Asian Journal of Scientific Research

ISSN 1992-1454

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http://ansinet.com

OPEN ACCESS Asian Journal of Scientific Research

ISSN 1992-1454
DOI: 10.3923/ajsr.2017.345.353

Research Article
Fiscal Solvency of Asian Developing Countries Using Ad Hoc and Model-based Sustainability Tests

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Abstract

Background and Objective: This study assesses the sustain ability of fiscal policy of Asian developing countries by both the Ad hoc and Model-Based tests. The standard tests of unit root applied to debt-GDP ratio and cointegration between expenditures and revenues might produce contradictory results, however, a careful investigation can help in describing sustainability. The Model-Based test, on the other hand, disregards the time series properties and depends only on the response of primary-surplus to debt-GDP ratio. **Material and Methods:** Panel unit root and cointegration tests as Ad hoc tests while a pooled estimation technique is applied as Model-Based Tests. **Results:** The primary surplus and debt are stationary in levels for the sample. The existence of cointegration between primary-surplus-GDP ratio and debt-GDP ratio determines the sustainability of fiscal policy. **Conclusion:** This fiscal policy is sustainable according to Ad Hoc tests, however, the Model-Based test produce mixed results. The two test are helpful if applied simultaneously in order to have more faith in the results.

Key words: Fiscal policy, deficit surplus, sovereign debt, time-series models, panel data models

Received: January 31, 2017 Accepted: June 14, 2017 Published: September 15, 2017

Citation: Syed Munawar Shah, Syed Haider Shah, Anowar Zahid and Abdul Rahman Nizamani, 2017. Fiscal solvency of Asian developing countries using ad hoc and model-based sustainability tests. Asian J. Sci. Res., 10: 345-353.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The excess of government spending over government revenues in a given fiscal year is known as the budget deficit. Unlike an individual, the government usually has a set of options to equate expenditures to revenues including taxation, seigniorage and borrowing; therefore it enjoys the liberty of deciding on the level of expenditures in advance. The sources of income of government are limited in the case of taxes and seigniorage, leaving borrowing as a flexible source of funds.

The government borrows from domestic and foreign savers and uses bonds with short-term or long-term maturity. Borrowing from domestic savers leads to some interesting questions, such as Barro[1] quotes a question posed by Tobin[2] as "How is it possible that society merely by the device of incurring a debt to itself can deceive itself into believing that it is wealthier? Do not the additional taxes which are necessary to carry the interest charges reduce the value of other components of private wealth?".

The reliance of governments on debt is not a big sin, in fact, many developed nations are heavily indebted these days. However, it is important to monitor the structure of debt for it may build up to dangerous levels and may lead governments into crisis and eventually default.

This study compares two well-known models used for assessing the sustainability of fiscal policy. The first method utilizes the unit root and cointegration tests in order to examine the sustainability of fiscal policy. Whereas, the second method, proposed by Bohn[3], the Model-Based test (henceforth the MBS test), requires a positive response of primary-surplus to the change in debt.

We compare the two techniques using central government data of Asian developing countries, including, Pakistan, India Bhutan, Sri Lanka, Maldives, Malaysia, Indonesia, Thailand and Singapore for the period 1990-2010. The data has been collected from the following publically available sources, World Development Indicators, Asian Development Bank, international Financial Statistics and Annual Surveys.

The study is organized as follows, the next section presents the Ad hoc and MBS tests of sustainability. It is followed by the Methodology section that presents a discussion on the panel unit root and cointegration tests and their results. Finally, the conclusion concludes the study.

MATERIAL AND METHODS

Ad hoc tests of sustainability: In order to differentiate between the two methodologies for the fiscal solvency we call the tests based on unit root and cointegration tests as 'Ad Hoc Tests of Sustainability', whereas, the methodology based on the relationship between primary surplus and debt is commonly known as 'Model-Based Sustainability' (MBS). The former was initiated by Hamilton and Flavin [4] whereas the latter proposed by Bohn[5]. Under the intertemporal budget constraint, the Ad Hoc tests require the debt to be stationary which indicates that debt has a manageable constant mean. Both the techniques depends on the idea that the government should necessarily generate surpluses in future such that the discounted sum of all those surpluses is equal to the existing public debt. This can be described by the budget constraint identity as:

$$S_t+(1+r_t)D_{t-1} = T_t+D_t \quad (1)$$

where, S is government spending, r is the real interest rate, D is the government debt and T is real government revenues. The identity in (1) can be written as intertemporal budget constraint simply by solving it recursively as:

$$D_{t-1} = \sum_{i=0}^{\infty} \frac{T_{t+i}-S^r_{t+1}}{(1+r)^{i+1}} + \lim_{i\to\infty} \frac{D_{t+i}}{(1+r)^{i+1}} \quad (2)$$

where, $S^r_t = S_t+(r_t - r)D_{t-1}$, this is to replace r_t with a r. The fiscal policy is sustainable if the second term in (2) disappears in the long-run. In other words, the debt should be stationary for the fiscal policy to be sustainable. Hamilton and Flavin[4] initially applied the unit root tests to debt. As the debt is the deference of revenues and spending therefore some later studies applied cointegration test to revenues and spending including Smith and Zin[6] and Trehan and Walsh[7]. The equation for cointegration between government receipts and government spending can be written as:

$$T_t = \mu+bS^{r_t}_t+\varepsilon_t \quad (3)$$

The fiscal policy, in this case, is sustainable if the cointegrating coefficient in the (3) that is 'b' remains between 0 and 1 according to Quintos[8] and Hakkio and Rush[9]. Currently, panel tests of stationarity and cointegration are used for sustainability of fiscal policy. Particularly, in the last decade, attention has been drawn to other countries including Latin American countries, the European Union and some of the developing countries. For instance, Afonso[10] has examined the sustainability of the deficit process for the European Union using tests of unit roots and cointegration for panel data. The panel cointegration equation for expenditures and revenues becomes:

$$T_{it} = \mu_i+bS^{r_i}_{it}+\varepsilon_{it} \quad (4)$$

where, the subscripts i and t represent the countries and time respectively.

Model-based tests of sustainability: In contrast to Ad hoc tests, Bohn[5] suggested model based tests of sustainability. He argues that the response of the primary-surplus-GDP ratio to changes in the debt-GDP ratio in the presence of temporary government and output shocks provides more information for policy makers. A positive response shows that the government is taking action, such as reducing non-interest outlays or raising revenues that neutralise the changes in debt.

Bohn argues that the Ad hoc tests are misused because the debt-GDP ratio is subject to various shocks, e.g. fluctuations in income growth, in interest rates and shocks in government spending. These make the mean reversion of the debt-GDP ratio difficult to interpret. However, war-time spending or shocks have been considered in various studies such as Wilcox[11], Trehan and Walsh[7] and Quintos[8] in term of break points. Furthermore, Bohn[12] argues that there is inconsistency among the results of Augmented Dickey-Fuller (ADF)[13,14], Phillips-Perron (PP)[15] and the KPSS[16] test. For instance, the PP test is robust with regard to heteroskedasticity but ignores autocorrelation beyond a finite lag window, whereas the ADF test includes an autoregressive correction but ignores heteroskedasticity. After reporting various results produced by ADF, PP and KPSS tests, he concluded that the results about the deficits are contradictory. Since the time series were not covariance stationary the variances change over time, however, according to Bohn, the standard unit root tests depicted them as stationary. Due to these problems, Bohn suggested a method of examining the response of primary surplus to changes in debt.

The IBC (2) can be derived alternatively using expectations. Let p_t be the primary surplus, d_t is the debt-GDP ratio and $E_t[.]$ represents conditional expectations. The lower-case represent the series as ratios of GDP.

$$d_{t-1} = \sum_{i\,0}^{\infty} \frac{E_t[s_{t+i}]}{(1+r)^{i+1}} + \lim_{i\to\infty} \frac{E_t[d_t]}{(1+r)^{i+1}} \quad (5)$$

Hence, the transversality condition is the second term in Eq. (5) as. According to Bohn[12], the ad hoc sustainability tests are obtained by assuming that potential lenders are infinitely-lived optimizing agents and that financial markets are complete. This implies that the agents' asset accumulation necessarily satisfies the transversality condition. In complete markets imply the agents apply a common pricing kernel to value the financial assets; therefore the transversality conditions aggregate; while, the very agents in the presence of uncertainty may not behave in the same manner therefore, the policies sustainable in a certain world may no longer be so with uncertainty Bohn[17,18]. In contrast to ad hoc sustainability discount factor (i.e. the interest rate on government debt), the discount factor in MBS is determined by the marginal rate of substitution between t and t+1. Thus, with some manipulations the IBC can be written as:

$$D_t = -E_t \sum_{j=0}^{\infty} \frac{\beta^j u'(S_{t+j})}{u'(S_t)} (S_{t+i} - T_{t+i}) \quad (6)$$

