THE RIMINI CENTRE FOR ECONOMIC ANALYSIS

WP 10-05

Mark J. Holmes
Department of Economics, Waikato University, New Zealand

Jesús Otero
Facultad de Economía, Universidad del Rosario, Colombia

Theodore Panagiotidis
Department of Economics, University of Macedonia, Greece

ON THE STATIONARITY OF CURRENT ACCOUNT DEFICITS IN THE EUROPEAN UNION

The Rimini Centre for Economic Analysis
Legal address: Via Angherà, 22 – Head office: Via Patara, 3 - 47900 Rimini (RN) – Italy
www.rcfea.org - secretary@rcfea.org

ON THE STATIONARITY OF CURRENT ACCOUNT DEFICITS IN THE EUROPEAN UNION♦

Mark J. Holmes
Department of Economics
Waikato University
New Zealand
holmesmj@waikato.ac.nz

Jesús Otero
Facultad de Economía
Universidad del Rosario
Colombia
jotero@urosario.edu.co

Theodore Panagiotidis
Department of Economics
University of Macedonia
Greece
tpanag@uom.gr

July 2009

Abstract

In this paper, we test for the stationarity of EU current account deficits. Our testing strategy addresses two key concerns with regard to unit root panel data testing, namely (i) the identification of which panel members are stationary, and (ii) the presence of cross-sectional dependence. For this purpose, we employ an AR-based bootstrap approach to the Hadri (2000) test. While there is only mixed evidence that current account stationarity applies when examining individual countries, this does not appear to be case when considering panels comprising both EU and non-EU members.

JEL Classification: C33, F32, F41

Keywords: Heterogeneous dynamic panels, current account stationarity, mean reversion, panel stationarity test.

♦ Work on this paper began while Jesús Otero was a Visiting Fellow in the Department of Economics at the University of Warwick. For this, we thank the Universidad del Rosario for its financial assistance. We are also grateful for helpful comments and suggestions received from seminar participants at the University of Canterbury, the 2007 Australasian Meeting of the Econometric Society (ESAM) at the University of Queensland as well as from an anonymous referee. The usual disclaimer applies.

1. Introduction

The stationarity of the current account occupies a position of special importance related to the sustainability of external debts and the incentive for a country to default. While temporary current account deficits may simply reflect the reallocation of capital to countries where it is more productive, persistent deficits may be regarded as more serious. Deficits may lead to increased domestic interest rates to attract foreign capital. However, the accumulation of external debt owing to persistent deficits will imply increasing interest payments that impose an excess burden on future generations. A further reason of importance is that sustainability of the current account is consistent with the intertemporal model of the current account, and hence supports its validity.[1] The modern intertemporal model of current account determination uses consumption smoothing behaviour to predict that the current account acts as a buffer to smooth consumption in the face of shocks.

For these reasons, the stationarity and sustainability of OECD current account balances has been the focus of many researchers over a number of years [see, *inter alia*, Trehan and Walsh (1991), Otto (1992), Wickens and Uctum (1993), Liu and Tanner (1996), Wu (2000), Wu *et al*. (2001) and Holmes (2006)]. This literature examines the sustainability question within two alternative frameworks. On the one hand, a time series perspective is employed where researchers investigate either the long-run relationship between exports and imports or the stationarity of the current account deficit or external debt process (see Chortareas *et al.* 2004 and the references therein). With the exception of Liu and Tanner (1996), who consider the impact of structural breaks, the abovementioned studies generally find that current accounts are non-stationary for several major industrialised countries including the US, UK, Canada, Germany and Japan.

On the other hand, panel unit root techniques have been applied to current account data to address low test power associated with univariate unit root tests. In recent years, a number of alternative procedures have been proposed to test for the presence of unit roots in panels that combine information from the time-series dimension with that from the cross-section dimension such that fewer time observations are required for these tests to have power. The most commonly used unit root test applied to panels include Maddala and Wu (MW) (1999) and Im, Pesaran and Shin (IPS) (2003). These test the joint null hypothesis of a unit root against the alternative of at least one stationary series, by using the augmented Dickey–Fuller (ADF) (1979) statistic across the cross-sectional units of the panel. Recent studies that employ panel data methods include Wu (2000), Wu *et al*. (2001) and Holmes (2006) who confirm sustainability of OECD current account deficits using IPS panel data unit root and cointegration tests. However, IPS (2003, p.73) warn that the heterogeneous nature of the alternative hypothesis in their test means that one needs to be careful when interpreting the results. This is because the null hypothesis of a unit root in each cross section may be rejected when only a fraction of the series in the panel is in fact stationary. A further issue of concern is that the presence of cross-sectional dependencies can undermine the asymptotic normality of the IPS test and lead to over-rejection of the null hypothesis of joint non-stationarity. To some extent, these concerns are addressed by Holmes (2006) who conducts ADF unit root tests within a seemingly unrelated regression framework to reveal that the evidence concerning OECD current account stationarity is actually mixed.

