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Public debt sustainability and the participation of the new member states in the euro area[1]

Abstract: The recent financial and economic crisis pushed the ratio of public debt to GDP in a number of industrialised countries to unprecedented levels. This phenomenon was especially marked in the peripheral countries of the euro area, which questioned again the adequacy of the institutional framework of the Economic and Monetary Union (including the Maastricht criteria related to public finance). Thus, the new entrants and candidates to the euro area must put a deeper emphasis on the interrelations between public debt sustainability and participation in the monetary union. The article analyses empirically the interrelationships between the participation of the EU-10 countries in the euro area and the sustainability of their debts. The principal method of investigation is the use of panel stationarity tests. The results, contrary to intuition, indicate no significant differences between countries in the euro area and those remaining outside.
Keywords: debt sustainability, Economic and Monetary Union, new EU Member States, panel stationarity tests.
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Introduction

The concept of debt sustainability has become highly topical since the outbreak of the debt crisis in peripheral countries of the euro area in 2010. This

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notion undoubtedly draws on the idea of sustainability defined as behaviour not undermining the possibilities for the next generations to meet their own needs – see e.g. the seminal Brundtland Report [UN 1987, p. 16]. On the other hand it is rooted in the literature focused on intertemporal budget constraint [cf. Blanchard & Weil 1992; Bohn 1995, p. 262; Greiner, Koeller & Semmler 2007, p. 196].

Participation in a monetary union can have a two-channel influence on debt sustainability. First, joining the monetary union forces the country to abandon domestic monetary policy. This, in turn, will mean that any policy aiming at "inflating out" the debt is impossible and that the country should have a sound debt situation before deciding upon monetary integration. The existing monetary union is also interested in accepting countries which will have a sustainable debt level because, in case of debt crisis in one member, insulation might be impossible [Cooper, Kempf & Peled 2014]. Thus, it seems rational to expect that (prospective) members of a monetary union would practice sustainable debt policies.

The aim of the paper is to investigate empirically the consequences of participation of the new Member States of the EU (EU-10)[2] in the Economic and Monetary Union (EMU) for the sustainability of their debts. In order to realize such a goal the underlying research hypothesis can be expressed in the following way: countries participating in the euro area (or aiming at accession within a short time) will exhibit better indicators in terms of debt sustainability as compared to the countries remaining outside the EMU.

The method of analysis will consist in panel stationarity tests of the debt to GDP ratios in the whole sample over the period between the first quarter of 2000 and the third quarter of 2013. Additionally, in order to detect any potential differences between the countries participating in the euro area as well as potential change in debt to GDP behavior related to the crisis, tests on a number of relevant subsamples will be conducted.

The paper is divided into four sections. The first section provides a short review of the literature. In the second section the utilized data is presented and the methodology discussed. In section 3 the main results are presented and analysed then the conclusions follow.

[2] Given the small size of Cyprus and Malta and their obvious structural dissimilarity with the Central and Eastern European Countries they are excluded from the sample and analysis presented in this article.

1. Survey of the literature

The research on debt sustainability can be divided into three principal domains: theoretical research on its determinants and conditions, methodological studies proposing ways of its practical assessment and purely empirical and comparative studies.

As mentioned in the introduction, the main theoretical economic approach to define debt sustainability is based on the intertemporal budget constraint of the government. Put differently it starts with the following description of the debt dynamics:

$$B_t = B_{t-1} - S_t + r_t * B_{t-1}, \tag{1}$$

where B_t is the nominal value of debt at time t, S_t – nominal primary fiscal balance (surplus) at time t (without interest payments) and r_t – nominal interest rate at time t.[3] However in order to ensure comparability across countries and in time the most intuitive indicator of debt sustainability is the ratio of public debt to gross domestic product. Thus an additional key determinant of such an indicator is the growth rate of the economy and short run dynamics might be presented as:

$$\Delta b \equiv b_t - b_{t-1} = -s_t + \left(\frac{r_t - g_t}{1 + g_t} \right) b_{t-1}, \tag{2}$$

where b_t is the debt to GDP ratio at time t, s_t is the primary surplus related to GDP at time t and g_t is the nominal growth rate at time t. It is possible to show that if the economic processes are deterministic then the interest rate must be higher than growth rate in order to ensure the dynamic efficiency of the economy. In such a case the government must generate primary surpluses to ensure the debt sustainability. On the other hand if the economy is better described by stochastic processes then it is possible that the growth rate is higher than interest for longer time periods and allows the government to behave as in a type of Ponzi game [e.g. Blanchard & Weil 1992, p. 4]. In such a case it is necessary to develop some tools for empirical analysis which would

