0.50 (0.21, 0.92)
Bulgaria	1.03 (0.68, 1.56)	1.01 (0.46, 1.67)	1.18 (0.65, 1.73)
Croatia	0.83 (0.69, 1.10)	1.07 (0.92, 1.39)	1.08 (0.83, 1.44)
Estonia	1.15 (0.91, 1.46)	1.17 (0.94, 1.49)	1.16 (0.95, 1.46)
Finland	1.02 (0.85, 1.25)	1.03 (0.85, 1.28)	1.03 (0.85, 1.28)
Germany	0.84 (0.62, 1.42)	**1.49 (1.17, 1.91)**	**1.44 (1.12, 1.84)**
Hungary	0.91 (0.74, 1.17)	1.09 (0.94, 1.33)	1.09 (0.94, 1.34)
Ireland	0.99 (0.59, 1.57)	0.69 (0.35, 1.40)	0.61 (0.04, 1.38)
Italy	0.38 (0.24, 0.80)	0.75 (0.48, 1.34)	0.26 (-0.27, 1.38)
Latvia	0.71 (0.58, 0.97)	1.00 (0.87, 1.45)	0.88 (0.59, 1.52)
Lithuania	1.04 (0.88, 1.26)	1.09 (0.89, 1.33)	1.08 (0.92, 1.32)
Luxembourg	0.21 (-0.01, 0.84)	0.22 (-0.19, 1.15)	0.54 (-0.31, 1.17)
Netherlands	0.74 (0.58, 1.02)	1.11 (0.93, 1.79)	1.10 (0.72, 1.83)
Poland	0.77 (0.32, 1.32)	1.14 (0.83, 1.60)	1.21 (0.90, 1.65)
Portugal	0.88 (0.45, 1.47)	0.59 (0.29, 0.98)	0.71 (0.37, 1.22)
Romania	0.93 (0.69, 1.26)	1.12 (0.89, 1.47)	1.14 (0.89, 1.52)
Slovenia	0.74 (0.52, 1.25)	0.75 (0.46, 1.03)	0.58 (0.21, 1.06)
Spain	0.98 (0.84, 1.18)	0.93 (0.83, 1.06)	0.92 (0.81, 1.07)
Sweden	0.64 (0.43, 1.00)	0.48 (0.29, 1.00)	0.44 (0.04, 1.01)
UK	0.88 (0.69, 1.14)	0.88 (0.69 1.14)	0.88 (0.70, 1.14)

Note: Estimation of the *d* parameter in equation (5).In bold, evidence of explosive behaviour (d > 1) at the 5% level.

Table 8: Semi-parametric estimates for NIIP. Data ending in 2007q4

Country/Bandwidth	5	6	7	8	9	10
Austria	<0.500	<0.500	<0.500	0.549	0.593	<0.500
Bulgaria	0.669	1.088	**1.333**	**>1.500**	**1.380**	---
Croatia	**>1.500**	**>1.500**	1.061	1.034	1.088	1.156
Estonia	0.775	0.849	1.016	1.195	**1.328**	**>1.500**
Finland	0.947	1.036	0.976	1.026	1.095	1.213
Germany	**>1.500**	**1.483**	**>1.500**	**>1.500**	**>1.500**	---
Hungary	**1.345**	1.263	**1.419**	**1.406**	**1.381**	1.192
Ireland	**>1.500**	0.911	0.944	0.996	1.036	---
Italy	0.500	1.296	0.893	0.882	1.064	---
Latvia	0.716	0.964	1.117	0.991	1.138	1.084
Lithuania	**>1.500**	1.163	1.069	1.012	1.016	1.156
Luxembourg	**>1.500**	1.454	1.284	1.144	0.990	---
Netherlands	<0.500	<0.500	<0.500	<0.500	<0.500	---
Poland	**>1.500**	**>1.500**	**>1.500**	**>1.500**	**1.329**	---
Portugal	1.187	1.284	**>1.500**	1.194	1.023	---
Romania	1.315	**>1.500**	**1.355**	**1.363**	1.249	**1.300**
Slovenia	<0.500	0.514	0.696	0.807	---	---
Spain	1.200	1.208	1.187	1.219	1.283	1.303
Sweden	0.505	0.559	0.621	0.374	0.500	<0.500
UK	0.562	0.726	0.821	0.894	1.045	1.149
95% I(0)	-0.367 0.367	-0.335 0.335	-0.310 0.310	-0.290 0.290	-0.274 0.274	-0.260 0.260
95% I(1)	0.632 1.367	0.664 1.335	0.689 1.310	0.709 1.290	0.725 1.274	0.740 1.260

