Testing Stationarity of Budgetary Position in Developing Countries

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ABSTRACT

In this paper, we examine stationarity properties of data on budget deficits for a cluster of twenty-seven developing countries (D-27) for the period spanning 1970 to 2003. It has been argued in the literature that this statistical property correlates well with the economic property of sustainability of the budget deficit. The univariate unit root tests indicated a non-stationary process of $I(1)$ with the exception of three countries. However, the non-stationary properties were rejected when the panel unit roots procedures were adopted. Since panel procedures provide greater power, the statistical evidence favors stationarity. This in turn suggests that budgets deficits in our sample of countries are sustainable, an important conclusion with many real world economic implications. The conflict between single country results and panel results suggests that univariate procedures may lead to the wrong conclusions.

Key words: *Budgetary Position, Stationarity, Sustainability, Government Intertemporal Budget Constraint*
JEL Classifications: E62, H62, H63

1. INTRODUCTION

The concept of fiscal sustainability relates to the fact that governments require sufficient resources in order to function well, which also determines whether or not the currently held governmental policies can be maintained in the long run. Good governance requires sustainable policies. In addition, there are implications for the other macroeconomic variables since a non-sustainable fiscal policy involves the risk of a future rise in interest rate and a slowdown in economic growth (Cunado et al., 2004). On the other hand, it is crucial to determine whether it will be necessary to curtail the imbalances to avoid any form of

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economic un-sustainability. As noted by Edwards (2002), huge imbalances might lead to hard lending for countries that appear to be insolvent.

In an innovative paper, Hamilton and Flavin (1986) argued that the economic notion of sustainability translates to the statistical notion of stationarity of the budget deficit. That is, a stationary budgetary position is consistent with the idea that a government should run a sequence of discounted future non-interest budget surpluses capable of offsetting the current outstanding debt/deficit. They find that on US GNP data, the null of non-stationarity is rejected, and conclude that there is no basis for expecting a violation of the present value borrowing constraint (PVBC). On the basis of this correspondence between stationarity and sustainability, we can use readily available statistical tools for testing stationarity to assess the sustainability of government budgetary positions.

Many authors have applied this methodology to assess the sustainability of budget deficit. For US data, Trehan and Walsh (1988) found support for the sustainability of the fiscal policy, while Wilcox (1989) and Kremers (1989) found evidence against the sustainability. Makrydakis et al. (1999) support strongly the failure of the Greek government to satisfy the intertemporal budget balances. Using a different data base, Feve and Henin (2000) and Uctum and Wickens (2000) found inconclusive evidence of sustainability in developed countries. This line of research evaluates the sustainability condition based on certain key fiscal aggregates, and assesses them empirically using the standard unit root tests[1]. The failure to show that the budgetary position achieves stationarity is inconsistent with the theoretical argument of government intertemporal budget constraint (GIBC). This approach in evaluating the sustainability hypothesis, which is also known as the non-Ponzi game condition, has gained popularity among economists due to its amenability to econometric analysis (Makrydakis et al., 1999).

Considering the importance of the sustainability issue, some research on developing countries has also been conducted. Partially, the list of studies include Green et al. (2001), Chung (2002) and Radulescu (2003). This study contributes to this literature in two main ways. Firstly, this paper is the first attempt to examine the issue of sustainability in fiscal position using a cluster of 27 developing countries (D-27) which consists of Asia (Asia-10), Latin America (Latin-9) and Africa (Africa-8). Furthermore, whereas most of the previous studies devoted to developing countries examine the sustainability notion using the cointegration approach, we will use an array of unit root tests.

Secondly, we drew upon the advances in the econometrics of nonstationary panel time series and the univariate stationarity testing procedures. For the panel approach, the latest tests advocated by Harris and Tzavalis (1999, HT), Maddala and Wu (1999, MW), Breitung (2000, UB), Hadri (2000, HADRI) and Im et al. (2003, IPS) are deployed to evaluate the stationarity property of fiscal position. The purpose is to capture the cross-sectional information of all these economies in one panel. The development of the econometric analysis of panel data has received considerable attention since the mid 1990s (see Breitung and Pesaran, 2008, for their excellent surveys). We also relied on Said and Dickey (1984, ADF), Kwiatkowski et al.