[3] Conventionally capital letters are used for nominal variables whereas lower case letters are used for percentage variables (rates of growth, interest or values expressed as percentage of GDP).

allow for an assessment as to whether the fiscal policy is conducted in a way to ensure debt sustainability.

An excellent survey of available methods of testing fiscal sustainability is provided by Mackiewicz [2010a, 2010b]. He mentions tests of stationarity of the debt to GDP ratio, tests of cointegration of government expenditure and fiscal revenues and an estimation of the fiscal reaction function (response of the government to the increasing level of indebtedness in terms of improving the primary balance). Simulations indicate that estimations of the fiscal reaction function give the most reliable results. Similarly Afonso [2005] starting the analysis at deriving present value budget constrained from the equivalent of the aforementioned equation (1), provides an algorithm for the construction of a series of stationarity and cointegration tests of relevant variables, which permits knowledge of whether the debts are sustainable. It should be also underlined that he additionally presents an excellent survey of earlier studies in the domain.

Empirical literature on the topic is incredibly rich but dominated by the studies focused on the "old" member states of the euro area [Collignon 2010; de Grauwe 2011; ECB 2012; Greiner, Koeller & Semmler 2007; Jędrzejowicz et al. 2008; Moszyński 2011; Semmler, Greiner & Zhang 2005] or even concentrated on a single country [de Rosario et al. 2008]. Studies analysing the situation of the other monetary unions are rare [Kufa, Pellechio & Rizavi 2003; Oshikoya & Taravalie 2009] and do not take into consideration the consequences of the recent financial and economic crisis. Moreover they do not contain any comparisons with similar countries remaining outside monetary unions (following the floating exchange rate regime). Kowalski [2012] presents an excellent conceptual framework allowing for the analysis of the impact of a financial crisis on the fiscal performance of the EMU countries. An attempt to analyse fiscal policy sustainability in the EU-10 countries was presented by Molendowski and Stanek [2012]. However it presented policy choices adopted by individual countries and based the inference rather on an intuitive interpretation of time series than on any formal econometric modelling.

The study which seems relatively close to the present article is recent research by Cuestas, Gil-Alana and Staehr [2014]. They perform a set of tests to detect the structural breaks in the debt to GDP series of the 12 "old" member countries of the euro area. For most of the countries they find a break in the early quarters of the financial crisis (between the third quarter of 2007 and the third quarter of 2008). Some results are quite striking: Germany, Greece and Portugal are revealed to have a structural break in 2010–2011 and France much earlier – in 2005. However, in a check for robustness and utilizing another method they find that all the countries have a structural break between 2007Q3 and 2008Q3, apart from France and Germany where no breaks were detected. Another study by Włodarczyk [2011] was concentrated only on Visegrad countries and thus did not allow for an inference concerning the participation in the euro area (apart from suggestions related to the fulfilment of the Maastricht criteria).

Thus on empirical grounds the results presented below contribute to the existing state of knowledge in terms of explicit comparisons of the situation of the new EU member states participating in the monetary union with the non-participants.