Note: Estimation of the *d* parameter in equation (6).In bold, evidence of explosive behaviour (d > 1) at the 5% level. Values of *d* equal to 1.500 indicate that the proper estimate of the series may be higher than this number since the estimation is restricted to the interval (-0.5, 0.5) in first differences.

Table 9: Estimation of the AR parameters, I(1)/I(0) breaks, NED

Country	$\hat{\alpha}$(t-statistic)	Break date	$\widehat{\alpha_1}$(t-statistic)	$\widehat{\alpha_2}$(t-statistic)	I(0) start-end	M
Austria	-0.010 (-0.690)	No break	-	-	-	-3.61
Bulgaria	0.002 (0.134)	2008:4	0.111 (4.048)	-0.028(-1.944)	-	-2.49
Croatia	0.028 (2.304)	2013:2	0.016 (1.759)	0.308 (6.754)	-	-2.20
Estonia	-0.008 (-0.517)	2010:3	0.022 (1.620)	-0.190 (-5.794)	-	-1.13
Finland	-0.006 (-0.360)	2008:3	-0.060 (-2.269)	0.041 (1.632)	-	-2.54
Germany	-0.043 (-1.120)	2011:4	-0.090 (-2.371)	0.197 (2.297)	-	-2.58
Hungary	0.006 (0.800)	2009:1	0.034 (3.009)	-0.014 (-1.467)	-	-2.37
Ireland	0.023 (2.263)	2008:4	-0.013 (-0.819)	0.042 (3.559)	-	-3.09
Italy	0.018 (2.965)	No break	-	-	-	-3.14
Latvia	0.007 (1.263)	2010:2	0.028 (5.124)	-0.032 (-4.203)	-	-1.05
Lithuania	0.010 (1.101)	2008:3	0.063 (3.709)	-0.006 (-0.686)	-	-1.95
Luxembourg	0.000 (0.065)	No break	-	-	2012:1-2013:1	-5.31*
Netherlands	-0.010 (0.021)	No break	-	-	-	-3.11
Poland	0.016 (1.990)	2005:3	-0.057 (-2.142)	0.023 (2.906)	-	-2.43
Portugal	0.020 (4.082)	2013:2	0.024 (5.120)	-0.038 (-1.961)	-	-2.88
Romania	0.021 (2.626)	2010:2	0.055 (4.501)	0.002 (0.262)	-	-1.27
Slovenia	0.016 (1.387)	2009:4	0.080 (3.896)	-0.004 (-0.392)	-	-3.72
Spain	0.017 (4.116)	2010:1	0.040 (8.942)	-0.000 (-0.169)	-	-3.04
Sweden	0.001 (0.165)	No break	-	-	-	-2.52
UK	-0.004 (-0.392)	2011:4	0.007 (0.648)	-0.168 (-3.944)	-	-2.71