This paper examines the long-run stationarity of current account deficits of several EU countries and main trade competitors. Given that subsequent expansions of the EU

[1] See, for example, Husted (1992) and references therein.

have taken place during our sample period, we investigate whether these have affected sustainability. This study differs in one important aspect from the existing literature. Hadri (2000) tests are employed on the null hypothesis that all the individual series are stationary against the alternative of at least a single unit root in the panel. The Hadri tests thus offer the advantage that if the null hypothesis is not rejected, there is evidence that all the current account deficits in the panel are stationary. Reliance on the IPS test alone does not allow the researcher to conclude that all panel members are stationary. A further important feature of our analysis is that we allow for the presence of potential cross-sectional dependencies, since failing to account for this leads to size distortion and over-rejection of Hadri test statistics. More specifically, we implement an AR-based bootstrap procedure that allows us to account for both serial correlation and cross-sectional dependency.

The plan of the paper is as follows. Section 2 discusses the framework that can be used to test current account stationarity and briefly reviews the Hadri approach to test for stationarity in heterogeneous panels of data allowing for the likely case in which there is cross section dependence. Section 3 describes the data and presents the results of the empirical analysis. Section 4 concludes.

2. Testing for current account stationarity in heterogeneous panel data

This study evaluates current account sustainability on the basis of testing for stationarity. The importance of current account stationarity is highlighted in the following model. Consider the case of a small open economy where an optimising representative individual, who is able to borrow and lend in international financial markets at a given world rate of interest, faces the following current-period budget constraint,

$$C_0 = Y_0 + B_0 - I_0 - (1 + r_0) B_{-1} \tag{1}$$

where C_0 , Y_0 , B_0 and I_0 refer to current consumption, income, borrowing and investment, r_0 is the one-period current world interest rate which is assumed to be stationary with an unconditional mean *r* and $(1+r_0)B_{-1}$ is the initial debt size.[2]

Equation (1) should hold in every time period and can therefore be solved forwards to derive the intertemporal budget constraint (IBC)

$$B_0 = \sum_{t=1}^{\infty} \psi_t (X - MM)_t + \lim_{n \to \infty} \psi_n B_n \tag{2}$$

where $Y_t - C_t - I_t = (X - MM)_t$ is the trade balance (exports expenditure minus imports expenditure) and ψ_t is the discount factor defined as the product of the first *t* values of $\lambda_0 = 1/(1+r_0)$. The IBC indicates that the present value of future trade surpluses is equal to the amount a country borrows or lends in international financial markets. This model may be used to derive a testable equation. Let

$$Z_t + (1+r) B_{t-1} = X_t + B_t \tag{3}$$

where $Z_t = MM_t + (r_t - r) B_{t-1}$ denotes imports plus additional interest payments on debt dependent on whether the world interest rate is above or below the long-run mean value, *r*. Solving forwards yields

$$MM_t + r_t B_{t-1} = X_t + \sum_{j=0}^{\infty} \lambda^{j-1} \left[\Delta X_{t+j} - \Delta Z_{t+j} \right] + \lim_{j \to \infty} \lambda^{t+j} B_{t+j} \tag{4}$$

[2] There are parallels with the literature on the sustainability of the government budget deficit. In this literature, a stationary interest rate is assumed by Hakkio and Rush (1991) and Trehan and Walsh (1991) in their modelling of the government budget deficit. However, Ahmed and Rogers (1995) actually show that the interest rate need not necessarily be stationary where cointegration tests are still appropriate in a stochastic environment.

