ASSESSING THE MEAN REVERSION BEHAVIOR OF FISCAL POLICY: THE CASE OF ASIAN COUNTRIES

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Abstract

Maintaining sustainable fiscal policy has been increasingly important in the scope of economists and the policy makers as the key requirement of macroeconomic stability and sustainability of an economy. Without exception, the issue of fiscal sustainability also being in the spotlight for the developing countries especially in Asian, after the financial shock in 1997. Motivated by this development, this paper test the mean-reverting behavior of fiscal position by adopting families of univariate and panel unit root tests for the panel of ten Asian countries. Univariate unit root tests indicates that the fiscal position follows a non-stationary process of *I(1)* while mean reverting property were detected when we adopt the *commonly used* panel unit roots techniques. By utilizing the series-specific panel unit root test developed by Breuer *et al*. (2002, SURADF) that allows one to test for the presence of non-stationarity within individual cross sectional of the panel, we found that four out of ten countries in the panel are stationary suggesting little evidence of fiscal sustainability in Asian. These results also confirm the complexity properties of the panel data.

Keywords: fiscal policy, mean reversion, sustainability, government intertemporal budget constraint, unit root tests, Asian

JEL classification: E62, H62, H63

1. Introduction

Sustainability of public finances and sound fiscal policies had been increasingly important for the economists and policy makers. From a fiscal perspective, maintaining sustainable fiscal policy is one of the core requirements for a stable macroeconomic environment and a sustainable economy. The interest arise from two important developments in the global economy: (1) the large fiscal imbalances

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witnessed in many of Western Europe and the Unites States over the past two decades; and (2) the fiscal discipline demanded from the European Union (EU) member countries for European Monetary Union (EMU) membership by the end of the 1999[1].

In addition, international organizations dwell upon with wide-ranging plan and surveillance program in assessing and monitoring fiscal sustainability among their member countries (Chalk and Hemming, 2000; Edwards, 2002 and IMF, 2002). The purpose is to find out whether the fiscal imbalances in the developing world need to be curtailed before they become economically unsustainable. Under the present condition of the world economy, huge internal imbalances might lead to a hard landing for countries that appear to be insolvent. Elsewhere, the role and coordination of the fiscal policy as the stabilizing policy in developing countries is, by now, a widely accepted argument. The aim of stabilization policy is to keep the level of output close to its potential while keeping inflation and the external imbalances at the accepted levels. Numerous authors had concluded that the effectiveness of the fiscal policy as an instrument for stabilizing and stimulating the economy (see, Hemming *et al*., 2002; Jansen, 2004 and Rosengard, 2004).

Nearer home, the Asian countries are also working towards an economic and monetary cooperation within the region after the financial shock in 1997[2]. This is to ensure a greater degree of economic integration and strengthened the perceptions of mutual economic interdependence among the member countries. In moving towards these objectives, the fiscal policies of all member countries need to be coordinated

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[1] According to the Masstricht Treaty protocol, the government budget deficit should in fact not exceeded 3 percent and the public debt should be lower than 60 percent, both measured in term of real GDP. Interestingly, the newly formed Euro area had pursued one step further to evaluate the effectiveness of the fiscal policies for their members countries following the fiscal regulatory set up by European Central Bank (ECB) (see for example, Marin, 2002; Buiter, 2003; Annicchiarico and Giammarioli, 2004 and Moraga and Vidal, 2004)

[2] Chiang Mai Initiative was hailed as an important first step toward creating a manifestation of the broader desire for economic, monetary and financial cooperation in Asian. For a latest literature on economic cooperation and integration in Asian, see Kwack (2004), Wang (2004) and Aminian (2005).

and their deficits must be kept under control. With the current climate of intense global uncertainty that leads to economic slowdown and latest catastrophic impact of Asian Tsunami, it could potentially generate additional stress on the fiscal situation for the Asian countries.

Measuring fiscal sustainability has been a highly contentious issue (Chalk and Hemming, 2000). Developments in time series techniques, notably tests for stationarity, allow for econometric testing of the fiscal sustainability. The literatures focus on the two different empirical approaches. The first approach was initiated by Hamilton and Falvin (1986) and was further empirically tested in Kremers (1988, 1989), Trehan and Walsh (1988, 1991), Wilcox (1989), Smith and Zin (1991), MacDonald (1992), Makrydakis *et al*. (1999), Feve and Henin (2000) and Uctum and Wickens (2000). This line of research tests the univariate stationarity of the debt or deficit while verifying whether it is sustainable for the whole trajectory path of the fiscal positions and not only at a particular point in time. The second approach originated by Hakkio and Rush (1991) in examining the bivariate long run cointegration relationship between government revenue and expenditure (Tanner and Liu, 1994; Liu and Tanner, 1995; Quintos, 1995; Payne, 1997; Papadopoulos and Sidiropoulos, 1999; Martin, 2000; Hatemi-J, 2002; Bohn, 2004). Most of these studies focus on the US and the Western European countries.