2. Methodology and data

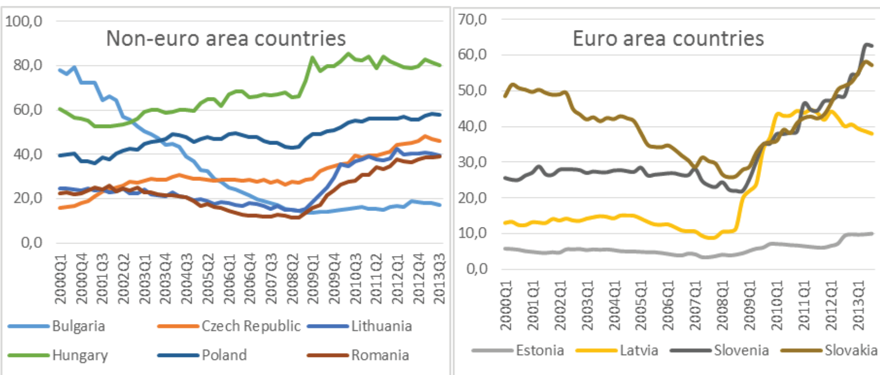
The main method of analysis applied in the present study is, on the one hand very traditional, and on the other – utilizes relatively recent advances in econometric techniques. This method is a verification of stationarity of the debt to GDP ratio but using panel data tests directly. This method seems appropriate if one wants to compare the behaviour of public debt to GDP ratios in two group of countries rather than between individual states. An excellent survey of such methods is provided by Hlouskova and Wagner [2006].

In general stationarity can be defined as the property of a process which has a constant joint distribution of random variables (whichever subset in time is chosen). This, in turn, guarantees that the values of moments are constant too. For the purposes of macroeconomic analysis verification of weak stationarity (covariance stationarity) is usually sufficient (mean, variance and covariance are finite and constant) – see Welfe [2013, pp. 9–10]. Thus a (weak) stationarity of the debt to GDP ratio implies that this indicator is "mean reverting" and has a "short memory" of shocks. On the other hand the lack of stationarity means that shocks are cumulated and would possibly allow this key ratio to grow to infinity which would clearly violate the definition of the debt sustainability.

Stationarity of a variable can be tested using three assumptions: without constant nor trend, with constant (drift) but without trend and with constant and trend. For the purposes of the present study testing stationarity without constant and trend would not make much sense as debt to GDP ratios are always positive and significantly higher than zero in all countries (see the presentation of the data in section 2 below). Stationarity with drift but without trend would be consistent with the definition of debt sustainability, whereas stationarity under the assumption of the trend (trend-stationarity) would be consistent with debt sustainability only if the estimated trend coefficient is negative (otherwise the debt to GDP ratio could grow linearly and thus possibly to infinity).

The available panel tests of stationarity can be divided into three categories, depending on the character of the null hypothesis. Most of the tests – Im, Pesaran and Shin, Fisher Chi-square based on the Augmented Dickey-Fuller (ADF) test, Fisher Chi-square based on the Phillips-Perron (PP) test assume that the variable follows a process characterized by a different unit root in each of the cross-sections (countries). Two tests: Levin, Lin and Chu as well as Breitung assume a common unit root process but Breitung allows for testing only under the assumption of both drift and trend. Finally there is one test (Hadri) available for panel data where the null hypothesis is stationarity. However even the econometric software packages indicate that in a case of high autocorrelation this test tends to over-reject the null hypothesis (and thus possibly indicates non-stationarity even if the time series is stationary). Nevertheless it was decided to include this test as one of the detailed research methods, as this is the only one assuming stationarity and a situation when the conclusion is supported by tests having different null hypotheses would be a very strong support in its favour (e.g. when stationarity is rejected and unit root is not or when stationarity is not rejected and unit roots are).

The set of available data for the EU-10 countries is limited and covers the period between 2000 Q1 and 2013 Q3. On the other hand, taking into con-



Debt to GDP ratios in the EU-10 countries (2000Q1 – 2013Q3, in %)
Source: Own elaboration based on the Eurostat data (database gov_q_ggdebt, retrieved 10.03.2014)

sideration the dynamics of the economic structure of these countries and adjustments made in order to meet the conditions of the accession into the EU, the inclusion of earlier data might result in having even more structural breaks and could undermine the viability of inference.