Avoiding the basic derivation in Bohn's early papers[17,18], the Model-Based Sustainability tests proposed in Bohn[12] can be written as:

$$p_t = \rho d_{t-1} + \mu_t + \varepsilon_t \quad (7)$$

where, p_t is the primary-surplus-GDP ratio at time t, d_{t-1} is the debt-GDP ratio at t-1 and μ_t includes the temporary shocks to the economy (GDP) and government outlays (spending). Thus, by adding the cyclical components (7) becomes:

$$p_t = \rho d_{t-1} + \beta_0 + \beta_1 \tilde{s}_t + \beta_2 \tilde{y}_t + \varepsilon_t \quad (8)$$

where, $(\tilde{g}_t)$ represents the level of temporary government spending and $(\tilde{y}_t)$ is the business cycle indicator, where $(\tilde{y}_t)$ and $(\tilde{s}_t)$ are the temporary fluctuations in government spending and output. The cyclical components can be obtained by de-trending the government spending and output using Hodrick Prescott filter. Mendoza and Ostry[19] and Ghatak and Sanchez-Fung[20] used the cyclical components as $GVAR_t = \left(s_t - s_t^T / s_t^T \right) s_t^T / y_t$ and $GVAR_t = \left(y_t - y_t^T / y_t^T \right) s_t^T / y_t$. The superscript T denotes the trend value of the corresponding variables.

RESULTS AND DISCUSSION

Unit root tests: Recently, Mendoza and Ostry[19] and Ghatak and Sanchez-Fung[20] have applied MBS tests. The debt data in these studies are assumed to be stationary in levels. However, a necessary and careful investigation require the data to be checked for the unit root. The results are presented in Table 1 and 2. The ADF test results are presented in the first column, the DF-GLS results in column 2 and the Phillips-Perron results in column 3. The final verdict on whether there exists a unit root is given in column 4.

The lag-length is selected using the Akaike Information Criterion (AIC)[21], for all the tests. As the span of the data series is very short, we rely on a maximum of 3 lags in the model. The ADF and PP test results are given along with their p-values.

Table 1: Debt-GDP ratio in levels

	Country	ADF	PP	DF-GLS	Verdict
Bangladesh	Intercept	-3.940 (0.013)	-1.999 (0.283)	-2.196	I(1)
	Trend	-2.921 (0.195)	-1.720 (0.687)	-2.947	I(1)
Bhutan	Intercept	-0.826 (0.780)	-0.718 (0.811)	-0.883	I(1)
	Trend	-2.835 (0.210)	-2.820 (0.214)	-2.870	I(1)
India	Intercept	-2.273 (0.195)	-1.352 (0.572)	-2.367	I(0)
	Trend	-0.746 (0.937)	-1.519 (0.768)	-1.825	I(1)
Pakistan	Intercept	0.043 (0.948)	0.043 (0.948)	-0.203	I(1)
	Trend	-1.310 (0.841)	-1.294 (0.845)	-1.508	I(1)
Sri Lanka	Intercept	-3.585 (0.026)	-1.485 (0.511)	-3.831	I(0)
	Trend	-3.726 (0.066)	-1.369 (0.823)	-3.647	I(0)
Maldives	Intercept	-0.425 (0.880)	-0.010 (0.942)	-0.695	I(1)
	Trend	-1.590 (0.744)	-1.590 (0.744)	-1.992	I(1)
Indonesia	Intercept	-2.149 (0.231)	-2.065 (0.259)	-2.179	I(0)
	Trend	-0.365 (0.974)	-1.768 (0.665)	-2.176	I(1)
Malaysia	Intercept	-3.007 (0.065)	-3.305 (0.035)	-2.527	I(0)
	Trend	-2.174 (0.456)	-3.528 (0.075)	-3.237	I(1)
Thailand	Intercept	-0.833 (0.778)	-0.914 (0.752)	-1.343	I(1)
	Trend	-1.868 (0.605)	-1.508 (0.776)	-3.092	I(1)
Singapore	Intercept	-0.929 (0.747)	-0.929 (0.747)	-0.867	I(1)
	Trend	-1.927 (0.574)	-1.927 (0.574)	-1.771	I(1)

