Journal of Empirical Economics
Vol. 4, No. 4, 2015, 207-215

Public Debt Sustainability in Europe and Leading Countries

Bodo Herzog[1], Larissa Dausch[2]

Abstract

We investigate public debt sustainability in Europe and leading industrialised countries. The recent debate about the debt ceiling in the US and the sovereign debt crisis in Europe demonstrate the urgency of the topic. We measure debt sustainability of public finance with a standard and alternative methodology and compare both results. We use panel data of 205 OECD countries from 1970 to 2014. The paper finds unsustainable public debt levels for almost all countries in the past decades. Furthermore, given the low economic growth and demographic challenge ahead, debt levels may upsurge even more. There is a huge looming 'debt meltdown' on the horizon if countries do not change public policy soon.

Keywords: Public Debt Sustainability, Measurement of Sustainability, European Debt Crisis

JEL-Code: P16, G38,D72, E32

1. Introduction

Throughout the past decades policy-makers and academics have discussed public debt sustainability. How do governments react to excessive debt accumulation? Do they take corrective measures or do they let the debt grow? Recently these questions gain edrelevance due to rising debt levels during the financial crisis of 2007 to 2009 and the demographic challenge ahead. In addition, there is evidence that a high debt-to-GDP ratio is mitigating future economic growth (Blanchard 1984, Reinhart and Rog off 2010, Raza et al. 2011, Woo and Kumar 2015).

Despite the importance of the topic, the measurement of sound public finances is by no means an easy task. The older theories in this literature argue that sound public finance implies a non-stationary debt-to-GDP ratio. This methodological approach was developed by Hamilton (1986) and Wilcox (1989).But the empirical verification of public debt stationarity is both insufficient and difficult due to the methodological restrictions of rejecting a unit root in a time series. Usually it is even impossible to reject a unit root, despite a declining debt-to-GDP ratio (Kitterer 2006). The econometric limitations of unit root tests have to do with the fact that the debt-to-GDP ratio is affected by various shocks and thus mean-reversion is almost impossible to detect. Therefore, the older approaches are not useful for practical policy decision-making.

In the beginning of the 1990s a new academic discussion on public debt sustainability was developed by Bohn (1995). The new approach is highly technical and based on a general equilibrium model. However, the intuition is as follows: as long as the present-value of all future primary surpluses is not smaller than the accumulated public debt including the initial debt stock, the public debt is defined as sustainable. Obviously, no creditor will lend money to a state if the state is not able to pay back the expected loan – here public debt. Hence, the future government revenues minus expenditures, i.e. the primary surplus, must be positive and increasing as long as the debt stock increases as well.

[1] ESB Business School, Reutlingen University, Alteburgstrasse 150, 72762 Reutlingen, Germany,Reutlingen Research Institute, Reutlingen University, Germany,Institute of Finance and Economics, ESB Business School,Germany,

[2] ESB Business School, Reutlingen University, Alteburgstrasse 150, 72762 Reutlingen, Germany, Institute of Finance and Economics, ESB Business School,Germany

However, even this intuitive condition is difficult to verify in practice because it requires a great deal of information regarding future interest rates and growth rates. Clearly, we assuredly know that the economic future is uncertain. But Bohn (1998, 2005) derived from his theory an econometric model that is capable of verifying the sustainable condition with existing and available data. As long as we have a positive relationship between the primary surplus and the debt-to-GDP ratio including some control variables –i.e. government expenditures and the business cycle –the public debt can be judged sustainable. Hence, the econometric condition is true under fairly weak conditions and in a sense it is the same as an empirical test of the intertemporal budget constraint in the theoretical model. Therefore, this empirical approach is more promising for economic policies.

To our knowledge, this paper is one of the first that studies the question in the wake of the financial and European sovereign debt crisis and includes25 OECD (Organization for Economic Cooperation and Development) countries from 1970 to 2014. Overall, we find that only one country (Germany) has public debt sustainability according to all tests. All other countries are only weakly sustainable or even unsustainable. In particular, the US, the UK and Japan have unsustainable public finances while Europe as a whole seems to be at least weakly sustainable. This finding is somehow surprising because since 2010 we have had a so-called sovereign debt crisis in Europe. But this is rather a debt crisis in the wake of the financial crisis for some countries, such as Portugal, Spain and Greece.