Only recently, empirical investigations on intertemporal fiscal solvency constraint on the Asian region the transition economy (eg. Eastern Europe) have becoming increasing available in the literature (see, Wu, 1998; Green *et al.*, 2001; Chung, 2002; Cashin *et al*., 2003; Radulascu, 2003). Both Wu (1998) and Chung (2002) found sustainable fiscal policies for Taiwan and Korea while Pakistan is on the unsustainable path (see, Cashin *et al*., 2003). Empirical study by Green *et al.* (2001) support the sustainability condition for Poland while Radulascu (2003) noted that Romania is on unsustainable fiscal policy path in their transition period.

With these motivations and importance of fiscal sustainability, this paper examine the mean-reverting property of fiscal positions in ten Asian countries (Asian-10: India, Indonesia, Korea, Malaysia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka and Thailand) covering the period from 1970 to 2003. The selections of these countries are interesting as it posses similar contention due to the episodes of currency crisis over 1975-1997 period as defined in Glick and Hutchison (2005). As such, the issues presented here are indeed significant for the Asian economy for the coordination of fiscal policies.

To accomplish the objective, we apply the new panel unit root test developed by Breuer *et al.* (2002, SURADF) to the fiscal positions of these Asian countries[3]. There are strong reasons for believing that there is considerable heterogeneity in the countries under investigation and thus, the *commonly used* panel unit root tests may lead to misleading inferences. In highlighting this point, we also report the unit root test of Harris and Tzavalis (1999, HT) Maddala and Wu (1999, MW) and Breitung (2000, UB), Hadri (2000, HADRI) and Im *et al.* (2003, IPS) to the same data set. Additionally, we also relied on the Said and Dickey (1984) Augmented Dickey-Fuller test (ADF), Kwiatkowski *et al*. (1992, KPSS) and the modified ADF tests of Elliott *et al.* (1996, DFGLS) for testing the univariate stationary process of each of the country series.

The remainder of the paper is structured as follows. Section 2 briefly describes the fiscal sustainability model. Empirical methodologies are outlines in Section 3. Section 4 introduces the data and reports the empirical results. Conclusions and further implications for empirical research are discussed in the final section.

2. Theoretical Framework: Fiscal Sustainability Model

Most of the theoretical discussions of fiscal sustainability literature start from the representative agent model in which the government intertemporal budget constraint (GIBC) is being fulfilled in the long run. The model starts with the budget constraint faces by the government at period *t* written as

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[3] Levin and Lin (1993, LL) and Quah (1994) pioneered the analysis of the panel unit root tests. Later, Im *et al*. (2003, IPS), Taylor and Sarno (1998, MADF), Harris and Tzavalis (1999, HT), Maddala and Wu (1999, MW), Breitung (2000, UB) and Hadri (2000, HADRI) improved the first-generation panel unit root tests. All these tests had increased the statistical power of unit root tests over the single-equation counterparts that were solely based on a limited time series dimension. These techniques exploit the benefits from cross-sectional information to produce much more favorable evidence of stationarity in the numerous economics literature.

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

with b_t is government debt, d_t is the primary fiscal deficit and r_t is the (one period) real ex post rate of interest rate adjusted for real output growth[4].

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

$$b_t = -E_t \sum_{i=1}^{n} \delta_{t,i} d_{t+i} + E_t \delta_{t,n} b_{t+n} \tag{2}$$

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 conditional expectations. $\delta_{t,n}$ can also be expressed as $\delta_{t,n} = {q_{t+n}}/{q_t}$ where $q_t = \prod_i^t (1+r_i)^{-1}$ 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) 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

$$B_t = -E_t \sum_{i=1}^{n} D_{t+i} + \lim_{n\to\infty} E_t b_{t+n} \tag{3}$$

Equation (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 represented the asymptotic expected present value of the government's debt. Eventually $\sum_{i=1}^{n}[D_{t+i}]$ represent the difference between the between government revenue

[4] In the literature, specific assumption had been made to the process generating the variable r_t. Studies like Hamilton and Flavin (1986), Trehan and Walsh (1988, 1991) and Kremers (1989) postulated a strictly exogenous d_t and a constant r_t while Wilcox (1989) and recently Makrydakis *et al.* (1999) and Uctum and Wickens (2000) tested in terms of stochastic r_t. In this paper, the r_t is assumed to be stochastic rather than fixed to reflect the more recent empirical regularities and over time there exist interest rate variability, a more realistic assumption.