[1]Statistically, stationarity implies that the probability laws controlling a process are stable over time. That is, they are in statistically in equilibrium (Vandaele, 1983). In contrast, series that are nonstationary in levels have a unit root. Shocks to a time series that has a unit root are in part, where they do in actual fact change the long run level of the series permanently. In this case, a unit root in budgetary variable implies that the shocks have permanent effects that are inconsistent with the view of reverting to its long run equilibrium path over time. In other words, future evolution of budgetary position development is unpredictable based on past observations.

(1992, KPSS) and Elliott et al. (1996, DFGLS) for testing the univariate stationary process in each country.

With the motivation and objective in place, this paper is set out as follows. Section 2 describes the theoretical model. Testing procedures are outlined in Section 3. Section 4 contains the data description and the empirical results. The concluding remarks regarding the empirical research are provided in Section 5.

2. THE MODEL

The model starts with the budget constraint faced by the government at period *t* written as

$$b_t = (1 + r_t)b_{t-1} + d_t \tag{2.1}$$

where b_t is government debt, d_t is the primary budget deficit and r_t is the (one period) real ex post rate of interest rate adjusted for real output growth.

The budget constraint in Equation (2.1) pertains only to period *t*. Subsequently, there is a similar constraint in Equation (2.1) for periods of t+1, t+2, t+3,…, t+n and recursively solving that equation would lead to

$$b_t = -E_t \sum_{i=1}^{n} \delta_{t,i} d_{t+i} + E_t \delta_{t,n} b_{t+n} \tag{2.2}$$

where $\delta_{t,n} = \Pi_{s=1}^{n}(1 + r_{t+s})^{-1}$ is the n time-varying real discount factor and E_t denotes the conditional expectations. Further, $\delta_{t,n}$ can also be expressed as $\delta_{t,n}=q_{t,n}/q_t$ where $q_t = \Pi_i^t (1 + r_i)^{-1}$ is the sequence of the discount factors from period t back to period 1 with $q_0=0$.

Defining $B_t=q_t b_t$ and $D_t=q_t d_t$ as the discounted debt to GDP ratio and primary deficit to GDP ratio respectively, Equation (2.2) can be rewritten as $q_t b_t = -E_t \sum_{i=1}^{n} q_{t+i} d_{t+i} + E_t q_{t+n} b_{t+n}$ or compactly expressed as

$$B_t = -E_t \sum_{i=1}^{n} D_{t+i} + \lim_{n\to\infty} E_t B_{t+n} \tag{2.3}$$

Equation (2.3) shows that the current value of government debt B_t is equal to the expected present value of all future primary surpluses $\sum_{i=1}^{n}[D_{t+i}]$, plus a limiting term that represents the asymptotic expected present value of the government's debt. Eventually $\sum_{i=1}^{n}[D_{t+i}]$ represents the differences between the between government revenue (R) and expenditure (which covers the total government spending on goods and services and transfer payments and interest on the debt, G)[2].

A necessary and sufficient condition for sustainability is that the expectation of the discounted debt to GDP ratio should converge to zero as the planning horizon recedes (Makrydakis et al., 1999 and Uctum and Wickens, 2000). In notation, it implies that the last element in Equation (2.3) $\lim_{n\to\infty} E_t B_{t+n} = 0$. This is also known as the transversality condition[3] as we rule out a Ponzi

[2]The difference between (R–G) is the government budget position. If $G>R$, the government experiences a budget deficit; while analogously, if $R>G$ the country would experience a budget surplus.