Figure as well as Table 1 provide the basic information about the data used in the present study. It can be noticed that for each of 10 analysed countries 55 observations are available which leads to a total sample of 550 points. The chart was divided into two panels the one on the left depicting the situation of countries which have not joined the euro area until now (even if they apply a fixed exchange rate against euro which is the case for Bulgaria and Lithuania) and the right hand panel covering countries which have ultimately joined the euro area (even if the date of accession is after the end of the analysed time span, which is the case for Latvia).

Table 1. Descriptive statistics of the public debt to GDP quarterly data in the EU-10 countries (2000Q1 – 2013Q3)

	Mean	Std dev.	Median	Minimum	Maximum	N	Euro area membership
Bulgaria	33.0	21.14	21.6	13.4	79.2	55	no
Czech Republic	30.9	8.04	28.6	16.0	48.3	55	no
Estonia	5.7	1.60	5.4	3.4	10.0	55	yes, since 2011
Latvia	22.1	13.20	14.2	8.8	44.7	55	yes, since 2014
Lithuania	25.5	8.69	23.0	14.3	42.3	55	no
Hungary	68.1	10.62	66.3	52.7	85.5	55	no
Poland	47.8	6.12	47.7	36.0	58.3	55	no
Romania	22.9	8.22	22.5	11.4	38.9	55	no
Slovenia	32.5	10.37	27.5	22.0	62.6	55	yes, since 2007
Slovakia	40.9	8.53	42.1	25.8	58.1	55	yes, since 2009
EU-10	32.9	19.25	28.6	3.4	85.5	550	

Source: Own computations based on Eurostat data (database gov_q_ggdebt, retrieved 10.03.2014).

It can easily be noticed that all the new euro area countries (euro-4 hereinafter) have significantly increased their debt to GDP levels during the crisis (after 2007), which is somewhat less visible for Estonia mainly because of very limited initial debt level. Such a marked increase is also the case for Lithuania and Romania but in all the EU countries except for Bulgaria the indebtedness at the end of the sample is significantly higher than in early 2000's. The most indebted countries in the group since their accession to the EU were Hungary and Poland, (the latter still obeying the 60% debt to GDP limit), but recently Slovakia and Slovenia have also approached this level. The only country which successfully reduced their debt level during the pre-crisis economic boom was Bulgaria. This enabled some more room for manoeuver for an expansionary fiscal policy in the crisis.

Such a preliminary analysis seems to confirm that the countries having irrevocably fixed their exchange rates follow somewhat different patterns in terms of their debt to GDP ratios than the countries remaining outside the euro area as outlined in the introduction. This will be formally tested in the following section 3.

3. Results and discussions

Verification of stationarity in every relevant subsample will consist of performing tests for the levels of debt to GDP indicator as well as the analogical tests for the first differences in this variable. If the results of the tests for the level is in favour of non-stationarity and the result for the first difference confirms stationarity then the interpretation is that the variable is integrated of order 1: I(1). This indicates the lack of sustainability.

The test results summarized in Table 2 clearly indicate that the debt to GDP ratio is not stationary in the total sample (the panel of 10 countries observed during the period between first quarter of the year 2000 and the third quarter of 2013). The Hadri test rejects stationarity in both setups (with drift only and with drift and trend) whereas any of the other tests assuming unit root(s) is not able to reject the null hypothesis.

On the other hand the results presented in Table 3, where the changes of the debt to GDP ratios as compared to the previous quarter should be interpreted as showing stationarity (and thus the conclusion would be that the analysed indicator of sustainability is I(1)). The only exception is the result of the Hadri test (still rejecting stationarity) but as mentioned in the discus-

Table 2. Results of panel stationarity/unit root tests for the level of debt to GDP ratios for 2000Q1–2013Q3[a]

Method	H0	Individual effects			Individual effects and time trends		
		Statistic	*p*-value	Obs.	Statistic	*p*-value	Obs.
Hadri (Heteroscedastic Consistent Z-stat)	stationarity	9.31363	0.0000	550	8.87231	0.0000	550
Levin, Lin & Chu t*	common unit root process	–0.33797	0.3677	533	1.79031	0.9633	536
Breitung		–	–	–	4.36559	1.0000	526
Im, Pesaran and Shin W-stat	individual unit root processes	3.18255	0.9993	533	4.27424	1.0000	536
ADF – Fisher Chi-square		12.5985	0.8939	533	9.90801	0.9698	536
PP – Fisher Chi-square		10.5213	0.9577	540	7.49332	0.9947	540

Source: Own computation based on Eurostat data (database gov_q_ggdebt, retrieved 10.03.2014). Software utilized: E-views8[b].