Parentheses contain p-values, DF-GLS: When intercept is included the critical values for 1, 5 and 10% are -2.755, -1.971 and -1.604, respectively, -2.792, -1.978 and -1.602 for India (as it has fewer values than others in the group). DF-GLS: When intercept and linear trend are included the critical values for 1, 5 and 10% are -3.770, -3.190 and -2.890

Table 2: Primary-Surplus-GDP ratio in levels

	Country	ADF	PP	DF-GLS	Verdict
Bangladesh	Intercept	-0.699 (0.816)	-0.848 (0.773)	-1.255	I(1)
	Trend	-2.549 (0.304)	-2.183 (0.462)	-2.711	I(1)
Bhutan	Intercept	-2.746 (0.091)	-2.709 (0.097)	-2.567	I(0)
	Trend	-2.325 (0.396)	-2.223 (0.443)	-2.743	I(1)
India	Intercept	-3.288 (0.038)	-3.225 (0.042)	-2.863	I(0)
	Trend	-3.067 (0.153)	-3.055 (0.156)	-3.041	I(1)
Pakistan	Intercept	-2.626 (0.117)	-1.464 (0.521)	-2.369	I(0)
	Trend	-0.447 (0.971)	-1.122 (0.887)	-2.274	I(1)
Sri Lanka	Intercept	-3.950 (0.015)	-3.955 (0.011)	-3.630	I(0)
	Trend	-3.337 (0.112)	-4.044 (0.033)	-3.779	I(0)
Maldives	Intercept	-2.699 (0.099)	-2.713 (0.096)	-2.537	I(0)
	Trend	-3.079 (0.148)	-3.185 (0.127)	-3.141	I(1)
Indonesia	Intercept	-3.024 (0.057)	-3.042 (0.055)	-3.021	I(0)
	Trend	-2.902 (0.200)	-4.482 (0.017)	-4.722	I(0)
Malaysia	Intercept	-1.306 (0.596)	-1.306 (0.596)	-1.184	I(1)
	Trend	-1.170 (0.876)	-1.124 (0.886)	-1.425	I(1)
Thailand	Intercept	-1.382 (0.560)	-1.388 (0.557)	-1.293	I(1)
	Trend	-2.123 (0.480)	-0.159 (0.986)	-2.725	I(1)
Singapore	Intercept	-2.244 (0.201)	-2.158 (0.228)	-2.253	I(0)
	Trend	-2.090 (0.507)	-1.910 (0.597)	-2.265	I(1)

Parentheses contain p-values, DF-GLS: When intercept is included the critical values for 1, 5 and 10% are -2.755, -1.971 and -1.604, respectively, -2.792, -1.978 and -1.602 for India (as it has fewer than others in the group). DF-GLS: When intercept and linear trend are included the critical values for 1, 5 and 10% are -3.770, -3.190 and -2.890

The critical values for the DF-GLS test with trend are obtained from ERS (1996, Table 1) and are given in the footnotes to Table 1 and 2.

As shown in Table 1 and 2, with few exceptions, the debt-GDP and primary-surplus-GDP ratios are nonstationary in levels, therefore, the MBS test of sustainability can only be applied to countries with both the series being stationary in level.

COINTEGRATION RESULTS

As discussed above, if debt and the primary surplus are used in levels the regression results, in this case, would be meaningless unless the two series are tied in a long-run relationship. The preliminary step for testing cointegration is to confirm the order of integration. The primary-surplus-GDP ratio and debt-GDP ratio are I(1) in most of the cases.

We applied the unit root tests to the first difference of the series and the results suggest that all the series are integrated of order I(1). In order to save space, the results are not reported. In the second step, we applied the Engle-Granger test of cointegration. Engle-Granger is of the view that residuals drawn in the first step from a cointegrating equation do not have the exact limiting distribution as tabulated by Dickey and Fuller. Therefore, following Engle and Granger[22] recommendation, the CADF-tests with the critical values are used. The critical values for these tests are slightly different from the critical values used in standard unit root tests. For instance, the critical values for the Engle-Granger cointegration test are given by Enders[23] in Table 3. We have applied the Engle-Granger method as a preliminary check on the equilibrium relationships[24]. For more detailed analysis we have relied on the cointegration tests from panel data that will be presented in the following sections.