[3]The transversality condition requires a zero limit of future government debt discounted at a rate that depends on the probability distribution of future debt and not on the government bond rate. The requirement that budget

scheme. Therefore, in the long run, budget policy will be sustainable if the limiting term is equal to zero. If this condition is met, the government intertemporal budget constraint (GIBC) would be expressed as

$$B_t = -E_t \sum_{i=1}^{n} D_{t+i} \tag{2.4}$$

Equation (2.4) states that for budgetary position to be sustainable in the long run, the government should run a sequence of discounted future non-interest budget surpluses capable of offsetting the current outstanding debt/deficit. In this regard, we follow the empirical applications in this branch of literature that adopted the unit root approaches to determine whether the government budget position follows an $I(0)$ process (see Makrydakis et al., 1999; Chalk and Hemming, 2000; Uctum and Wickens, 2000 and Bohn, 2004). In his paper, Bohn (2004) suggested that such a derivation is an ad hoc sustainability condition. Hence, using these empirical regularities as a guide, the sustainability notion is in accordance with the stationary property of budgetary position or it follows a mean-reverting process of $I(0)$[4].

All together, eight unit root procedures will be applied here to produce a clear-cut conclusion on the requirement of the order of integration[5]. This is to relax the assumption and avoid the potential pitfalls by relying on the conclusion made from a single unit root test. In the next section, we briefly outline the testing procedures. For complete derivations and details, we refer readers to the original articles cited.

3. EMPIRICAL METHODOLOGIES

3.1. Univariate Unit Root and Stationary Testing Procedures

Said and Dickey (1984, ADF) and Elliott et al. (1996, DFGLS) testing principles share the same null hypothesis of a unit root. Their difference centers on the way the latter specifies the alternative hypothesis and treats the presence of the deterministic components in a variable's data generating process (DGP). Specifically, the DFGLS procedure relies on locally demeaning and/or detrending a series prior to the implementation of the usual auxiliary ADF regression. The use of the DFGLS tests statistics is likely to minimize the danger of erroneous inferences emerging when the series under investigation has a mean and/or linear trend in its DGP (see Elliott et al., 1996). The t_μ and t_τ stand for the ADF test statistics while DFGLS are denoted by τ_μ and τ_τ with mean (μ) and trend (τ) stationarity. In contrast, the KPSS (Kwiatkowski et al., 1992) procedure tests for level (η_μ) or trend stationarity (η_τ) against the alternative of a unit root. In this sense, the KPSS principles involve different maintained hypotheses from the ADF and DFGLS unit root tests.

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process be sustainable implies effectively that Ponzi games are ruled out as a viable option of government finance where further new borrowing cannot be used indefinitely as a method of financing interest payments on existing debt.

[4]As pointed out by the editor and anonymous referee, this definition is rather vague and restrictive. Small changes in the theoretical conditions can change the meaning of the test. A point also made by Bohn (2007) is that the intertemporal budget constraint (IBC) per se imposes very weak econometric restrictions. We did consider such a restrictive definition of the GIBC and the fragile link with econometric modeling process. As our paper is empirical in nature, we resort to the sound theoretical foundations (dated over a period of more than two decades) and adopt appropriate econometrics analysis to gauge the sustainability condition and bring about the conclusion of the sustainable condition.

[5]Karlsson and Lothgren (2000) suggested that a combination of both individual and the panel unit root test results are warranted for a full assessment of the stationarity properties of a series.

3.2. Panel Unit Root and Stationary Tests

For the purpose of illustration, this study estimates various panel unit root tests developed in the last decade. Among them are the Harris and Tzavalis (1999, HT), Maddala and Wu (1999, MW) and Breitung (2000, UB), Hadri (2000, HADRI) and Im et al. (2003, IPS). The null hypothesis of these tests is that the panel series has a unit root (non-stationary) except for the HADRI test. The HADRI test is similar to the KPSS type unit root test in which it has a null hypothesis of stationarity in the panel. A combination of both procedures can give a clear-cut conclusion into the stationarity properties of the budgetary positions in the D-27 developing countries.

Harris and Tzavalis (1999, HT) developed the asymptotic unit root test for first-order autoregressive models using panel data with serially uncorrelated errors, under the assumption that $N \to \infty$ and fixed time dimension. This procedure offers three different models corresponding to the three different assumptions[6].