The remainder of this paper is structured as follows. Section 2presents a literature review. Section 3 develops the theoretical conditions for the measurement of public debt sustainability. Thereafter, we illustrate the econometric model that we estimate with our data in Section 4. Section5 discusses the empirical findings. Finally, section 6concludes the paper.

2. Literature Review

Several seminal papers exist on the topic of public debt sustainability especially by Hamilton (1986), Wilcox (1989) and Bohn (1995, 1998,2005).Remarkably so far, there is little literature on this issue in particular the measurement of public debt sustainability, since the financial crisis and the European sovereign debt crisis.

The older literature by Hamilton (1986) and Wilcox (1989) is based on time series analysis such as a unit root test. Since then, the augmented Dickey-Fuller (ADF) or Phillips-Perron (PP) unit test have been applied in literature. However, unit root tests are flawed when addressing the problem of rejecting a unit root in debt-to-GDP levels. The main difficulty is that the debt-to-GDP ratio is usually non-stationary (i.e. growing) and furthermore affected by various shocks, for example fluctuations in output growth, interest rates, and governments pending (Trehan &Walsh 1991,Ahmed &Rogers 1995). Hence, the detection of mean-reversion, measured by unit root tests is empirically difficult. The key challenge of unit root regressions is the flawed consideration of systematic components. In addition, the unit root of primary deficits,$s(t)$, is frequently strongly rejected and thus the public deficit is stationary.

These difficulties are already demonstrated by Bohn (1998, 2005). Bohn (1995) shows in a dynamic stochastic general equilibrium model that the general transversality condition, that satisfies the intertemporal budget constraint, contains a stochastic discount factor. Moreover, the stochastic discount factor is linked to fiscal and economic policy measures. Hence, the discount factor is time-variant. But this finding is disregarded by all the unit root tests of the past. Consequently, Bohn (1998)develops a theoretical and empirical alternative to unit root tests. However so far, this literature is mainly based on U.S. data. We use and extend this approach to 25OECD countries in the wake of the European sovereign debt crisis. Consequently, this paper fills a significant gap in the current literature of public debt sustainability.

In addition, our analysis is in line with current research, however, goes beyond the existing studies (Ghosh et al. 2013, European Commission 2014). We study the public debt sustainability in a broader context and discuss country and panel regressions based on a new data sample and measurement of sustainability. To our knowledge, this paper contributes significantly to the current policy debate on debt sustainability in Europe and the World.

3. Theoretical Model

Our theoretical framework is a dynamic stochastic general equilibrium model that is based on the intertemporal public budget constraint. First, let us start with a simplified and well-known period-by-period budget constraint

$$\boldsymbol{D(t) - D(t-1) \;=\; -S(t) + i(t) * D(t-1)}$$
$$\boldsymbol{D(t) \;=\; -S(t) + \big(1 + i(t)\big)D(t-1),} \qquad (\mathbf{1})$$

where$D(t)$ is the period's t debt stock, $S(t)$is the primary deficit(i.e. tax revenues minus non-interest spending) and $i(t)$ thenominal interest rate on the debt payment.[3] Therefore, the equation (1) demonstrates that the discounted debt in period t has to be equal to the previous debt stock minus primary surplus in period t. In a growing economy with an expanding taxbase and rising government spending, it is instructive to write thisbudget equation in relation to GDP, such as

$$\boldsymbol{d(t) \;=\; -s(t) + \big(1 + r(t)\big)d(t-1)}\,, \qquad (\mathbf{2})$$

where$d(t) = D(t)/Y(t)$ is defined as the debt-to-GDP ratio,$s(t) = S(t)/Y(t)$ is the deficit ratio, and$1 + r(t) = (1 + i(t))/(1 + g(t))$ is the ratio of the gross return ongovernment debt to the gross rate of GDP. Equation (2) can be seen in real and nominal terms because the inflation cancels out. We take the variables $r(t)$ and $g(t)$as real variables and such they denote the real interest rate and the real GDP growth rate, respectively. The recursive solution of equation(2) yields

$$\boldsymbol{d(t) \;= \sum_{j=1}^{n} \left(\frac{1}{1+r}\right)^{j} E_t[s(t+j)] + \left(\frac{1}{1+r}\right)^{n} E_t[d(t+n)]} \quad , \qquad (\mathbf{3})$$