(R) and expenditure (that covers the total government spending on goods and services and transfer payments and interest on the debt) (G)[5].

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) $\lim_{n\to\infty} E_t B_{t+n} = 0$, where the limit taken as $n \to \infty$ shows the infinite planning horizon. When the limit term is zero [$\lim_{n\to\infty} E_t B_{t+n} = 0$], this means that in the long run, we rule out a Ponzi scheme where the government is 'bubble' financing its expenditure by issuing new debts to finance the deficits. Therefore, a fiscal policy will be sustainable if the limiting term equal to zero. A non-Ponzi game restriction is typically regarded as synonymous with sustainability, which implies that the transversality condition[6] $\lim_{n\to\infty} E_t B_{t+n} = 0$ has to hold. If this condition is met, the government intertemporal budget constraint (GIBC) expressed as

$$B_t = -E_t \sum_{i=1}^{n} D_{t+i} \tag{4}$$

Equation (4) states that for fiscal policy to be sustainability in the long run, government should run a sequence of discounted future non-interest budget surpluses capable of offsetting the current outstanding debt/deficit. A formal assessment of the sustainability condition is to test whether government budget position follows an *I(0)*process. Hence, the sustainable fiscal policy typically assumed that the stationary property of budgetary variable or it follows a mean-reverting process of *I(0)*. Our empirical methodologies are based on the univariate (time series) and panel-based approaches. In the next section we briefly outlined the testing procedures but

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[5] The difference between $(R-G)$ is the government budget position. If $G > R$ the government experiencing budget deficit while analogously if $R > G$ the country would experiencing budget surplus.

[6] 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 in the government bond rate. The requirement of budget process to 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.

interested readers may refer to the original article for the complete derivation of the methods.

3. Empirical Methodology

3.1 Univariate Unit Root and Stationary Testing Procedures

The ADF and DFGLS testing principles share the same null hypothesis of a unit root. Their difference however 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 denoted by τ_μ and τ_τ with mean (μ) and trend (τ) stationarity.

In contrast, the KPSS procedure tests for level (η_μ) or trend stationarity (η_τ) against the alternative of a unit root. The KPSS test statistic for level (trend) stationary is

$$\eta_\mu(\eta_\tau) = \frac{1}{s^2(k)T^2}\sum_{t=1}^{T} S_t^2 \quad (5)$$

where $S_t = \sum_{i=1}^{t} u_i, u_t$ are the residuals from the regression of X_t on a constant (a constant and trend) for the level (trend) stationarity, $s^2(k)$ is the non-parametric estimate of the 'long run variance' of u_t while k stands for the lag truncation parameter.

3.3 Panel Unit Root and Stationary Tests

Our estimation procedures incorporated the panel unit root tests advocated by IPS, HT, UB, MW and HADRI. The null hypothesis of these tests is that the panel series has a unit root (non-stationary) except for HADRI test. The HADRI test is similar to the KPSS unit root test and has a null hypothesis of stationarity in the panel. A comparison of the results obtained from both procedures can give some insights into the stationarity properties of the data. If both procedures fail to reject the null hypothesis (or if both reject), we have mixed results and can only conclude that the data are not informative enough. But, on the other hand, if ADF type panel unit root test reject the null and the KPSS type test fail to rejects, we have confidence that the series under consideration is in fact stationary variable denotes as the *I(0)* process.

Im *et al*. (2003, IPS) proposed *t*-bar statistic, which is based on the average of the individual ADF *t*-statistics to examine the unit root hypothesis for panels. They evaluates 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

$$\Gamma_{\bar{t}} = \frac{\sqrt{N}\{\bar{t}_{NT} - E(t_T \mid \beta_i = 0)}{\sqrt{Var(t_T \mid \beta_i = 0)}} \Rightarrow \text{N }(0,1), \text{ where } \bar{t}_{NT} = \frac{1}{N}\sum_{i=1}^{N} t_{iT} \quad (6)$$

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 converges to the standard normal distribution as T (time periods dimension) and N (cross-sectional dimension of the panel) tends to infinity and N/T tends to zero under the null hypothesis of unit roots, $\beta_i = 0,\ i=1,2\ldots N$.