Maddala and Wu (1999, MW), on the other hand, developed test statistics based on combining the *p*-values of the test statistics from ADF unit root tests (p_i say for the *i*th cross section, $i=1,...,N$). This is a version of the non-parametric test that was based on Fisher (1932). The MW test statistics can be given as

$$P(\lambda) = -2\sum_{i=1}^{N} \log(p_i) \tag{3.5}$$

where p_i is the *p*-value of the test statistic for unit *i* distributed as a χ^2 with degree of freedom twice the number of the cross section units (2*N*) under null hypothesis.

Breitung (2000, UB) proposed a class of *t*-statistics (λ_{UB}) that does not employ a bias adjustment. Through the Monte Carlo experiments, the power of the UB test is substantially higher than that of LL and the IPS tests. By defining the T×1 vectors $Y_i=[\Delta y_{i1},...,\Delta y_{iT}]'$ and $X_i=[y_{i0},...,\Delta y_{iT-1}]'$ while the transformed vectors $Y_i^*=Ay=[y_{i1}^*,...,y_{iT}^*]'$ and $X_i^*=Bx_i=[x_{i1}^*,...,x_{iT}^*]'$, the UB statistics can be given by,

$$\lambda_{UB} = \frac{\sum_{i=1}^{N} \sigma_i^{-2} y_i^{*\prime} x_i^*}{\sqrt{\sum_{i=1}^{N} \sigma_i^{-2} x_i^{*\prime} A' A x_i^*}} \tag{3.6}$$

which has the standard normal limiting distribution $(N, T \to \infty)_{seq}$ under the assumption of $E(y_{it}^* x_{it}^*)=0$ and $\lim_{T\to\infty} E(T^{-1} y_i^{*\prime} y_i^*) > 0$, $\lim_{T\to\infty} E(T^{-1} x_i^{*\prime} A' A x_i^*) > 0$.

Im et al. (2003, IPS) had proposed *t*-bar statistics based on the average of the individual ADF *t*-statistics in order to examine the unit root hypothesis for panels. They evaluate the null hypothesis as H_0: $\beta_i=0$ for all *i*, against the alternative that all the series are stationary, H_1: $\beta_i<0$ for all *i*. In short, the test statistics of t-bar are given as

$$\Gamma_{\bar{t}} = \frac{\sqrt{N}\{\bar{t}_{NT} - E(t_T \mid \beta_i = 0)\}}{\sqrt{Var(t_T \mid \beta_i = 0)}} \Rightarrow N(0,1) \tag{3.7}$$

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[6]Model 1 refers to the homogenous version of the model while Model 2 follows a unit root process with heterogeneous drift parameters. In the most general case, they derived a model that includes the heterogeneous fixed effects and individual trends (Model 3). In this paper, we only adopted Models 2 and 3 in drawing conclusions regarding the mean-reverting properties of budget position.

where $\bar{t}_{NT} = \sum_{i=1}^{N}(t_{iT} / N)$ such that $\bar{t}_{NT}$ is the average ADF t-statistics for individual countries. The terms $E(t_T \mid \beta_i=0)$ and $Var(t_T \mid \beta_i=0)$ are the finite common mean and variance of the individual ADF statistics t_{iT}, tabulated in IPS. The test statistics converge to the standard normal distribution as T (time periods dimension) and N (cross-sectional dimension of the panel) tend to infinity and N/T tends to zero under the null hypothesis of unit roots, $\beta_i=0$, $i=1,2\ldots N$.