And if $n \to \infty$,the transversality condition obtains:$\lim_{n\to\infty}(1/(1+r))^n$: $\boldsymbol{E_t}[d(t+n)] = 0$. Hence, the resulting intertemporal budget constraint simplifies to

$$\boldsymbol{d(t) \;= \sum_{j=1}^{n} \left(\frac{1}{1+r}\right)^{j} E_t[s(t+j)]}. \qquad (\mathbf{4})$$

This equation represents the famous result that the debt-to-GDP ratioin $t = 0$ has to equal the present value of the expected primary surpluses. However, the ad hoc definition or ad hoc approach assumes that the discount factor$1/(1 + r)$ is constant.Thus, there is no effect of fiscal policy on economic growth or the interest rate and thus 'r'is constant in this approach. Obviously, this is too restrictive for a serious economic assessment of public debt sustainability. Therefore, we discuss next an extension towards a general equilibrium model.

According to Bohn (1995) it is possible to show that the general economic discount factor is a stochastic and time-variant factor and represents the intertemporal rate of substitution. Hence, the transversality condition modifies to $\lim_{t\to\infty} \boldsymbol{E_t}[u(t,n) * d(t+n)] \;\; = 0$,where $u(t,n)$ is the marginal rate of substitution between period $t$and $t + n$ and thus is the economy's pricing kernel for contingent claims on period $t + n$. The intertemporal budgetconstraint finally yields

$$\boldsymbol{d(t) \;= \sum_{n=1}^{\infty} E_t[u(t,n) * s(t+n)]}\,. \qquad (\mathbf{5})$$

Thepublic budget constraint of equation (5) is by construction consistent with optimizing bond holder behaviour. However, it differs to the ad hoc condition in equation (4) and hence the pricing kernel is stochastic and more general. Intuitively, this reflects economic reasoning: debt sustainability under

[3]Later, we define $1 + R(t)$ thegross interest rate factor.

uncertainty cannot be computed via a constant discount factor because the future behaviour of the debt stock $d(t+n)$includes unknown deficits and interest rates. Hence, the resulting stock of debtcan vary and is often correlated with major economic sources, such as output growth or discretionary government spending. The old approaches simply do not consider these issues and therefore unit root tests are unsuitable for the measurement of public debt sustainability in general.

4. Data and Econometric Methodology

For our econometric model, we gather data of25 OECD countries, including Canada, China, Japan, Russia, and the United States and the remaining European countries such as Austria, Belgium, Cyrus, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Slovak Republic, Slovenia, Spain, and the United Kingdom. In order to have sufficient quality for the assessment of debt sustainability, we always use the longest time series available, which range from 1970 to 2014, however in many cases data ends in 2012.The econometric model is derived from the stochastic general equilibrium model and is suitable to test public debt sustainability empirically. We merely have to test for a systematic negative relationship between the debt-to-GDP ratio, $d(t)$, and the primary surplus, $s(t)$.First, let us rewrite an econometric equation for the primary surplus,$s(t)$, such as

$$\boldsymbol{s(t) = \alpha * Z(t) + \rho d(t) + \epsilon(t)}\,,$$

where$Z(t)$is a set of other determinants of the primary surplus, $\epsilon(t)$ a standard error term with$E[\epsilon(t)]$=0 and$\sigma^2[\epsilon(t)] = 1$. In other words, we study the link between the primary surplus$s(t)$ and the debt level$d(t)$and estimate the parameter ρ. If both$s(t)$ and $d(t)$are non-stationary, while $\alpha * Z(t) + \epsilon(t)$ is stationary, onecould interpret a regression model of this type as a co-integration regression without having to model the stationary term explicitly. However, if $s(t)$ and $d(t)$do not haveunit roots, a regression of both variables that omits otherdeterminants of the primary surplus will produce inconsistent estimates.To put the regression model into practice we control for the non-debt determinants of the primary surplus, i.e. $\alpha * Z(t) + \epsilon(t)$, by including two factors: (i) the measurement of the level of temporary government spending, GVAR and the measurement of the business cycle, YVAR. Thus, we will estimate the following regression model

$$\boldsymbol{s(t) = \alpha + \rho d(t) + \underbrace{\alpha_G * GVAR + \alpha_Y * YVAR}_{Z(t)} + \epsilon(t)}\,. \qquad \textbf{(6)}$$

This equation is estimated for all countries over the whole time period. The variables GVAR and YVAR are defined as the public budget gap and the output gap. They are computed with the Hodrick-Prescott-Filter for annual data. To adjust for autocorrelation and heteroskedasty, we use Newey-West standard errors and apply dummy variables for exogenous events. This approach yields an unbiased and consistent OLS estimation of parameter ρ.