[a] Details of results are available from the author upon request.

[b] Technical details for all tests performed to obtain the results presented in Tables 2–9 are the following: Automatic selection of maximum lags and lag length selection based on SIC: 0 to 3. Newey-West automatic bandwidth selection and Bartlett kernel. Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality. Breitung's test requires individual constant and time trends.

sion of the method it tends to over-reject the null hypothesis so its results are treated with special caution.

Given the description of data provided in section 2 it seemed necessary to test also stationarity of the debt to GDP ratio and its first differences for a sample which would be limited in time to cover only the pre-crisis period 2000–2008. The results are reported, respectively, in Tables 4 and 5. Interestingly there is some evidence in favour of (trend) stationarity: Breitung test as well as both Fisher Chi-square tests reject stationarity at acceptable confidence levels. The Hadri test (as in all results presented in this article) rejects stationarity but also Levin, Lin and Chu (LLC) test as well as Im, Pesaran and Shin (IPS) test are not able to reject the unit roots in the debt to GDP process. As could be expected the tests for the changes in debt to GDP level (table 5) indicate the stationarity of such a series with the exception of the Hadri test

Table 3. Results of panel stationarity/unit root tests for the first differences of debt to GDP ratios for 2000Q1–2013Q3

Method	H0	Individual effects			Individual effects and time trends		
		Statistic	*p*-value	Obs.	Statistic	*p*-value	Obs.
Hadri (Heterosceda-stic Consistent Z-stat)	statio-narity	3.89108	0.0000	540	3.77354	0.0001	540
Levin, Lin & Chu t*	common unit root process	−13.0617	0.0000	525	−18.8786	0.0000	528
Breitung		–	–	–	−10.7370	0.0000	518
Im, Pesaran and Shin W-stat	indi-vidual unit root processes	−12.2383	0.0000	525	−17.3900	0.0000	528
ADF – Fisher Chi-square		183.065	0.0000	525	243.737	0.0000	528
PP – Fisher Chi-square		275.996	0.0000	530	264.394	0.0000	530

Source: Own computation based on Eurostat data (database gov_q_ggdebt, retrieved 10.03.2014). Software utilized: E-views8.

Table 4. Results of panel stationarity/unit root tests for the levels of debt to GDP ratios for 2000Q1–2008Q4

Method	H0	Individual effects			Individual effects and time trends		
		Statistic	*p*-value	Obs.	Statistic	*p*-value	Obs.
Hadri (Heterosceda-stic Consistent Z-stat)	statio-narity	7.94176	0.0000	360	6.26573	0.0000	360
Levin, Lin & Chu t*	common unit root process	−1.18110	0.1188	342	0.94979	0.8289	334
Breitung		–	–	–	−6.50113	0.0000	324
Im, Pesaran and Shin W-stat	indi-vidual unit root processes	1.23224	0.8911	342	0.10792	0.5430	334
ADF – Fisher Chi-square		19.4756	0.4911	342	29.8468	0.0724	334
PP – Fisher Chi-square		14.0148	0.8297	350	29.1367	0.0851	350

Source: Own computation based on Eurostat data (database gov_q_ggdebt, retrieved 10.03.2014). Software utilized: E-views8.

Table 5. Results of panel stationarity/unit root tests for the first differences of debt to GDP ratios for 2000Q1–2008Q4

Method	H0	Individual effects			Individual effects and time trends		
		Statistic	*p*-value	Obs.	Statistic	*p*-value	Obs.
Hadri (Heterosceda-stic Consistent Z-stat)	statio-narity	1.92248	0.0273	350	6.56610	0.0000	350
Levin, Lin & Chu t*	common unit root process	−8.71024	0.0000	331	−3.35960	0.0004	321
Breitung		–	–	–	2.34182	0.9904	311
Im, Pesaran and Shin W-stat	indi-vidual unit root processes	−11.7384	0.0000	331	−8.56091	0.0000	321
ADF – Fisher Chi-square		168.955	0.0000	331	133.732	0.0000	321
PP – Fisher Chi-square		207.276	0.0000	340	701.583	0.0000	340

Source: Own computation based on Eurostat data (database gov_q_ggdebt, retrieved 10.03.2014). Software utilized: E-views8.