Unlike the other panel unit root test, the Hadri (2000, HADRI) has a null hypothesis of stationarity in the panel. It is based on the residuals from the individual OLS regression of y_{it} on a constant, or on a constant and trend. We specified the general form specification that includes both a constant and a trend as

$$y_{it} = \alpha_{it} + \beta_t t + \varepsilon_{it} \tag{3.8}$$

where α_{it} is a random walk: $\alpha_{it}=\alpha_{it-1}+ \theta u_{it}$ where both u_{it} and α_{it} are generated from $N(0,1)$. The stationary null hypothesis is expressed as H_0: $\sigma_u^2=0$. The test statistic for the null hypothesis of one-sided LM test for stationary null hypothesis is defined as

$$LM = \frac{\sum_{i=1}^{N}\sum_{t=1}^{T} S_{it}^2}{N.T^2 \varpi^2} \tag{3.9}$$

where $S_{it} = \sum_{j=1}^{t} \varepsilon_{ij}$ and ϖ^2 is the consistent Newey and West (1987) estimates of the long run variance of distribution terms ε_{it} defined as $\sigma_i^2 = \{\lim_{T\to\infty} E(S_{iT}^2)\}/T$. To avoid the size distortions, the truncation lag is set equal to the integer of $4(T/100)^{1/4}$ in the Bartlett window.

The introduction of the panel analysis in the economic literature offers a more promising explanation in the empirical world given the well-known power deficiencies which plague pure time-series based tests for unit roots and cointegration (Banerjee, 1999). Such panel techniques have been used predominately in testing the purchasing power parity, business cycle synchronization, house price convergence, regional migration and household income dynamics. These techniques enable the researchers to exploit the benefits from cross-sectional information to obtain a more definitive evidence regarding stationarity. For this study, the selection of the D-27 countries poses a diverged heterogeneity and this is embodied in the panel analysis adopted for this study.

4. DATA DESCRIPTION AND EMPIRICAL RESULTS

4.1. Data Description

Annual data of budget position and Gross Domestic Product (GDP) for the period from 1970 to 2003 provides us with 34 observations. The countries included in the D-27 are India, Indonesia, Korea, Malaysia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand (Asia-10), Argentina, Bolivia, Brazil, Chile, Columbia, Paraguay, Peru, Uruguay, Venezuela (Latin-9) and Botswana, Ghana, Kenya, Mauritius, Morocco, Nigeria, South Africa, Zambia (Africa-8). All the data, which are not seasonally adjusted, are expressed in nominal terms and obtained from several issues of the International Financial Statistics (IFS), published by the International Monetary Fund (IMF). The IFS provided budget position and Gross Domestic Product (GDP) denominated in domestic currency. For consistency and cross-countries comparison especially for a panel analysis, we express all the variables based on a common currency denominator of US dollars.