5. Empirical Results and Discussion

Table 1: Unit Root Tests

	Canada	China	Japan	Russia	US	EU-Panel
Levin, Lin & Chu t*	-0.665	-0.557	-2.294**	-4.033***	-4.722***	-0.958
Breitung t-stat	-0.534	-0.845	-0.021	-0.631	-3.651***	0.068
Im, Pesaran and Shin W-stat	-2.194**	-2.033**	-2.487***	-2.168**	-7.845***	-16.529***
ADF - Fisher Chi-square	22.946***	18.063**	19.327***	18.387**	76.219***	266.252***
PP - Fisher Chi-square	63.761***	9.499	16.065**	13.491*	68.937***	142.239***

Null Hypothesis: Unit root. The Levin, Lin&Chu and Breitung Test assumes a common unit root process. The Im, Pesaran and Shin, ADF and PP Test assumes indivdiual unit roots. We indicate the significance at 1% = ***, 5% = ** and 10% = *.

In the following, we discuss our econometric regression results. First we study the 'older' unit root approaches. The results are summarised in Table [1] and Table [2].

According to the augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root test and other related test statistics, we first find, as explained above, biased evidence of public debt sustainability. It turns out that Canada, the US, and Europe, in particular Belgium, Cyprus, Finland, France, Germany, Italy, Luxembourg, Malta, Portugal, and the UK are significant at 1 per cent. It is obvious that some countries of this list may not be good examples of debt sustainability in the past decades.

Table 2: Unit Root Tests

	Austria	Belegium	Cyprus	Estonia	Finland	France	Germany	Greece	Ireland
Levin, Lin & Chu t*	-0.232	-1.321*	-1.978**	-2.317**	-2.780**	-0.342	-4.402***	-1.354*	5.081
Breitung t-stat	-1.026	-0.696	-3.691***	2.402	-2.841**	-2.087**	-2.691***	0.292	5.539
Im, Pesaran and Shin W-stat	-1.911**	-2.944***	-3.050***	0.032	-3.307***	-2.787***	-4.018***	-1.666**	3.083
ADF - Fisher Chi-square	17.499**	28.036***	27.686***	7.631	25.201***	24.356***	29.269***	19.052**	11.037
PP - Fisher Chi-square	184.374***	52.942***	37.717***	5.346	27.859***	23.369***	22.136***	31.116***	15.854**

Null Hypothesis: Unit root. The Levin, Lin&Chu and Breitung Test assumes a common unit root process. The Im, Pesaran and Shin, ADF and PP Test assumes indivdiual unit roots. We indicate the significance at 1% = ***, 5% = ** and 10% = *.

	Italy	Luxemburg	Malta	Netherlands	Slovakia	Slovenia	Spain	Portugal	UK
Levin, Lin & Chu t*	-1.106	-1.434*	-0.938	-0.538	-2.074**	-1.662**	-0.541	-0.154	-0.344
Breitung t-stat	-0.659	-0.112	-1.262	-0.171	-2.452***	-0.713	-1.381*	1.222	0.616
Im, Pesaran and Shin W-stat	-3.029***	-2.271**	-2.204**	-1.189	-0.909	-1.913**	-2.497*	-3.961***	-2.679***
ADF - Fisher Chi-square	27.357***	24.788***	26.078***	14.356*	13.718*	16.995**	19.482**	38.126***	25.049***
PP - Fisher Chi-square	24.325***	22.188***	24.546***	42.868***	8.299	11.871	3.434	29.265***	28.602***

Null Hypothesis: Unit root. The Levin, Lin&Chu and Breitung Test assumes a common unit root process. The Im, Pesaran and Shin, ADF and PP Test assumes indivdiual unit roots. We indicate the significance at 1% = ***, 5% = ** and 10% = *.