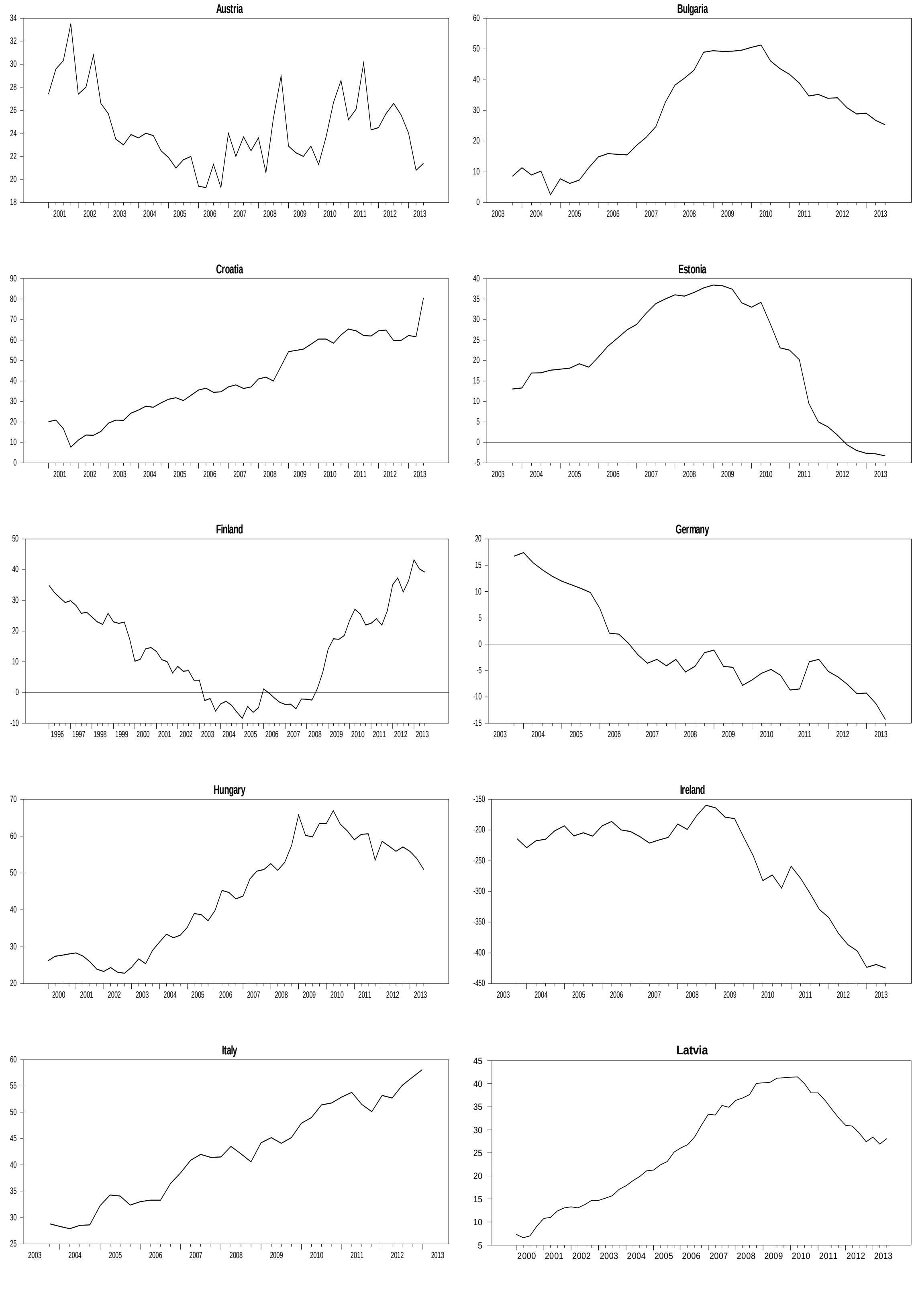
Note: the symbol * means rejection of the null at least at the 10% level for the M-test. Critical values can be obtained from Leybourne et al. (2007).