Table 6. Results of panel stationarity/unit root tests for the levels of debt to GDP ratios for 2000Q–12013Q3 in euro-4 countries

Method	H0	Individual effects			Individual effects and time trends		
		Statistic	*p*-value	Obs.	Statistic	*p*-value	Obs.
Hadri (Heterosceda-stic Consistent Z-stat)	statio-narity	4.70657	0.0000	220	7.11987	0.0000	220
Levin, Lin & Chu t*	common unit root process	1.64605	0.9501	211	1.41285	0.9211	212
Breitung		–	–	–	3.06965	0.9989	208
Im, Pesaran and Shin W-stat	indi-vidual unit root processes	2.93261	0.9983	211	3.45761	0.9997	212
ADF – Fisher Chi-square		2.94345	0.9379	211	3.73784	0.8800	212
PP – Fisher Chi-square		0.68544	0.9996	216	0.73030	0.9994	216

Source: Own computation based on Eurostat data (database gov_q_ggdebt, retrieved 10.03.2014). Software utilized: E-views8.

and, (somewhat surprisingly), the Breitung test (which previously indicated the stationarity of the debt to GDP level).

It could be argued that such results might be expected because of the heterogeneity of the sample and the results would get more consistent if we test countries belonging to the euro area separately (euro-4). In line with the hypothesis outlined in the introduction one might expect that euro-4 countries will exhibit more sustainable behaviour, at least for the period before the crisis.

Table 6 reports the results of the stationarity tests of debt to GDP ratios for the euro-4 countries for the whole period of analysis. Without any doubt they indicate that these series are not stationary.

Table 7 presents the analogical outcomes for the changes in debt to GDP ratio and according to the results obtained for the whole sample, they exhibit rather convincing evidence of stationarity (the Hadri test is again an exception). Thus for the period 2000–2013 the euro-4 countries do not really behave differently than the complete 10-country panel.

Finally the results for the subsample of the euro-4 countries observed only for 2000–2008 period are presented in Tables 8 and 9. Somewhat surprisingly, again the stationarity can be rejected without reservation (mixed results were exhibited by the whole panel which was interpreted as some signs of debt sustainability before the crisis). Results for the changes in debt to GDP ratio con-

Table 7. Results of panel stationarity/unit root tests for the first differences of the levels of debt to GDP ratios for 2000Q1–2013Q3 in euro-4 countries

Method	H0	Individual effects			Individual effects and time trends		
		Statistic	*p*-value	Obs.	Statistic	*p*-value	Obs.
Hadri (Heteroscedastic Consistent Z-stat)	stationarity	3.67391	0.0001	216	2.75235	0.0030	216
Levin, Lin & Chu t*	common unit root process	−7.55550	0.0000	210	−8.42483	0.0000	210
Breitung					−4.10116	0.0000	206
Im, Pesaran and Shin W-stat	individual unit root processes	−7.23615	0.0000	210	−7.89032	0.0000	210
ADF – Fisher Chi-square		69.2773	0.0000	210	72.5182	0.0000	210
PP – Fisher Chi-square		88.6418	0.0000	212	88.4271	0.0000	212

Source: Own computation based on Eurostat data (database gov_q_ggdebt, retrieved 10.03.2014). Software utilized: E-views8.