Harris and Tzavalis (1999, HT) developed the asymptotic unit root test for first-order autoregressive model using panel data with serially uncorrelated errors, under the assumption that $N \rightarrow \infty$ and fixed time dimension. The procedure offers three different models corresponding to the three different assumptions[7].

Maddala and Wu (1999, MW)[8] developed the test statistics that is based on combining the *p*-values of the test statistics from ADF unit root tests (p_i say for the i th cross

[7] 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 on the mean-reverting properties of fiscal position.

[8] The Fisher test achieves more accurate size and high power relative to LL test. It also does not require a balanced panel as in the case of IPS test and can adopt different lag lengths in the individual ADF regressions (Maddala and Wu, 1999). The disadvantage is that the *p*-values have to be derived by Monte Carlo simulation.

section, $i = 1,..., N$). This is a version of non-parametric test that was based on Fisher (1932). The MW test statistics is given as

$$P(\lambda) = -2\sum_{i=1}^{N} \log(p_i) \tag{7}$$

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 cross section units (2N) under null hypothesis.

Following Breitung (2000, UB), proposed a class of test statistic (λUB) that does not employ a bias adjustment given by,

$$\lambda_{UB} = \frac{\sum_{i=1}^{N} \sigma_i^{-2} y_i^{*\prime} x_i^{*}}{\sqrt{\sum_{i=1}^{N} \sigma_i^{-2} x_i^{*\prime} A' A x_i^{*}}} \tag{8}$$

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

Like the KPSS test, the Hadri (2000, HADRI) test is based on the residuals from the individual OLS regression of y_{it} on a constant, or on a constant and trend. For the sake of presentation, we includes both constant and a trend specified below

$$y_{it} = \alpha_{it} + \beta_t t + \varepsilon_{it} \tag{9}$$

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 stationarity null hypothesis is defined as

$$LM = \frac{\sum_{i=1}^{N}\sum_{t=1}^{T} S_{it}^2}{N.T^2 \varpi^2} \tag{10}$$

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.

3.4 Series Specific Panel Unit Root Test: SURADF

A common feature of the panel tests mentioned above is that they maintained the null hypothesis of a unit root in all panel members except for HADRI test. Therefore, their (non-) rejection indicates that at least one panel member is stationary, with no information about how many series or which ones are stationary.

In addressing this issue, Breuer *et al.* (2002, SURADF) developed a panel unit root test that involves the estimation of the ADF regression in a SUR framework and then test for individual unit root within the panel members[9]. This procedure also handles heterogeneous serial correction across panel members. Importantly, the test minimized the possibility of the misleading conclusion of stationarity when only one panel member behave in a stationary manner.

The SURADF test is based on the system of ADF equations which can be represented as

$$\Delta y_{1,t} = \alpha_1 + \beta_1 y_{1,t-1} + \sum_{j=1} \varphi_j \Delta y_{1,t-j} + u_{1,t}$$

$$\Delta y_{2,t} = \alpha_2 + \beta_2 y_{2,t-1} + \sum_{j=1} \varphi_j \Delta y_{2,t-j} + u_{2,t}$$

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$$\Delta y_{N,t} = \alpha_N + \beta_N y_{N,t-1} + \sum_{j=1} \varphi_j \Delta y_{N,t-j} + u_{N,t} \qquad (11)$$

where $\beta_j = (\rho_j - 1)$, ρ_j is the autoregressive coefficient for series j and $t = 1,...,T$. This system is estimated by the SUR procedure with the null and the alternative hypotheses are tested individually as

$H_0^1 : \beta_1 = 0;$ $\qquad$ $H_A^1 : \beta_1 < 0$

$H_0^2 : \beta_2 = 0;$ $\qquad$ $H_A^2 : \beta_2 < 0$

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[9] This test is a general form of the Abuaf and Jorion (1990) and Taylor and Sarno (1998, MADF) panel unit root tests.

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$H_0^N : \beta_N = 0; \qquad H_A^N : \beta_N < 0$

with the test statistics computed from SUR estimates of system (11) while the critical values are generated by Monte Carlo simulations. This procedure posed several advantages. First, by exploiting the information from the error covariances and allowing for autoregressive process, it produced efficient estimators over the single equation methods. Second, the estimation also allows for heterogeneous fixed effect, heterogeneous trend effects and heterogeneity in lag structure across the panel members. Third, the SURADF test allows us to identify how many and which member(s) of the panel contain a unit root.