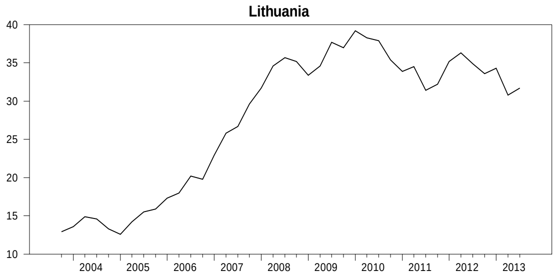
Table 10: Estimation of the AR parameters, I(1)/I(0) breaks, NIIP

Country	$\hat{\alpha}$(t-statistic)	Break date	$\widehat{\alpha_1}$(t-statistic)	$\widehat{\alpha_2}$(t-statistic)	I(0) start-end	M
Austria	-0.036 (-1.097)	2008:4	-0.002 (-0.070)	-0.30 (-3.473)	-	-4.05
Bulgaria	0.011 (0.007)	2009:1	0.062 (6.993)	-0.013 (-2.111)	-	-1.76
Croatia	0.011 (1.422)	2007:2	0.067 (4.421)	-0.003 (-0.484)	-	-1.89
Estonia	0.003 (0.400)	2005:1	0.051 (4.262)	-0.019 (-2.349)	-	-2.26
Finland	-0.041 (-1.328)	2000:1	0.131 (2.992)	-0.147 (-4.280)	-	-2.19
Germany	0.029 (2.540)	2006:2	0.144 (3.404)	0.021 (1.959)	-	-2.86
Hungary	0.005 (1.194)	2010:1	0.013 (2.707)	-0.013 (-1.781)	-	-2.36
Ireland	0.017 (0.771)	No break	-	-	2005:2-2006:2	-4.60*
Italy	0.011 (0.848)	No break	-	-	-	-3.73
Latvia	0.009 (2.292)	2007:3	0.0356 (5.924)	-0.003 (-0.787)	-	-1.17
Lithuania	0.008 (1.415)	1999:4	0.088 (3.278)	0.004 (0.843)	-	-2.35
Luxembourg	-0.024 (-0.680)	No break	-	-	-	-3.18
Netherlands	0.043 (1.305)	2009:1	-0.480 (-2.948)	0.061 (2.031)	2005:3-2006:4	-4.52*
Poland	0.012 (3.091)	No break	-	-	-	-2.77
Portugal	0.0147 (3.331)	2009:3	0.029 (4.825)	0.003 (0.754)	-	-1.49
Romania	0.017 (3.427)	2009:4	0.034 (4.531)	0.006 (0.981)	-	-2.44
Slovenia	0.015 (1.482)	2008:4	0.113 (4.782)	0.000 (0.043)	2010:2-2012:1	-5.59*
Spain	0.015 (3.525)	2009:4	0.027 (4.837)	0.001 (0.282)	-	-3.92
Sweden	-0.056 (-1.689)	No break	-	-	-	-2.72
UK	-0.038 (-1.198)	2011:4	-0.017 (-0.606)	-0.964 (-5.159)	-	-2.43

Note: the symbol * means rejection of the null at least at the 10% level for the M-test. Critical values can be obtained from Leybourne et al. (2007).

Figure 1: Net external debt/GDP (%)