where $\lambda = \left(1/\left(1+r\right)\right)$ and $MM_t + r_t B_{t-1}$ represents expenditure on imports plus interest payments on net foreign debt. Assume that expenditure on exports and imports are both non-stationary processes,

$$X_t = a_1 + X_{t-1} + e_{1t} \tag{5}$$

$$Z_t = a_2 + Z_{t-1} + e_{2t} \tag{6}$$

Substitute (5) and (6) into (4) and rearrange,

$$X_t = \alpha + \left(MM_t + r_t B_{t-1}\right) - \lim_{j\to\infty} \lambda^{t+j} B_{t+j} + \mu_t \tag{7}$$

where $\alpha = \left[\left(1+r^2\right)/r\right]\left(a_2 - a_1\right)$ and $\mu_t = \sum \lambda^{j-1}\left(e_{2t} - e_{1t}\right)$. Finally, we can write

$$X_t = \alpha + \beta M_t + \mu_t \tag{8}$$

where $M_t = MM_t + r_t B_{t-1}$ and it is assumed that $\lim_{j\to\infty} \lambda^{t+j} B_{t+j} = 0$.

Stationarity of the current account deficit is equivalent to finding that exports and imports are cointegrated with a known cointegrating vector of $\left(1,-1\right)'$, implying that exports and imports must be linked by a long-run equilibrium relationship. The sustainability of the current account $\left(X_t - M_t\right)$ concerns the validity of existing and future exports and imports. The current account balance is said to be unsustainable if the behaviour of exports and imports will lead to the violation of the IBC. In this case, there may be a need for the government to change policy and engage in corrective action. This might be the case if $\beta < 1$. However, if the current account balance is stationary, the implication is that with unchanged policies, the current account balance will not grow without limit where the discounted deficit will converge asymptotically to zero. Stationarity of the current account is therefore consistent with sustainability.[3]

Hadri (2000) proposes an LM procedure to test the null hypothesis that all the individual series are stationary (either around a mean or around a trend) against the alternative of at least a single unit root in the panel. The two LM tests proposed by Hadri (2000) are panel versions of the test developed by Kwiatkowski, Phillips, Schmidt and Shin (KPSS) (1992). Following Hadri (2000), consider the following two models:

$$y_{it} = f_{it} + \varepsilon_{it}, \tag{9}$$

$$y_{it} = f_{it} + \gamma_i t + \varepsilon_{it}, \tag{10}$$

where f_{it} is a random walk,

$$f_{it} = f_{it-1} + u_{it},$$

and ε_{it} and u_{it} are $i.i.d$ across i and over t, with $E\left[\varepsilon_{it}\right]=0$, $E\left[\varepsilon_{it}^2\right]=\sigma_{\varepsilon,i}^2>0$, $E\left[u_{it}\right]=0$, $E\left[u_{it}^2\right]=\sigma_{u,i}^2\geq 0$, $t=1,...,T$ and $i=1,...,N$. The null hypothesis that all series are stationary is given by $H_0:\sigma_{u,i}^2=0$, $i=1,...,N$, while the alternative that some of the series are non-stationary is $H_1:\sigma_{u,i}^2>0$, $i=1,...,N_1$ and $\sigma_{u,i}^2=0$, $i=N_1+1,...,N$.

Let $\hat{\varepsilon}_{it}$ be the residuals from the regression of y_i on an intercept, for model (9) (or on an intercept and a linear trend term, for model (10)). Then, the individual univariate KPSS stationarity test is given by:

[3] In the debate over budget sustainability, Trehan and Walsh (1988, 1991) consider the relationship between stationarity and sustainability of the budget deficit while Hakkio and Rush (1991) consider cointegration between revenues and expenditures.

$$\eta_{i,T} = \frac{\sum_{t=1}^{T} S_{it}^2}{T^2 \hat{\sigma}_{\varepsilon_i}^2},$$

where S_{it} denotes the partial sum process of the residuals given by $S_{it} = \sum_{j=1}^{t} \hat{\varepsilon}_{ij}$, and $\hat{\sigma}_{\varepsilon_i}^2$ is a consistent estimator of the long-run variance of $\hat{\varepsilon}_{it}$ from the appropriate regression. In their original paper, KPSS propose a nonparametric estimator of $\hat{\sigma}_{\varepsilon_i}^2$ based on a Bartlett window having a truncation lag parameter of $l_q = \text{integer}\left[q\left(T/100\right)^{1/4} \right]$, with $q = 4,12$. However, Caner and Kilian (2001) have pointed out that stationarity tests, such as the KPSS tests, exhibit very low power after correcting for size distortions. Thus, in our paper we follow recent work by Sul, Phillips and Choi (2005), who propose a new boundary condition rule that improves the size and power properties of the KPSS stationarity tests. In particular, Sul et al. suggest the following procedure. First, an AR model for the residuals is estimated, that is:

$$\hat{\varepsilon}_{it} = \rho_{i,1}\hat{\varepsilon}_{i,t-1} + \ldots + \rho_{i,p_i}\hat{\varepsilon}_{i,t-p_i} + \upsilon_{it} \tag{11}$$

where the lag length of the autoregression can be determined by using the Schwarz Information Criterion (SIC) or the GEneral-To-Specific (GETS) algorithm proposed by Campbell and Perron (1991). Second, the long-run variance estimate of $\hat{\sigma}_{\varepsilon_i}^2$ is obtained with the boundary condition rule:

$$\hat{\sigma}_{\varepsilon_i}^2 = \min\left\{ T\hat{\sigma}_{\upsilon_i}^2, \frac{\hat{\sigma}_{\upsilon_i}^2}{\left(1-\hat{\rho}_i(1)\right)^2} \right\},$$

where $\hat{\rho}_i(1) = \hat{\rho}_{i,1}(1) + \ldots + \hat{\rho}_{i,p_i}(1)$ denotes the autoregressive polynomial evaluated at $L = 1$. In turn, $\hat{\sigma}_{\upsilon_i}^2$ is the long-run variance estimate of the residuals in equation (11) that is obtained using a quadratic spectral window Heteroscedastic and Autocorrelation Consistent (HAC) estimator.[4]

The Hadri (2000) panel stationarity test statistic is given by the simple average of individual univariate KPSS stationarity tests:

$$\widehat{LM}_{T,N} = \frac{1}{N}\sum_{i=1}^{N}\eta_{i,T},$$

which, after a suitable standardisation and using appropriate moments, follows a standard normal limiting distribution.[5] That is:

$$Z = \frac{\sqrt{N}\left(\widehat{LM}_{T,N} - \bar{\xi}\right)}{\bar{\zeta}} \Rightarrow N\left(0,1\right)$$

where $\bar{\xi} = \frac{1}{N}\sum_{i=1}^{N}\xi_i$ and $\bar{\zeta}^2 = \frac{1}{N}\sum_{i=1}^{N}\zeta_i^2$.

The Monte Carlo experiments of Hadri (2000) show that these tests have good size properties where T and N are sufficiently large. However, Giulietti et al. (2009) show that even for relatively large T and N, the Hadri (2000) tests suffer from severe size distortions in the presence of cross-sectional dependence. Indeed, the magnitude of distortion increases with the strength of the cross-sectional dependence. This finding is consistent with results obtained by Strauss and Yigit (2003) and Pesaran (2007) on both the IPS and the MW panel unit root tests. In order to correct for the size distortion caused by cross-sectional dependence, Giulietti et al. (2009) apply the bootstrap method and find that the bootstrap Hadri tests are approximately correctly sized.

To implement the bootstrap method in the context of the Hadri tests, we begin by

[4] Additional Monte Carlo evidence reported by Carrion-i-Silvestre and Sansó (2006) also indicates that the proposal in Sul et al. (2005) is to be preferred since the KPSS statistics exhibit less size distortion and reasonable power.

correcting for serial correlation using equation (11) and obtain $\hat{\upsilon}_{it}$, which are centred around zero. As suggested by Maddala and Wu (1999), the residuals $\hat{\upsilon}_{it}$ are then re-sampled with replacement with the cross-section index fixed. This is so their cross-correlation structure is preserved. Denoting the resulting bootstrap innovation as $\hat{\upsilon}_{it}^{*}$, $\hat{\varepsilon}_{it}^{*}$ is then generated recursively as:

$$\hat{\varepsilon}_{it}^{*} = \hat{\rho}_{i,1}\hat{\varepsilon}_{i,t-1}^{*} + \ldots + \hat{\rho}_{i,p_i}\hat{\varepsilon}_{i,t-p_i}^{*} + \upsilon_{it}^{*}.$$

In order to ensure that the initialisation of $\hat{\varepsilon}_{it}^{*}$, i.e. the bootstrap samples of $\hat{\varepsilon}_{it}$, becomes unimportant, we follow Chang (2004) who advocates generating a large number of $\hat{\varepsilon}_{it}^{*}$, say $T+Q$ values and discard the first Q values of $\hat{\varepsilon}_{it}^{*}$ (for our purposes we choose $Q=30$). Lastly, the bootstrap samples of y_{it}^{*} are calculated by adding $\hat{\varepsilon}_{it}^{*}$ to the deterministic component of the corresponding model, and the Hadri LM statistic is calculated for each y_{it}^{*}. The results that will be shown in this paper are based on 2,000 bootstrap replications used to derive the empirical distribution of the LM statistic.