Country	Test statistics					
	t_μ	t_τ	η_μ	η_τ	τ_μ	τ_τ
Argentina	-1.054 (3)	-1.943 (3)	0.722 (3)*	0.167 (1)*	-1.192 (4)	-2.332 (4)
Bolivia	-2.463 (1)	-2.441 (1)	0.854 (1)*	0.244 (1)*	-1.213 (2)	-2.259 (2)
Botswana	-2.218 (1)	-1.785 (1)	0.611 (1)*	0.353 (1)*	-1.378 (1)	-1.662 (1)
Brazil	-2.309 (1)	-2.627 (1)	0.663 (1)*	0.199 (1)*	-1.484 (2)	-1.919 (2)
Chile	-2.273 (4)	-2.113 (5)	0.913 (1)*	0.271 (1)*	-1.341 (3)	-2.237 (3)
Columbia	-1.035 (1)	-2.379 (1)	0.820 (2)*	0.200 (2)*	-0.572 (2)	-2.073 (2)
Ghana	-1.588 (3)	-1.487 (3)	0.718 (1)*	0.404 (1)*	-1.607 (3)	-1.637 (3)
India	-2.063 (3)	-1.752 (3)	0.921 (1)*	0.644 (1)*	-1.366 (1)	-1.693 (1)
Indonesia	-1.850 (3)	-2.371 (3)	0.809 (1)*	0.174 (1)*	-1.589 (3)	-2.495 (3)
Kenya	-1.730 (2)	-2.575 (2)	0.672 (2)*	0.155 (2)*	-1.777 (2)	-2.294 (2)
Korea	-2.055 (1)	-2.533 (1)	0.853 (1)*	0.167 (1)*	-1.369 (4)	-1.767 (4)
Malaysia	-1.309 (2)	-1.738 (2)	0.854 (1)*	0.246 (1)*	-1.381 (2)	-1.677 (2)
Mauritius	-2.233 (3)	-3.053 (3)	1.070 (1)*	0.317 (1)*	-1.525 (1)	-1.795 (1)
Morocco	-1.966 (1)	-2.763 (1)	0.646 (1)*	0.168 (1)*	-1.305 (3)	-1.885 (3)
Nepal	-2.037 (1)	-1.448 (1)	0.620 (1)*	0.369 (1)*	-1.250 (2)	-1.374 (2)
Nigeria	-2.811 (1)*	-3.255 (1)*	0.102 (3)	0.076 (3)	-2.844 (1)*	-3.311 (1)*
Pakistan	-2.431 (2)	-2.866 (2)	0.790 (2)*	0.225 (2)*	-1.403 (5)	-1.846 (5)
Paraguay	-1.820 (2)	-2.037 (2)	0.700 (3)*	0.270 (3)*	-1.636 (2)	-1.783 (2)
Peru	-2.281 (1)	-2.935 (1)	0.663 (1)*	0.158 (1)*	-1.353 (3)	-1.630 (3)
Philippines	-2.308 (1)	-2.439 (1)	0.669 (1)*	0.208 (1)*	-1.558 (2)	-2.144 (2)
Singapore	-1.487 (1)	-1.493 (1)	0.766 (2)*	0.168 (2)*	-1.489 (1)	-1.659 (1)
South Africa	-2.171 (2)	-2.241 (2)	0.759 (2)*	0.256 (2)*	-1.128 (2)	-2.345 (2)
Sri Lanka	-2.175 (1)	-2.145 (1)	0.512 (1)*	0.509 (1)*	-1.430 (1)	-1.484 (1)
Thailand	-2.183 (1)	-2.267 (1)	2.455 (3)*	0.398 (3)*	-1.420 (3)	-1.897 (3)
Uruguay	-3.294 (1)*	-3.790 (1)*	0.176 (1)	0.088 (1)	-3.342 (1)*	-3.885 (1)*
Venezuela	-5.090 (1)*	-5.676 (1)*	0.144 (1)	0.046 (1)	-4.633 (2)*	-5.784 (2)*
Zambia	-2.385 (3)	-3.029 (3)	0.853 (3)*	0.4243 (3)*	-1.189 (4)	-1.746 (4)

Table 4.1 Univariate Unit Root Test Results.

Notes: The t, η and τ statistics refer to the ADF, KPSS and DFGLS tests, respectively. The subscripts μ and τ indicate the models that allow for a drift term and both a drift and a deterministic trend, respectively. The asterisk (*) shows significance at the 5 percent level. Figures in parentheses indicate the lag length. The asymptotic and finite sample critical values for ADF are obtained from MacKinnon (1996), while the KPSS critical values are obtained from Kwiatkowski et al. (1992, Table 1, pp. 166). The DFGLS for the drift term (μ) follows the MacKinnon (1996) critical values while the asymptotic distributions for the drift and deterministic trend (τ) are obtained from Elliott et al. (1996, Table 1, pp 825). Both the ADF and DFGLS tests examine the null hypothesis of a unit root against the stationarity alternative. KPSS tests the stationarity null hypothesis against the alternative hypothesis of a unit root.