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25
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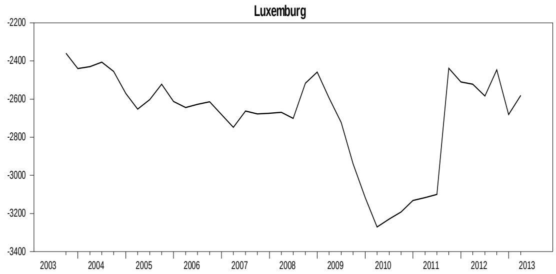
15
10
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013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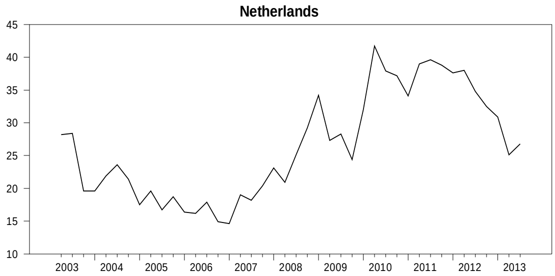
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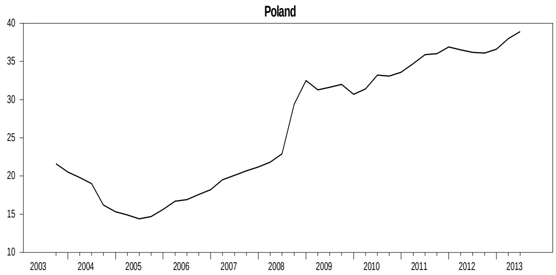
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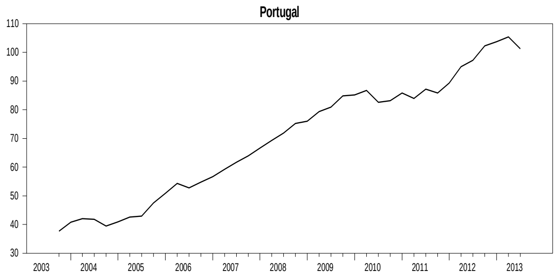
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013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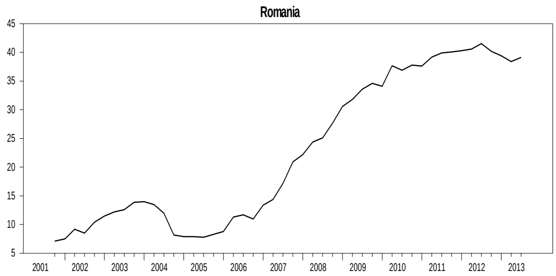
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013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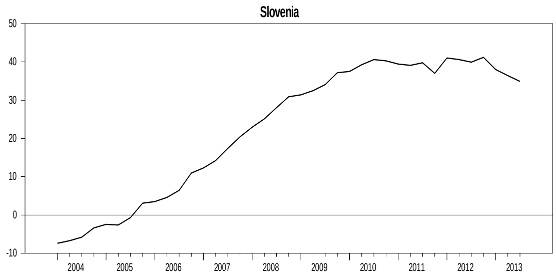