3. Data and empirical analysis

The data set, obtained from the *Datastream* database, consists of seasonally adjusted quarterly observations on current account deficits for the following thirteen EU countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Portugal, Spain, Sweden and the United Kingdom.[6] These countries allow us to consider

---

[5] Asymptotic moments can be found in Hadri (2000) while finite sample critical values appear in Hadri and Larsson (2005).

[6] This range of countries is dictated by the availability of consistent data with respect to the study period. This leads to the exclusion of Denmark and the Netherlands from the various EU samples.

the following groups: i) EU6 (based on the Founding States minus the Netherlands) that is Germany, France, Italy, Belgium, Luxembourg; ii) EU9 (after the 1973 expansion) that is EU6 plus Ireland and the United Kingdom; iii) EU12 (after the 1981 and 1986 expansions) that is EU9 plus Greece, Spain and Portugal; and iv) EU15 (after the 1995 expansion) that is EU12 plus Austria, Finland and Sweden. This provides a first important step at identifying the effects that subsequent expansions of the EU had on the sustainability of the current account. For reasons of comparison, we also collected data of the main trade competitors of the EU countries: Australia, Canada, Iceland, Japan, New Zealand, Norway, Switzerland and the United States (we refer to these as non-EU countries). The sample period is 1975q1-2005q4 and the current account deficits are expressed as a proportion of GDP.

Our empirical analysis begins by illustrating the risks involved in the mechanical application of the IPS panel unit root test statistic (see Table 1). The panels comprising the EU15 and non-EU countries provide IPS test statistics for p=1 lag (that is, computed using one lag in the individual ADF regressions) of -2.791 (p-value = 0.003) and -1.802 (p-value = 0.036) respectively. These statistics point towards rejection of the null hypothesis of joint non-stationarity. However, if one examines the corresponding ADF statistics on the individual countries within these panels, then it is clear that the rejection of the null hypothesis (at the 10% significance level) in the case of the EU15 is driven by five countries only (namely, Austria, Greece, Ireland, Luxembourg and the United Kingdom). In the case of the non-EU panel, rejection of the null is driven by only two countries (namely, Australia and New Zealand).[7]

[7] Similar findings, not reported here for brevity but available upon request, are observed when considering other groupings of countries, or when the test regressions are estimated using longer lag lengths.

A further issue that can adversely affect correct inference based on the IPS test is the presence of cross sectional dependence. In order to test whether cross sectional independence holds for the dataset under examination, we compute Pesaran's (2004) CD test for cross-sectional dependence. This test is based on the residual cross correlation of ADF(p) regressions. The results reported in Table 2 indicate that the null of independence is strongly rejected for all EU panels. There is some evidence that the null is not rejected in the case of Non-EU countries. However, this finding does not appear robust to the choice of the number of lags included in the ADF regressions. Overall, these results underline the need to take into account cross-section dependence when computing the panel stationarity tests.

The results from applying the KPSS univariate stationarity test, based on the model with intercept only, are reported in Table 3. As indicated in the previous section, the long-run variance required to calculate the KPSS statistic is consistently estimated using the new boundary condition rule proposed by Sul, Phillips and Choi (2005). Furthermore, to correct for possible serial correlation the autoregressive processes in (11) are estimated for up to p=8 lags where optimal number of lags is then chosen according to the SIC and the GETS algorithm. The GETS algorithm involves testing whether the last autoregressive coefficient is statistically different from zero (at the 10% significance level, say). If this coefficient is not statistically significant, then the order of the autoregression is reduced by one until the last coefficient is statistically significant. Focussing first on the EU countries, the null hypothesis of stationarity is rejected at the 10% significance level or better for three (two) out of the thirteen countries under consideration when the optimal lag length is chosen using the SIC (GETS algorithm). Turning to the non-EU countries, the null hypothesis is rejected for five countries when using the SIC; for four countries, rejection is at the 5% significance level and for one more country, rejection is at the 1% level. When using the GETS algorithm the null hypothesis of stationarity is rejected for six countries at least at the 10% significance level. In common with the existing literature, the evidence here is mixed and does not provide a clear indication of sustainability.