4.2. Univariate Unit Root and Stationary Evidence

Table 4.1 summarizes the outcome of the ADF, DFGLS and KPSS testing principles in level performed on all the countries while the lag length is tabulated in the parentheses. Here, Table 4.1 projects the ADF statistics to be small and less than their critical values, which suggests that the variables are not stationary except for Nigeria, Uruguay and Venezuela. Similarly, based on the DFGLS test, the null hypothesis of nonstationarity cannot be rejected except for these three cases. This finding is corroborated by the KPSS statistics, which strongly reject the $I(0)$ null at the 95 percent confidence level (columns 3 and 4, Table 4.1). Rejecting the null hypothesis in the KPSS test reveals that the variable under investigation is non-stationary in level. For the case of Nigeria, Uruguay and Venezuela, failing to reject the null hypothesis in the KPSS test accompanied by the rejection of both ADF and DFGLS indicates that the budget positions are indeed stationary series or behave in accordance to the $I(0)$ stochastic process. The evidence so far supports the non-stationarity of the budget positions in 24 out of the 27 developing countries studied.

Taken all together, the results thus far suggest that most of the countries are on an unsustainable path in governing their budgetary position. Nevertheless, the evidence presented must also be viewed with some caution. To overcome this problem, we created a panel data set to re-examine the stationarity of the series. Pooling the data from a group of countries can compensate for the lack of time series observations (34 in this study) for each country.

			Test Statistics		
	IPS	**HT**	**MW (Fisher-ADF)**	**UB-t**	**HADRI**
A: Model Specification: Individual Effects					
D-27	-7.384 (0.000)	-12.826 (0.000)	157.679 (0.000)	-4.803 (0.000)	0.814 (0.207)
D-24	-6.470 (0.000)	-10.597 (0.000)	133.694 (0.000)	-4.463 (0.000)	1.141 (0.127)
Asia-10	-3.085 (0.001)	-7.814 (0.000)	41.549 (0.000)	-2.436 (0.007)	0.915 (0.180)
Latin-9	-5.102 (0.000)	-9.135 (0.000)	60.845 (0.000)	-3.085 (0.001)	1.245 (0.107)
Latin-7	-3.525 (0.000)	-7.420 (0.000)	36.860 (0.001)	-2.447 (0.007)	0.596 (0.725)
Africa-8	-4.695 (0.000)	-12.357 (0.000)	55.258 (0.000)	-2.932 (0.002)	0.827 (0.204)
Africa-7	-4.498 (0.000)	-12.060 (0.000)	50.161 (0.000)	-2.526 (0.006)	0.304 (0.380)
B: Model Specification: Individual Effects and Individual Linear Trends					
D-27	-6.402 (0.000)	-16.627 (0.000)	139.464 (0.000)	-5.252 (0.000)	0.219 (0.412)
D-24	-5.387 (0.000)	-16.453 (0.000)	115.732 (0.000)	-4.781 (0.000)	1.289 (0.104)
Asia-10	-2.137 (0.016)	-15.870 (0.000)	34.770 (0.021)	-2.638 (0.004)	0.687 (0.246)
Latin-9	-3.683 (0.000)	-10.290 (0.000)	52.830 (0.000)	-3.683 (0.000)	0.488 (0.687)
Latin-7	-2.872 (0.002)	-8.893 (0.000)	29.098 (0.010)	-2.769 (0.003)	0.792 (0.214)
Africa-8	-4.438 (0.000)	-12.100 (0.000)	51.864 (0.000)	-2.936 (0.002)	0.598 (0.275)
Africa-7	-4.320 (0.000)	-11.653 (0.000)	47.703 (0.000)	-2.514 (0.006)	0.669 (0.252)

Table 4.2 Panel Unit Root Tests Results.

Notes: IPS, HT, UB and HADRI indicated the Im et al. (2003), Harris and Tzavalis (1999), Breitung (2000) and Hadri (2000) panel unit root and stationary tests. MW (Fisher-ADF) denotes the Maddala and Wu (1999) Fisher-ADF panel unit root test. The IPS, HT,UB and MW (Fisher-ADF) examine the null hypothesis of non-stationarity while HADRI tests the stationary null hypothesis. The D-27 and D-24 (excluding Nigeria, Uruguay and Venezuela) comprise the 27 and 24 developing individual countries grouped into one panel with sample N=27, T=34 and N=24, T=34 respectively. Asia-10, Latin-9, Latin-7 (excluding Uruguay and Venezuela), Africa-8, Africa-7 (excluding Nigeria) represent the individual countries grouped accordingly to their geographical continent. The parenthesized values are the probability of rejection. Probabilities for the MW (Fisher-ADF) test are computed using an asymptotic χ^2 distribution, while the other tests follows the asymptotic normal distribution. The estimation and the calculation of the IPS, HADRI, UB and MW (Fisher-ADF) panel-based procedures were carried out in E-Views version 6.0 while HT are conducted using GAUSS with the Nonstationary Panel Time Series (NPT) version 1.3 provided by Chiang and Kao (2002).