However, this positive result is due to the measurement bias in respect to the unit root methodology. Furthermore, it is interesting that almost all other countries are at least significant at 5 or 10 per cent. Hence, according to the unit root test public debt sustainability is not a problem at all. This overall positive observation highlights a natural concern you should have with the application of unit root tests in this field of literature.

Next, let us estimate our econometric equation (6) based on the general equilibrium model equation (5). These estimates should provide a better and more comprehensive picture on the issue of debt sustainability. Table [3] and Table [4] summarise the results of our estimation and they include all test statistics.

As already explained in the methodological section, public debt sustainability requires that the estimated debt-to-GDP parameter must be significantly negative. In Table [3] this is only the case for Canada at 1 per cent and for Europe at 10 per cent. Hence, only these two countries demonstrate public debt sustainability. In addition, this finding is in line with the unit root test above for both countries, however the empirical finding of equation (6) is stronger and thus more reliable. Interestingly, for Japan we even find a significant positive relation for the debt-to-GDP parameter at 1 per cent, which points to unsustainable public finances. With this model you can see the weakness of the unit root tests again. First, the Phillips-Perron (PP) test for Japan was less significant and the exact evaluation of debt sustainability by equation (6) now demonstrates even the opposite. That shows that the unit root test is unsuitable to reject the unit root but the estimation of equation (6) reveals the unsustainable situation.

A closer look to the other European countries provides interesting insights as well. Only Germany, Italy, Netherlands and Spain show weak indication of public debt sustainability at 1 to 10 per cent levels. But due to data constraints and the financial crisis the time series data for Italy and Spain ends in 2009, that means before the debt overhang in both countries started. Therefore, including the recent data, the picture for Italy and Spain would probably change. This also demonstrates that all estimates are quite sensitive.

Consequently, it makes sense to assess the findings of all estimates according to equation (6) together with the results of the unit root tests. If all tests point in the same direction you have reasonable evidence for sustainable or unstainable public debt levels. Thus, comparing the findings in Table [2] and Table [4] it demonstrates that only Germany's public debt can be assessed as sustainable. This finding is confirmed with different data but similar estimates by Herzog (2010). He estimated two time periods from1970 to 2005 and the German unification from 1990 to 2005. Moreover, he estimated the debt sustainability equation for all 16 states within in Germany. He found a significant negative sign for the debt-to-GDP coefficient which confirms sustainable public debt levels in Germany. However, he points to a decline in sustainability in the post-reunification period from 1990 to 2005.

Table 3: Estimation of Equation 6

	Canada	China	Japan	Russia	US	EU-Panel
Constant	12.177***	1.421***	-2.902***	-3.329***	-1.434	1.453***
Debt-to-GDP	-0.153***	-0.001	0.049***	-0.003	0.044	-0.019*
GVAR	1.654***	0.259*	1.471***	1.312***	1.485***	0.672***
YVAR	0.167	-0.098	0.014	-0.135**	0.176	-0.165***
R-squared	0.737	0.308	0.910	0.916	0.542	0.290
Adjusted R-squared	0.707	0.214	0.900	0.888	0.496	0.285
S.E. of regression	1.994	0.830	1.075	1.637	2.097	2.980
F-statistic	24.325	3.267	88.135	32.584	11.827	55.374
Prob(F-statistic)	0.000	0.041	0.000	0.000	0.000	0.000
Prob(Wald F-statistic)	0.000	0.185	0.000	0.000	0.000	0.000
Mean dependent var	0.301	1.402	2.583	-3.419	1.297	0.399
S.D. dependent var	3.685	0.936	3.400	4.883	2.954	3.525
Akaike info criterion	4.342	2.605	3.105	4.072	4.429	5.032
Durbin-Watson stat	0.450	0.996	0.689	2.212	0.423	0.311

Dependent: Primary Deficit. Regression mit Newy-West corrected standard errors. We indicate the significance at 1% = ***, 5% = ** and 10% = *. Own Estimates.