The results of the Hadri test using the AR-based bootstrap approach are reported in Table 4. Once again, we considered the same panels of countries as in Table 1. The main motivation for testing stationarity in a panel rather than univariate context is that the power of the test increases with the number of cross-sections in the panel. Each test allows for the presence of cross section dependence. The results show that we fail to reject the null hypothesis of panel stationarity for all the panels of countries under consideration. Indeed, this finding is robust to the choice of the criteria used to determine the lag length in equation (11). The findings are also robust to the choice of panel group and provide support to the view that the current account deficits of the EU and non-EU countries are sustainable in the long run. The *p*-values obtained for the panel of the founding states (EU6) are greater than for the EU15. This suggests that although stationarity cannot be rejected, the subsequent EU expansions have weakened the case for it. Finally, most of the different variations of EU panels provide higher *p*-values than the non-EU panel suggesting that current account stationarity is a stronger characteristic of the EU.

With respect to current account stationarity in the EU, there are implications for the stability of the Euro area.[8] One can initially draw on the optimum currency area literature (Mundell 1961, MacKinnon 1963) and consider current account deficits within a monetary union. Devaluations of the exchange rate are ruled out, so one must rely on wage flexibility and labour mobility, or national fiscal policies (Kenen 1969), to help restore macroeconomic equilibrium. A current account deficit will need to be matched by an inflow of resources to cover this shortfall where a member country borrows from other countries. A key issue is whether the corresponding accumulation of debt is sustainable. Sustainability of the current account might suggest that the other Euro members are prepared to continue lending to the deficit country. If the union capital market is efficient, then a risk premium will be attached to the debtor country's debt and this premium will reflect the likelihood of default. However, the case for sustainability of the current account deficit is slightly less convincing when the EU panel of 12 is expanded to include Austria, Finland and Sweden and is rejected for the panel of eight non-EU countries. This result offers an insight regarding EU further expansion. Lenders may find it difficult to attach the correct risk premium and may believe that other governments may simply help bail-out a member country that is unable to service its debts. In this respect, there will be less incentive for this country to reduce its deficit.[9]

4. Concluding remarks

This paper applies the Hadri (2000) tests for panel stationarity to examine evidence on current account stationarity and sustainability for EU and non-EU countries. In contrast to standard panel unit root tests, the Hadri tests employ the null hypothesis of joint stationarity. The standard panel tests are of a joint non-stationary null, the rejection of

[8] Sweden and the UK are not members of the single currency.

[9] These issues are related to the literature on fiscal discipline within European Monetary Union where the Stability Pact lays down rules concerning the size of the national debt budget deficits as a proportion of GDP. The difficulties of some Euro members in satisfying this aspect of the agreed pact, highlights credibility issues associated with the imposition and enforceability of rules.

which may be attributable to the stationary behaviour of as little as one panel member. We show that rejection of the joint non-stationary null occurs even though the majority of univariate unit root tests suggest otherwise. Further analysis confirms the presence of cross-sectional dependencies in the data. This study also addresses problems associated with cross-sectional dependence among panel members and the impact on size distortion through pursuing a bootstrap approach to the Hadri tests.

The use of individual KPSS tests for stationarity does not provide a clear indication that current account deficits are sustainable in the long run. However, within a panel context, and after allowing for the potential effect of cross sectional dependencies, we find support of the view that the current account deficits of the EU countries are sustainable in the long run. Evidence in favour of stationarity is weaker when we consider the largest EU panel or the non-EU panel. This suggests that the strongest evidence of sustainability is restricted to the core, more established EU members while those countries outside, or those who have recently joined the EU, may be regarded as unsustainable and may put the workings of the EU under pressure.

References

Ahmed, Shaghil and John H. Rogers, Government Budget Deficits and Trade Deficits: Are Present Value Constraints Satisfied in Long-Term Data?," *Journal of Monetary Economics* 36 (1995):351–74.

Campbell, John and Pierre Perron, "Pitfalls and Opportunities: What Macroeconomists Should Know About Unit Roots," *NBER Economics Annual* 6 (1991):141–201.

Caner, M. and L. Kilian, "Size Distortions of Tests of the Null Hypothesis of Stationarity: Evidence and Implications for the PPP Debate," *Journal of International Money and Finance* 20 (2001):639–57.

Carrion-i-Silvestre, Josep Lluís and Andreu Sansó, "A Guide to the Computation of Stationarity Tests," *Empirical Economics* 31 (2006):433–48.