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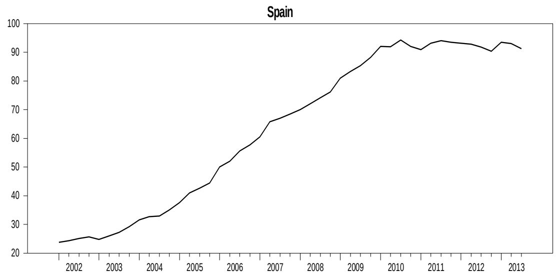
0
-10
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013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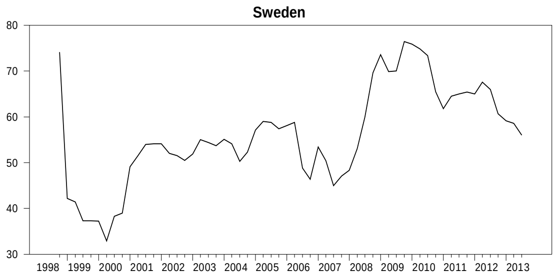
2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013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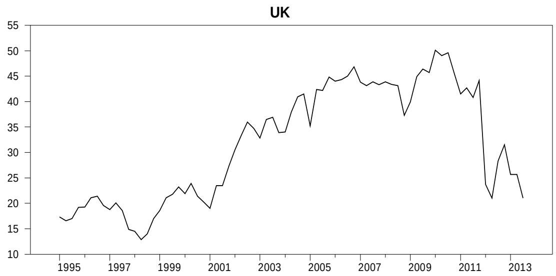
1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013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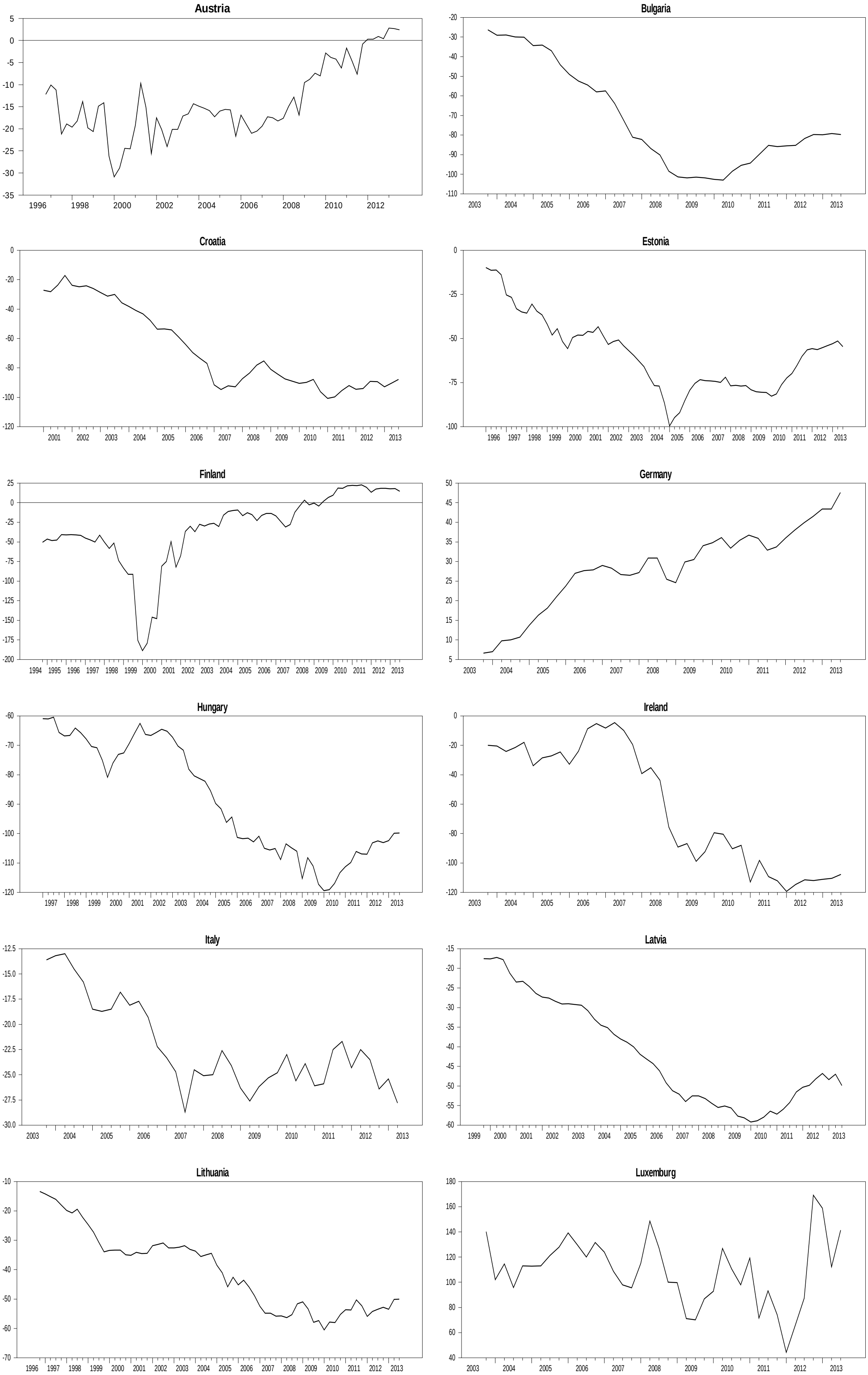
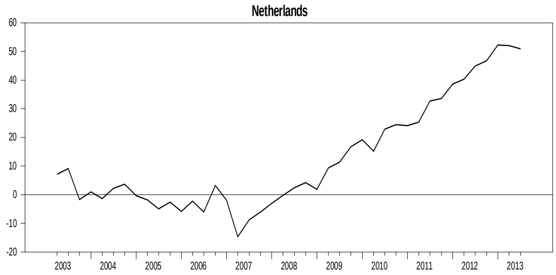
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013