Table [4] reveals that some countries, such as Slovenia, Portugal and the UK have according to the test of equation (6) significantly unsustainable public finances. Looking to the regression statistics, the regression model explains a higher proportion of the variance in the primary surplus (high R^2) and the overall regression (F-Test) is also highly significant. All the statistics point to robust estimations.

Table 4: Estimation of Equation 6

	Austria	Belegium	Cyprus	Estonia	Finland	France	Germany	Greece	Ireland
Constant	4.485	3.973	1.347	3.064	0.264	0.385	1.453***	1.809	3.363
Debt-to-GDP	-0.071	-0.057	0.029	-0.361	-0.022	0.014	-0.019*	-0.010	-0.042
GVAR	0.964***	1.117***	0.534	0.867***	0.641***	0.156	0.672***	-0.501	1.178*
YVAR	0.165*	0.198*	-0.456***	-1.654**	-0.239	-0.415**	-0.165***	-0.007	-0.456
R-squared	0.807	0.397	0.630	0.757	0.748	0.505	0.290	0.043	0.480
Adjusted R-squared	0.777	0.327	0.538	0.696	0.719	0.448	0.285	-0.108	0.420
S.E. of regression	0.649	2.993	1.778	1.124	2.222	1.185	2.980	4.279	5.472
F-statistic	26.484	5.707	6.823	12.464	25.747	8.849	55.374	0.286	8.001
Prob(F-statistic)	0.000	0.004	0.006	0.001	0.000	0.000	0.000	0.835	0.001
Prob(Wald F-statistic)	0.000	0.000	0.001	0.000	0.000	0.005	0.000	0.875	0.043
Mean dependent var	-0.015	-2.063	3.013	-0.001	-0.522	1.127	0.399	0.788	0.690
S.D. dependent var	1.373	3.650	2.616	2.040	4.193	1.596	3.525	4.065	7.186
Akaike info criterion	2.131	5.154	4.201	3.284	4.559	3.302	5.032	5.902	6.361
Durbin-Watson stat	1.415	0.353	1.326	2.317	0.936	0.739	0.311	0.613	0.243

Dependent: Primary Deficit. Regression mit Newy-West corrected standard errors. We indicate the significance at 1% = ***, 5% = ** and 10% = *. Own Estimates.

	Italy	Luxemburg	Malta	Netherlands	Slovakia	Slovenia	Spain	Portugal	UK
Constant	32.614***	-3.381**	-3.009	2.748*	5.318***	-5.792*	7.034***	-7.855**	-2.336
Debt-to-GDP	-0.316***	0.283***	0.086	-0.062**	-0.051	0.235***	-0.134***	0.144***	0.077**
GVAR	0.537***	0.719***	-0.787	1.727***	0.909***	-0.176	0.653***	0.337	1.262***
YVAR	-0.330*	0.112	-0.197	0.023	0.018	-0.163***	-0.611**	-0.088	-0.131
R-squared	0.669	0.595	0.316	0.888	0.914	0.802	0.674	0.460	0.772
Adjusted R-squared	0.617	0.494	0.023	0.860	0.888	0.753	0.634	0.383	0.746
S.E. of regression	1.545	1.505	3.015	1.076	0.875	0.823	1.750	1.656	1.533
F-statistic	12.824	5.876	1.079	31.811	35.291	16.249	17.200	5.972	30.396
Prob(F-statistic)	0.000	0.010	0.418	0.000	0.000	0.000	0.000	0.004	0.000
Prob(Wald F-statistic)	0.000	0.008	0.078	0.000	0.000	0.006	0.000	0.008	0.000
Mean dependent var	-1.638	-1.114	2.893	-0.883	3.323	0.256	0.657	0.557	1.362
S.D. dependent var	2.498	2.116	3.051	2.881	2.611	1.656	2.894	2.108	3.043
Akaike info criterion	3.865	3.868	5.320	3.198	2.805	2.660	4.084	3.992	3.812
Durbin-Watson stat	1.752	0.631	1.408	1.402	1.304	1.237	1.204	0.856	0.359

Dependent: Primary Deficit. Regression mit Newy-West corrected standard errors. We indicate the significance at 1% = ***, 5% = ** and 10% = *. Own Estimates.

The variables GVAR and YVAR are control variables for discretionary fiscal policy measures and the impact of the overall economy. These two measures are significant at 1 percent only for Germany, which points to the fact that Germany's public debt is sustainable and the controls are sufficient and support this positive result (Table 4).