Chang, Yoosoon, "Bootstrap Unit Root Tests in Panels with Cross-Sectional Dependency," *Journal of Econometrics* 120 (2004):263–93.

Chortareas, Georgios E., George Kapetanios and Merih Uctum, "An Investigation of Current Account Solvency in Latin America Using Non Linear Nonstationarity Tests," *Studies in Nonlinear Dynamics and Econometrics* 8 (2004):1–17.

Dickey, David A. and Wayne A. Fuller, "Distribution of the Estimators for Autoregressive Time Series with a Unit Root," *Journal of the American Statistical Association* 74 (1979):427–31.

Giulietti, Monica, Jesús Otero and Jeremy Smith, "Testing for Stationarity in Heterogeneous Panel Data in the Presence of Cross Section Dependence," *Journal of Statistical Computation and Simulation* 79 (2009):195–203.

Hakkio, Craig S. and Mark Rush, "Is the Budget Deficit Too Large?," *Economic Inquiry*

29 (1991):429–45.

Hadri, Kaddour, “Testing for Stationarity in Heterogeneous Panels,” *Econometrics Journal* 3 (2000):148–61.

Hadri, Kaddour and Rolf Larsson, “Testing for Stationarity in Heterogeneous Panel Data Where the Time Dimension is Finite,” *Econometrics Journal* 8 (2005):55–69.

Holmes, Mark J., “How Sustainable Are OECD Current Account Balances in the Long-Run?,” *Manchester School* 74 (2006):626–43.

Husted, Steven, “The Emerging US Current Account Deficit in the 1980s: A Cointegration Analysis,” *Review of Economics and Statistics* 74 (1992):159–66.

Im, Kyung So, M. Hashem Pesaran and Yongcheol Shin, “Testing for Unit Roots in Heterogeneous Panels,” *Journal of Econometrics* 115 (2003):53–74.

Kenen, Peter B. “The Theory of Optimum Currency Areas: An Eclectic View” in Robert A. Mundell and Alexander K. Swoboda (eds), *Monetary Problems of the International Economy*, Cambridge and New York: Cambridge University Press (1969):41-60.

Kwiatkowski, Denis, Peter C.B. Phillips, Peter Schmidt and Yongcheol Shin, “Testing the Null Hypothesis of Stationarity against the Alternative of a Unit Root,” *Journal of Econometrics* 54 (1992):159–78.

Liu, Peter C. and Evan Tanner, “International Intertemporal Solvency in Industrialized Countries: Evidence and Implications,” *Southern Economic Journal* 62 (1996):739–49.

Maddala, G.S. and Shaowen Wu, “A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test,” *Oxford Bulletin of Economics and Statistics* 61

(1999):631–52.

McKinnon, Ronald, "Optimum Currency Areas," *American Economic Review* 53 (1963):717–25.

Mundell, Robert A., "A Theory of Optimum Currency Areas," *American Economic Review* 51 (1961):657–65.

Otto, Glenn, "Testing a Present-Value Model of the Current Account: Evidence from US and Canadian Time Series," *Journal of International Money and Finance* 11 (1992):414–30.

Pesaran, M. Hashem, "General Diagnostic Tests for Cross Section Dependence in Panels," CESifo Working Papers, No.1233 (2004).

Pesaran, M. Hashem, "A Simple Panel Unit Root Test in the Presence of Cross Section Dependence," *Journal of Applied Econometrics* 22 (2007):265–312.

Sephton, Peter S., "Response Surface Estimates of the KPSS Stationarity Test," *Economics Letters* 47 (1995):255–61.

Strauss, Jack and Taner Yigit, "Shortfalls of Panel Unit Root Testing," *Economics Letters* 81 (2003):309–13.

Sul, Donggyu, Peter C.B. Phillips and Chi-Young Choi, "Prewhitening Bias in HAC Estimation," *Oxford Bulleting of Economics and Statistics* 67 (2005):517–46.

Trehan, Bharat and Carl E. Walsh, "Common Trends, the Government Budget Constraint and Revenue Smoothing," *Journal of Economic Dynamics and Control* 12 (1988):425–44.

Trehan, Bharat and Carl E. Walsh, "Testing Intertemporal Budget Constraints: Theory and Applications to US Federal Budget and Current Account Deficits," *Journal of*

Money, Credit and Banking 23 (1991):206–23.