Figure 2: Net international investment position/GDP (%)

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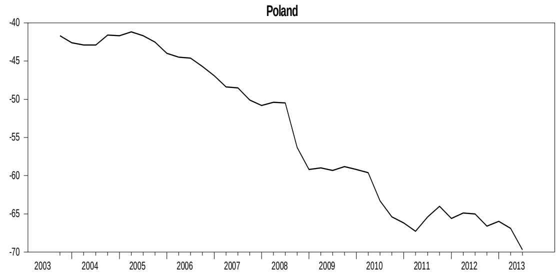
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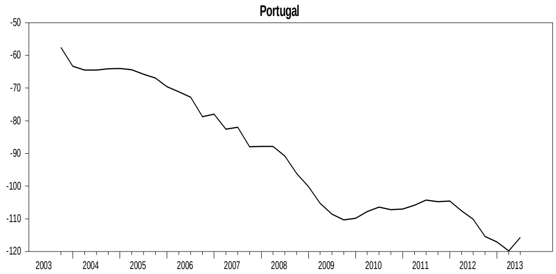
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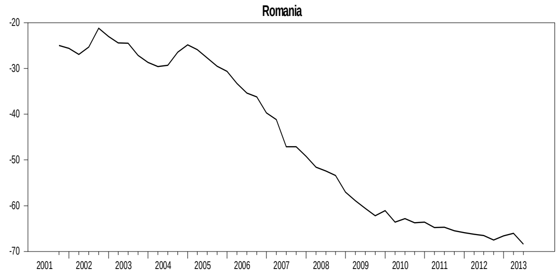
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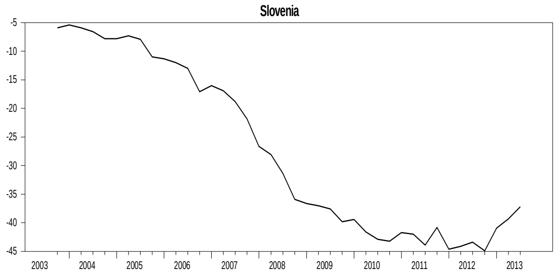
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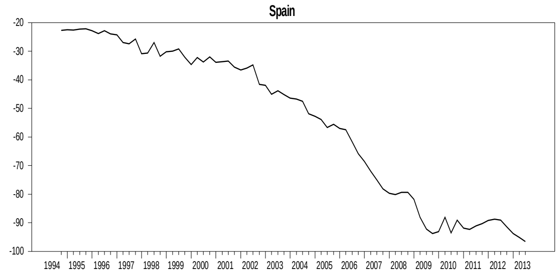
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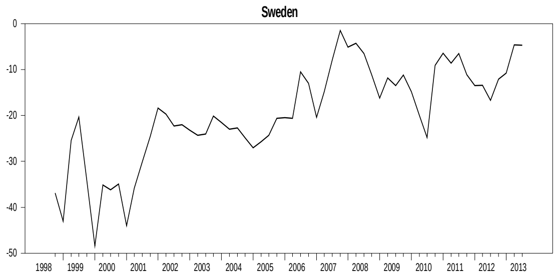
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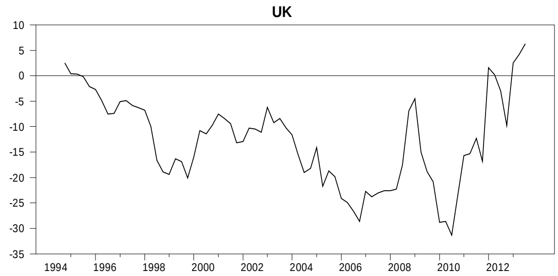
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