The critical value for the Engle-Granger method is taken from Enders[23] given in Table 3. As shown in Table 3, the error term is nonstationary for all countries except India and Maldives. Table 4 presents the results for the orders of integration, the existence of cointegration and the verdict on the applicability of MBS. Although the presence of cointegration in two countries allows for the MBS in levels but the presence of cointegration implies sustainability of fiscal policy as suggested by Trehan and Walsh[25]. Therefore the MBS is not necessarily required to evaluate sustainability. Furthermore, for countries having a primary surplus and debt neither stationary nor cointegrated, the MBS is not applicable in levels.

In the next section, we apply the panel unit root and cointegration test to the pooled data.

Panel unit root tests: Panel unit root testing increases the power, therefore, we use IPS that is Im *et al.*[26] and Levin *et al.*[27] (LLC) tests for panel unit root. The LLC test that is an extension of a univariate DF test that allows for fixed effects, time trends and common time effects. The LLC is criticised because if the null hypothesis of a unit root is rejected in one of the series in a pool, it may be enough to reject the unit root for the whole panel[28]. In other words, ignoring heterogeneity across countries in a panel may depict the whole panel as stationary, even though there may be a significant portion of nonstationary series in the panel. Following the discussion in Im *et al.*[26], the LLC testing framework of three models can be written as:

$$\Delta y_{it} = \gamma y_{i,t-1} + u_{it}$$
$$\Delta y_{it} = \gamma y_{i,t-1} + \alpha_{1i} + u_{it}$$
$$\Delta y_{it} = \gamma y_{i,t-1} + \alpha_{1i} + \alpha_{2i} t + u_{it}$$

where, the error process (u_{it}) is distributed independently across individuals and follows a stationary invertible ARMA process for each individual. As the LLC has a drawback of rejecting the null hypothesis of unit root for the whole panel even though there may be a significant portion of nonstationary series in the panel[28]. However, we encountered this problem rarely and in order to avoid this problem, we rely on Fisher[29] ADF and PP and IPS tests results.

The panel unit root results for the group of all countries are shown in Table 5. All the tests are applied to models with and without linear trend. The Table contains the results debt-GDP ratio, the primary-surplus-GDP ratio, real debt and real primary surplus. The primary-surplus-GDP ratio, in a model

Table 3: Engle-Granger cointegration test result

Country	ADF	Verdict
Bangladesh	-1.313	Unit root
Bhutan	-2.590	Unit root
India	-3.288	Stationary
Pakistan	-2.786	Unit root
Maldives	-4.117	Stationary
Thailand	-2.137	Unit root
Singapore	-3.110	Unit root

Calculated test statistics value of ADF unit root test is compared with critical values for the Engle-Granger Cointegration tests, given in Enders (2004, p.441)[20], Table 3. The critical value for two variables at 10 % level of significance is -3.130

Table 4: Applicability of MBS test

	Order of integration			
Countries	Debt-GDP	Primary-surplus-GDP	Cointegration (Engle-granger)	Verdict
India	I(1)	I(1)	Cointegration exists	Applicable
Maldives	I(1)	I(1)	Cointegration exists	Applicable
Sri Lanka	I(0)	I(0)	Stationary in level	Applicable
Bhutan	I(1)	I(1)	No cointegration	Not applicable
Pakistan	I(1)	I(1)	No cointegration	Not applicable
Bangladesh	I(1)	I(1)	No cointegration	Not applicable
Indonesia	I(1)	I(0)	No cointegration	Not applicable
Malaysia	I(1)	I(1)	No cointegration	Not applicable
Thailand	I(1)	I(1)	No cointegration	Not applicable
Singapore	I(1)	I(1)	No cointegration	Not applicable

Table 5: Panel unit root test for MBS (pool of all countries)