Wickens, M.R and Merih Uctum, "The Sustainability of Current Account Deficits: A Test of the US Intertemporal Budget Constraint," *Journal of Economic Dynamics and Control* 17 (1993):423–41.

Wu, Jyh-Lin, "Mean Reversion of the Current Account: Evidence from the Panel Data Unit-Root Test," *Economics Letters* 66 (2000):215–22.

Wu, Jyh-Lin, Show-Lin Chen and Hsiu-Yun Lee, "Are Current Account Deficits Sustainable? Evidence from Panel Cointegration," *Economics Letters* 72 (2001):219–24.

Table 1. IPS test statistics for the current account deficits

Panel	IPS(1)	*p*-value	Number of rejections
EU6	-1.314	[0.094]	1 out of 5
EU9	-2.162	[0.015]	3 out of 7
EU12	-2.469	[0.007]	4 out of 10
EU15	-2.791	[0.003]	5 out of 13
Non–EU	-1.802	[0.036]	2 out of 8
All countries	-3.308	[0.000]	7 out of 21

The *p*-values are based on the standard normal distribution. Number of rejections indicates the number of times for which the null hypothesis of non-stationarity of the ADF test is rejected at a 10% significance level.

Table 2. CD statistic of residual cross correlation of ADF(*p*) regressions

Countries	ADF(0)		ADF(1)		ADF(2)		ADF(4)	
	Statistic	*p*-value	Statistic	*p*-value	Statistic	*p*-value	Statistic	*p*-value
EU6	2.869	[0.000]	3.762	[0.000]	3.552	[0.000]	3.202	[0.000]
EU9	2.582	[0.000]	2.938	[0.000]	2.689	[0.000]	3.342	[0.000]
EU12	3.092	[0.000]	4.114	[0.000]	3.802	[0.000]	3.692	[0.000]
EU15	4.390	[0.000]	5.651	[0.000]	5.900	[0.000]	6.020	[0.000]
Non–EU	-1.673	[0.094]	-1.521	[0.128]	-1.728	[0.084]	-1.305	[0.192]
All	1.824	[0.068]	2.761	[0.000]	2.931	[0.000]	3.342	[0.000]

The CD statistic follows a standard normal distribution under the null hypothesis of cross-sectional independence.

Table 3. KPSS tests for mean stationarity

Countries	Lag length based on:			
	SIC		GETS	
	Lags	Statistic	Lags	Statistic
EU countries				
Austria	2	0.096	2	0.096
Belgium	4	0.311	8	0.322
Finland	2	0.593♦♦	6	0.594♦♦
France	2	0.079	4	0.145
Germany	1	0.044	8	0.062
Greece	2	0.162	2	0.162
Ireland	5	0.167	5	0.167
Italy	1	0.048	8	0.094
Luxemburg	2	0.599♦♦	7	0.176
Portugal	4	0.134	7	0.186
Spain	1	0.102	8	0.246
Sweden	3	0.393♦	3	0.393♦
United Kingdom	2	0.166	2	0.166
Non–EU countries				
Australia	1	0.186	3	0.371♦
Canada	1	0.497♦♦	6	0.439♦
Iceland	1	0.129	1	0.129
Japan	3	0.471♦♦	3	0.471♦♦
New Zealand	1	0.158	2	0.132
Norway	1	0.610♦♦	1	0.610♦♦
Switzerland	2	0.531♦♦	2	0.531♦♦
United States	1	1.133♦♦♦	1	1.133♦♦♦

For the KPSS tests the finite sample critical values are based on the response surfaces in Sephton (1995). ♦, ♦♦ and ♦♦♦ indicate significance at the 0.10, 0.05 and 0.01 levels, respectively. The long-run variance required to calculate the KPSS statistic is consistently estimated using the new boundary condition rule proposed by Sul et al. (2005).

Table 4. Bootstrap Hadri tests for panel stationarity

Countries	Lag length based on:			
	SIC		GETS	
	Statistic	*p*-value	Statistic	*p*-value
EU6	0.732	[0.239]	-0.126	[0.759]
EU9	0.610	[0.268]	-0.115	[0.716]
EU12	0.284	[0.400]	0.097	[0.700]
EU15	1.334	[0.180]	1.172	[0.409]
Non-EU	5.680	[0.232]	5.921	[0.236]
All countries	4.555	[0.189]	4.577	[0.248]

The *p*-values are bootstrap based on 2,000 replications.