Finally, we estimate the same regression model, however, we include autoregressive and moving average (ARMA) terms of the first- and second-order to control for explicit autocorrelation. The results are in Table [A1] and Table [A2] in the appendix. Again the results are as expected and confirm the findings above.

Overall, the regression sheds new light on public debt sustainability in Europe and other leading countries. Firstly public debt sustainability in Europe is at least as good as or even better than in the US, the UK or Japan. Hence, the simple comparison of public debt and deficit, which are usually discussed in business and during the European sovereign debt crisis, are hugely misleading. In fact our results point to the fact that the US, the UK and Japan have even greater problems with sound public debt levels, up to even unsustainable debt. The second result is that only a comprehensive study reveals the true picture of public debt sustainability. For analysing debt sustainability you have to look at debt and deficit levels, unit root tests, and a regression model of equation (6). If all information points in the same direction then you may conclude on a reliable foundation that this country has sustainable public debts. As long as you find contradicting evidence the final assessment is almost impossible. In general, our results demonstrate a wake-up call to policy-makers. They should not lose time to bring public finances back on track towards more sustainable levels.

6. Conclusion

In this paper we show that public finances have been unsustainable for almost all countries. Only a few countries, such as Canada and Germany demonstrate evidence towards public debt sustainability. The other countries in our sample show rather unsustainable public debt levels. Overall, this is not a surprising result. One explanation is that the past financial crises have deteriorated public finances significantly. Another explanation is the politico-economic argument that policy-makers have not taken the long-terminter temporal public budget constraint into account, due to high economic growth and the lack of future risks, such as an aging society.

The new and comprehensive data and methodology, which are applied in our paper, are exciting and thus provide a benchmark for future studies in this field of literature.Hence, our findings indicate some urgency but also a reference for further evaluation studies of public debt sustainability. We think that this study could start a new debate on the need of public and private debt sustainability.

References

Ahmed, S. and Rogers, J. (1995). Government budget deficits and trade deficits: Are present value constraints satisfied in long-term data? Journal of Monetary Economics, XXXVI:351–374.

Beetsma, R. and Uhlig, H. (1999).An Analysis of the Stability and Growth Pact.The Economic Journal, 109:546–571.

Blanchard, O. (1984). Current and anticipated deficits, interest rates and economic activity.European Economic Review, XXV:7–27.

Bohn, H. (1995). The Sustainability of Budget Deficits in a Stochastic Economy.Journal of Money, Credit and Banking, 27:257–271.

Bohn, H. (1998). The Behavior of U.S. Public Debt And Deficits. The Quarterly Journal of Economics, Vol. 113(3): 949–963.

Bohn, H. (2005). The Sustainability of Fiscal Policy in the United States.CESifo Working Paper.

European Commission (2014).Assessing Public Debt Sustainability in EU Member States: A Guide.European Economy, No. 200, p. 1-52.

Ghosh A.R. et al. (2013). Fiscal Fatigue, Fiscal Space and Debt Sustainability in Advanced Economies.The Economic Jounral, Vol. 123(556): 4-30.

Hamilton, J. and Flavin, M. (1986). On the Limitations of Government Borrowing: A Framework for Empirical Testing. American Economic Review, 76:808–819.

Herzog, B. (2010). Anwendung des Nachhaltigkeitsansatzes von Bohn zur Etablierung eines Frühindikators in den öffentlichen Finanzen – Beitrag zur aktuellen Debatte der Föderalismuskommission II,Journal ofCreditand Capital, Vol.43(2): 1-24.

Kitterer,W. and Finken, J. (2006). Zur Nachhaltigkeit der Länderhaushalte – Eine empirischeAnalyse. Finanzwissenschaftliche Diskussions beiträge, Vol. 6.

Raza, S. A., Sabir, M. S., & Mehboob, F. (2011). Capital inflows and economic growth in Pakistan. MPRA Paper No. 36790, University Library of Munich, Germany.

Reinhart, C. and Rog off, K. (2010), Growth in a Time of Debt, American Economic Review: Papers & Proceedings,Vol. 100: 573–578

Trehan, B. and Walsh, C. (1991). Testing intertemporal budget constraints: Theory and applications to u.s. federal budget and current account deficits. Journal of Money, Credit and Banking, XXIII: 210–223.