Table 8. Results of panel stationarity/unit root tests for the levels of debt to GDP ratios for 2000Q1–2008Q4 in euro-4 countries

Method	H0	Individual effects			Individual effects and time trends		
		Statistic	*p*-value	Obs.	Statistic	*p*-value	Obs.
Hadri (Heterosceda-stic Consistent Z-stat)	statio-narity	4.10533	0.0000	144	3.25392	0.0006	144
Levin, Lin & Chu t*	common unit root process	0.21999	0.5871	136	0.66715	0.7477	133
Breitung					3.86307	0.9999	129
Im, Pesaran and Shin W-stat	indi-vidual unit root processes	−0.10916	0.4565	136	−0.64825	0.2584	133
ADF – Fisher Chi-square		9.70816	0.2861	136	9.86234	0.2748	133
PP – Fisher Chi-square		3.33017	0.9120	140	9.37635	0.3115	140

Source: Own computation based on Eurostat data (database gov_q_ggdebt, retrieved 10.03.2014). Software utilized: E-views8.

Table 9. Results of panel stationarity/unit root tests for the first differences of the levels of debt to GDP ratios for 2000Q1–2008Q4 in euro-4 countries

Method	H0	Individual effects			Individual effects and time trends		
		Statistic	*p*-value	Obs.	Statistic	*p*-value	Obs.
Hadri (Heterosceda-stic Consistent Z-stat)	statio-narity	0.87588	0.1905	140	5.11870	0.0000	140
Levin, Lin & Chu t*	common unit root process	−5.44468	0.0000	134	−2.07104	0.0192	130
Breitung					3.28357	0.9995	126
Im, Pesaran and Shin W-stat	indi-vidual unit root processes	−6.26082	0.0000	134	−2.94469	0.0016	130
ADF – Fisher Chi-square		58.7179	0.0000	134	44.7801	0.0000	130
PP – Fisher Chi-square		81.2209	0.0000	136	318.413	0.0000	136

Source: Own computation based on Eurostat data (database gov_q_ggdebt, retrieved 10.03.2014). Software utilized: E-views8.

firm (with the analogical reservations that were present for the whole panel) that this variable follows an I(1) process.

Conclusions

Taking into consideration the results presented in section 3 it can be concluded that a series of panel data stationarity tests of the debt to GDP ratio performed on a sample of the EU-10 countries failed to provided evidence of a better debt sustainability in the countries joining, (or aiming to join shortly), the euro area. This result, (or lack of result), can be due to a number of factors. Firstly, testing stationarity has already been deemed to provide unreasonable results i.e. not satisfactory at the expected level of confidence [Mackiewicz, 2010b]. Secondly, the included number of cross-sections (countries) is limited, especially in the subsamples related to euro-4 group. Thus, a specific behaviour of an individual country might bias the overall result. Indeed, the results of tests performed for individual countries indicated that, in general, for all of the countries in both analysed sub-periods debt to GDP seemed to follow an I(1) process. However, Bulgaria exhibits stationarity, Hungary – trend-stationarity (but the trend is increasing, so the debt should be interpreted as unsustainable), whereas Latvia's debt to GDP is even integrated of the order 2 (I(2)) – once the debt starts to grow this growth even accelerates). This last result might be the reason why the whole euro-4 subsample is non-stationary.[4]

Additionally, analysing only the statistical properties of the time-series might be insufficient for the assessment of debt sustainability for a number of reasons. The first is that even if, for example, the debt to GDP in Estonia is not stationary, their level of indebtedness is so small that with a very high degree of certitude it might be stated that it is sustainable. Thus, only statistical assessment without a deeper economic analysis is not sufficient to fully evaluate the country's debt sustainability. Secondly, statistical analysis is by definition backward-looking and cannot be seen as the forecast of the behaviour of the government in the future. Thus the use of some more sophisticated instruments, including estimations of the governments' reactions in terms of adjustment to the primary balance in response to the increases in the debt level might give a more complete answer to the initial research question.

[4] Details of results of the stationarity tests for the individual countries are available from the author upon request.

These two remarks provide a clear path for future research. Finally, the statistics on government debt do not include until now the hidden burden related to the obligations towards the next retired generations which might mean that all the current debate on debt sustainability neglects a very important factor. But this is a topic which seems to remain outside the present research programme – relations between public debt crises and pension reforms are analysed e.g. by Hinrichs [2013].

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