4.3. Panel Unit Root and Stationary Evidence

Table 4.2 reports the panel unit root and stationarity findings. The IPS, HT, MW and UB tests are rejected at conventional significant levels (see Panel A). Consistently, we also found evidence of stationarity in Panel B, which includes individual effects and trends in the model specification. Next, it is clearly evident that all sub-groups (Asia-10, Latin-9 and Africa-8) support the finding of stationarity. To test for the robustness of these tests, the HADRI stationarity panel unit root test was conducted. From Table 4.2, the null hypothesis of stationarity is not rejected, as suggested by the probability of the *p*-values under both model specifications (see the last column, Table 4.2).

According to Taylor and Sarno (1998), a pitfall of these panel unit root tests is that it biases towards stationarity if only one or a few series in the panel are strongly stationary. Erroneously, the conclusion that the whole panel is stationary follows. The panel unit root tests are said to be meaningful only when the univariate tests fail to reject the null of a unit root. It is possible that the finding of stationarity has been influenced by the inclusion of Nigeria, Uruguay and Venezuela in the panel setting.

For this reason, Table 4.2 also reports the panel unit root and stationarity results for the remaining twenty-four countries (D-24), which support the budget positions as non-stationary at the univariate level. We also conducted similar tests for the remaining countries in the sub-groups of Latin-7 (excluding Uruguay and Venezuela) and Africa-7 (excluding Nigeria). Interestingly, we found that the null hypothesis is still strongly rejected at the 1 percent significance level in the panel of D-24, Latin-7 and Africa-7 under both model specifications (see Table 4.2). This suggests that while there is support for the concerns of Taylor and Sarno (1998) the exclusion of Nigeria, Uruguay and Venezuela from the panel does not prevent the evidence of stationary budget positions or they do indeed follow an $I(0)$ process.

5. CONCLUDING REMARKS

Sustainability of fiscal policy is essential to good governance since it plays a vital role in assisting and achieving macroeconomic stability, poverty reduction, resource and income redistribution and sustainable economic growth within a country. In contrast, lack of sustainability can pose a serious threat to the prospect for long-term growth for any country. Many authors have argued that the sustainability of budget deficits can be assessed by examining stationarity properties of associated time series. In accordance with this hypothesis, we employ a number of alternative panel unit root tests and univariate estimators in an effort to obtain robust inferences for the D-27 developing countries' budgetary positions.

The econometrics analysis leads to the following conclusions. First, the univariate unit root and stationarity tests suggest that 24 out of 27 developing countries have non-stationary budget deficits. However, we found the favorable evidence of mean-reverting behavior for all the sub-groups when adopting the IPS, HT, MW, UB and HADRI panel unit roots and stationary techniques. It has been suggested that panel tests can be biased by as few as one stationary series within the panel. To avoid this problem, we eliminated the three countries which might be the strongest source of such bias within our data set, and re-estimated the remaining D-24 developing countries. This did not change our results, and we found strong evidence of stationarity for all of these countries.

The results obtained in this study are limited to developing countries and may not generalize to richer nations. A possible extension to this research could consider using panel estimates which would allows one to recognize whether each individual series in a panel is stationary or not (Breuer et al., 2002, SURADF). Thus panel data approaches strongly suggest that the countries we examined are fiscally sustainable for the 1970-2003 period. This conflict between panel test procedures and univariate procedures is worth further examining further from several points of view, especially since it has serious implications regarding the quality of governance in developing countries.

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