Wilcox, D. (1989). The Sustainability of Government Deficits: Implications of the Present–Value Borrowing Constraint. Journal of Money, Credit, and Banking, 21(3):291–306.

Woo, J. and Kumar, M.S. (2015). Public Debt and Growth. Economica, (forthcoming).

Appendix

Table A1

	Canada	China	Japan	Russia	US	EU-Panel
Constant	5.538***	0.972***	-1.980***	-2.245	0.869	0.831***
Debt-to-GDP	-0.069***	0.009	0.031***	-0.011	-0.001	-0.012***
GVAR	0.469*	0.112*	0.853***	1.451**	0.574***	0.314***
YVAR	-0.313*	-0.116	-0.214***	-0.055	-0.318*	-0.229***
P_DEFICIT(-1)	0.850***	0.814***	0.475	0.232	0.885***	0.793
P_DEFICIT(-2)	-0.153	-0.536**	-0.056	-0.031	-0.232*	-0.084
R-squared	0.954	0.611	0.962	0.931	0.846	0.718
Adjusted R-squared	0.944	0.513	0.953	0.863	0.819	0.714
S.E. of regression	0.885	0.653	0.747	1.784	1.256	1.889
Sum squared resid	18.026	8.523	12.844	15.918	44.206	1337.842
Prob(F-statistic)	0.000	0.001	0.000	0.006	0.000	0.000
Prob(Wald F-statistic)	0.000	0.000	0.000	0.000	0.000	0.000
Mean dependent var	0.238	1.402	2.576	-4.164	1.297	0.262
S.D. dependent var	3.733	0.936	3.460	4.816	2.954	3.533
Akaike info criterion	2.776	2.184	2.437	4.298	3.453	4.125
Durbin-Watson stat	1.625	1.941	1.417	2.428	1.353	1.411

Dependent: Primary Deficit. Regression mit Newy-West corrected standard errors. We indicate the significance at 1% = ***, 5% = ** and 10% = *. Own Estimates.

Table A2

	Austria	Belegium	Cyprus	Estonia	Finland	France	Germany	Greece	Ireland
Constant	3.889	2.449	4.789*	7.356**	1.33	-0.156	0.831***	-1.189	4.153*
Debt-to-GDP	-0.062	-0.032*	-0.055	-1.223**	-0.041*	0.015	-0.012***	0.009	-0.052
GVAR	0.897***	0.324**	0.452	0.997***	0.309*	0.121	0.314***	0.554	0.512*
YVAR	0.153	-0.211	-0.554***	-1.287*	-0.464**	-0.282*	-0.229***	0.365*	-0.211
P_DEFICIT(-1)	0.244***	0.469***	0.464***	0.162	0.512**	0.609***	0.793***	1.036***	1.405***
P_DEFICIT(-2)	-0.117*	0.174**	0.076	-0.009	0.073	-0.199	-0.084	-0.227	-0.363
R-squared	0.865	0.868	0.840	0.831	0.880	0.705	0.718	0.704	0.864
Adjusted R-squared	0.820	0.839	0.740	0.726	0.854	0.641	0.714	0.606	0.834
S.E. of regression	0.607	1.266	1.399	1.107	1.621	0.972	1.889	2.480	2.941
Sum squared resid	5.526	36.870	15.661	9.811	60.437	21.750	1337.842	92.229	198.944
Prob(F-statistic)	0.000	0.000	0.005	0.006	0.000	0.000	0.000	0.001	0.000
Prob(Wald F-statistic)	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000
Mean dependent var	-0.065	-2.414	3.148	-0.190	-0.439	1.124	0.262	0.342	0.487
S.D. dependent var	1.429	3.157	2.743	2.115	4.242	1.624	3.533	3.949	7.225
Akaike info criterion	2.074	3.492	3.807	3.340	3.986	2.964	4.125	4.889	5.177
Durbin-Watson stat	1.681	1.425	2.963	2.637	2.089	1.764	1.411	1.868	1.253

Dependent: Primary Deficit. Regression mit Newy-West corrected standard errors. We indicate the significance at 1% = ***, 5% = ** and 10% = *. Own Estimates.