Series		LLC	Fisher ADF-χ^2	Fisher PP-χ^2	IPS	Verdict
Primary-Surplus-GDP ratio	Intercept	-2.639	36.709	37.506	-2.394	Stationary
	Only	(0.004)	(0.013)	(0.010)	(0.008)	I(0)
	Intercept and trend	-1.295	24.196	27.547	-0.281	Unit root
		(0.098)	(0.234)	(0.121)	(0.390)	I(1)
Debt-GDP ratio	Intercept	-0.795	25.353	16.179	-0.641	Unit root
	Only	(0.213)	(0.188)	(0.705)	(0.261)	I(1)
	Intercept and trend	-1.407	18.337	12.723	0.001	Unit root
		(0.080)	(0.565)	(0.899)	(0.501)	I(1)
Real primary surplus	Intercept	-0.240	26.750	24.777	-0.187	Unit root
	Only	(0.405)	(0.142)	(0.210)	(0.426)	I(1)
	Intercept and trend	-0.991	20.417	18.255	0.709	Unit root
		(0.161)	(0.432)	(0.571)	(0.761)	I(1)
Real debt	Intercept	2.430	19.308	6.136	3.149	Unit root
	Only	(0.993)	(0.502)	(0.999)	(0.999)	I(1)
	Intercept and trend	0.077	13.851	9.626	1.383	Unit root
		(0.531)	(0.838)	(0.975)	(0.917)	I(1)

Parentheses contain the p-values, LLC: Levin, Lin and Chu unit root test, PP-χ^2: Fisher chi-square test, PP-Z: Fisher Choi Z-statistics. IPS: Im, Pesaran and Shin

Table 6: Panel cointegration tests for all-countries

	Pedroni (Engle-Granger) test of panel cointegration		
	GDP ratios	Real variables	
Pools	Intercept and trend	Intercept only	Intercept and trend
Panel-v	0.139 (0.445)	1.311 (0.095)*	-1.555 (0.940)
Panel-rho	0.943 (0.827)	-5.061 (0.000)*	-2.769 (0.003)*
Panel-PP	-1.640 (0.051)*	-6.700 (0.000)*	-8.078 (0.000)*
Panel-ADF	-2.500 (0.006)*	-7.083 (0.000)*	-5.568 (0.000)*
Group-rho	1.838 (0.967)	0.864 (0.806)	1.619 (0.947)
Group-PP	-3.212 (0.001)*	-0.553 (0.290)	-1.938 (0.026)*
Group-ADF	-4.645 (0.000)*	-1.992 (0.023)*	-2.545 (0.005)

*Parentheses contain the p-values, Linear Trend in the data while there is no trend in the cointegrating equation, *shows the rejection of null of no cointegration at 10% or less than 10% level of significance

without a linear trend, is stationary in levels as confirmed by all three tests, using 10% level of significance in all the cases. However, it is non-stationary for the linear trend in the model. The primary-surplus-GDP ratio is regarded as nonstationary for the model including an intercept and a linear trend.

As shown in Table 5, the debt-GDP ratio is consistently nonstationary whether the linear trend is omitted or added. However, the series becomes stationary in first differences, i.e. I(1), the results are not reported in order to save space. The three-panel unit root tests were also applied to the real primary surplus and real debt. Again the unit root tests suggest the presence of a unit root in levels and the series become stationary in first differences.

As shown by the panel unit root tests results, the series are nonstationary in levels, due to unit root. Enders[23] has listed the following four implications for nonstationary variables, a) If all the variables are stationary in levels then the Ordinary Least Square (OLS) regression is appropriate, b) if the time-series variables are integrated of different orders then the regression results using such variables are meaningless, c) If the series are integrated of the same order but the error term contains a stochastic trend, the regression is spurious. The results from such regression are useless because the errors are permanent and d) finally if the series are integrated of the same order and the error term is stationary in levels these series are said to be cointegrated.

In the next section, the series are examined for cointegration based on Enders[23] suggestions in point's c and d.

PANEL COINTEGRATION TESTS

As the primary surplus and debt as a percentage of GDP are I(1) in most of the cases, we, therefore, check for cointegration using panel cointegration tests of Pedroni[30], Kao[31] and Johansen[32]. The panel cointegration test results applied to time-series processes both as percentages of GDP and in real terms are shown in Table 6.

The second column of Table 6 shows Pedroni's seven test statistics for GDP ratios with an intercept and a linear trend. The two-panel statistics, panel-v and panel-rho do not reject the null of no cointegration, whereas panel-PP does not reject the null of no cointegration at the 5% level of significance and finally, panel-ADF rejects the null hypothesis. Similarly, for group statistics only, group-rho does not reject the null of no cointegration while the other two, i.e. group-PP and group-ADF, reject the null of no cointegration.

For small samples, the researcher is advised to be careful when imposing cointegration or no cointegration. For instance, Gutierrez[33] states that for small-T panels there is a risk of modelling the whole panel as a non-cointegrated relationship, because of the low power of the tests even when a large number of cointegrated relationships exist. Moreover, the difference in the results of Pedroni's seven test statistics may lead one to different conclusions. However, the simulation results are drawn in Pedroni[30] suggest that group-ADF or panel-ADF is more appropriate when the sample is small. Hence, according to the test results of the group-ADF and panel-ADF tests, cointegration exists for the primary surplus and debt as percentages of GDP when an intercept and a linear trend are included in the model. We can also claim that cointegration exists for the real variables both for intercept only model and for the model with intercept and a linear trend.

The existence of cointegration between primary-surplus-GDP and debt-GDP ratios suggests that fiscal policy is sustainable as some of the studies suggested, such as Chalk and Hemming[34] and Trehan and Walsh[25]. Although, the existence of cointegration, however, allows the MBS to be applied in levels due to the existence of a long-run relationship. But, at the same time, it also implies that fiscal policy is sustainable. Therefore, there is no need for further evaluation of the sustainability of fiscal policy using MBS tests of sustainability. However, we apply the MBS test of sustainability in order to see what the results imply regarding sustainability.

MBS RESULTS

The MBS test of sustainability is applied to primary-surplus-GDP and debt-GDP ratios of all-countries both Model-I (without a linear trend) and Model-II (with a linear trend). The results are shown in Table 7. Column I of Table 7 shows the results of the MBS test when the model includes GVAR, YVAR and the first-order autoregressive term AR(1). Column II shows the results without the autoregressive term AR(1), while column III shows the results with only the autoregressive term AR(1). In order to adjust for heteroskedasticity, White cross-section standard errors are used and they are shown in the square brackets.

As shown in Table 7, the coefficient of debt in all the columns is negative and insignificant except for the model with only GVAR and YVAR, i.e. Column II. The coefficients of GVAR and YVAR are negative as predicted by Barro's tax smoothing model and are statistically significant. The R^2 values are above 85% for all the models. The negative value for the coefficient of debt is inconclusive regarding fiscal policy. Because according to Bohn the coefficient of debt-GDP between 0 and 1 indicates that the government is reacting to increases in debt by increasing the primary surplus. Whereas if the coefficient is greater than 1 the government is said to be accumulating infinite assets, see for example Mendoza and Ostry[19]. However, there is no explanation given for the negative coefficient. The negative coefficient mathematically implies that the government is not even responding to increases in the debt-GDP ratio, by increasing the primary-surplus-GDP ratio, rather it is decreasing the primary-surplus-GDP ratio over time.

Table 7: MBS Panel Regression *Dependent Variable: Primary-Surplus-GDP Ratio*

	GDP ratios (All countries)		
Variables	I	II	III
Debt-GDP ratio	-0.031 (0.024)	-0.043 (0.017)	-0.049 (0.033)
	(0.206)	(0.013)	(0.140)
Expenditures Gap (GVAR)	-5.85E-07 (1.70E-07)	-2.60E-07 (9.06E-08)	
	(0.001)	(0.005)	
Output Gap (YVAR)	-0.639 (0.296)	-0.351 (0.132)	
	(0.033)	(0.009)	
Country AR (1) Coeffs.	0.508 (0.086)		0.480 (0.084)
	(0.000)		(0.000)
Adj. R^2	0.905	0.864	0.893
No. Of observations	139	149	139

Parentheses contain p-values, square brackets contain the White cross-section standard errors Output and government spending gaps are percent deviations from Hodrick-prescott trends

Examining the response of government towards changes in debt is by no means a worthless approach but the analysis in the presence of I(1) variables produces meaningless results if there is no long run relationship.

SIGNIFICANCE STATEMENT

In this study it is revealed that, the two contemporary tests for fiscal solvency can helpful in cases where the one test produces mixed results.

CONCLUSION

Ad hoc sustainability tests are based on the standard tests of unit root and cointegration while the MBS test requires a significant response of the primary surplus to changes in debt. The two tests are useful in situations where one test produces mixed results. The results suggest that in the selected sample of the Asian developing countries the fiscal policy is sustainable.

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