As this test has non-standard distributions, the critical values of the SURADF test must be obtained through simulations. In the Monte Carlo simulations, the intercepts, the coefficients on the lagged values for each series were set equal to zero. In what follows, the lagged differences and the covariances matrix were obtained from the SUR estimation on the actual Asian-10 fiscal position data. The SURADF test statistic for each of the ten series was computed as the *t*-statistic calculated individually for the coefficient on the lagged level. Since the SURADF estimation takes into account error correlation, which will be different for different series, the critical values for SURADF will be different for each series. To obtain the critical values, the experiments were replicated 10000 times and the critical values of 1 percent, 5 percent and 10 percent are tailored to each of the ten panel members.

4. Empirical Investigation

4.1 Data Description

The empirical period begins in 1970 and ends in 2003 providing 34 observation of fiscal position per output of the ten Asian countries. The data include annually observations of the budget position and gross domestic product expressed in billions of US dollars. The data, which are not seasonally adjusted and expressed in nominal term were obtained from several *International Financial Statistics* (IFS) issues, published by the International Monetary Fund (IMF).

4.2 Univariate Unit Root and Stationary Evidence

For lag length selection criterion in the univariate tests, we estimated the recursive *t*-statistic procedure outlined in Campbell and Perron (1991) and Ng and Perron (1995) with an upper bound of k_{max} on k. The method involves starting with a high-order autoregression and sequentially excluding the highest-order lag until the coefficient on the highest-order lag is statistically significant. For this purpose, we set k_{max} to be 6 due to the annually observations adopted here. If no lags are significant then k is set to zero (k=0). The 5 percent value of the asymptotic normal distribution, 1.96 is used to assess the significance of the last lag. The procedure adopted here falls into the category of the general to specific or the top down selection procedures[10].

Table 1 summarizes the outcome of the ADF, DFGLS and KPSS testing principles in level and first differences performed on all the countries while the lag length is tabulated in the parenthesis. At the glance, it is observed that the calculated ADF statistics are small and less than their critical values, suggesting that the variables are not level stationarity for all the cases (see Panel A). Similarly, based on the DFGLS test, the null hypothesis of nonstationarity cannot be rejected in favor of the alternative in all cases. In addition, this finding is corroborated by the η_μ and η_τ of the KPSS statistic which strongly rejects the *I(0)* null at 95 percent confidence level (columns 4 and 5). Rejecting the null hypothesis in the KPSS test reveals that the variable under investigation is non-stationary or contains a unit root in level.

Next, we examined the first difference of the series as reported in Panel B, Table 1. All the testing principles support the hypothesis of fiscal position in each of the countries being stationary after taking first difference. Specifically, the ADF and DFGLS statistics strongly reject the unit root null in favor of stationary while the KPSS statistics further strengthened this conclusion by failing to reject the null hypothesis null at 95 percent confidence levels, contain a realization of an *I(1)* stochastic process or a unit root specification.

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[10] The liberal sequential testing strategy leads to a better size-power trade off in the subsequent inferences in the univariate framework (Ng and Perron, 1995). Furthermore, Ng and Perron (1995) discuss the advantage of recursive *t*-statistic method over the alternative procedure where k is chosen to minimize the Akaike Information Criterion (AIC).

[Insert Table 1]

Taken together, the integratibility results so far suggest that the studied countries are on an unsustainable path in governing their fiscal position. Nevertheless, the evidence presented so far must be viewed with some caution. While it is possible that shocks to the series are persistent, it may also be indicative of the inability of the single-estimation unit root procedures to discriminate between the conclusion stationary and non-stationary alternatives (see Shiller and Perron, 1985). To overcome this problem, we created a panel data set from the Asian-10 countries to re-examine the stationarity of the series and the findings are reported in the next section.

4.3 Panel Unit Root and Stationary Evidence

We summarized the panel unit root and stationarity findings in Table 2. In Panel A, the IPS, HT, MW and UB tests are rejected at conventional significant level. Consistently, we also found the evidence of stationarity in Panel B that includes individual effects and trends in the model specification.

To test for the robustness of these tests, we conducted the HADRI stationarity panel unit root test. From Table 2, the null hypothesis of stationarity is not been rejected. This is shown using the probability of p-values under both model specifications. Rejecting the null hypothesis for IPS, HT, MW, UB procedures while failing to reject the null hypothesis for HADRI test imply that the fiscal position are indeed stationary in level or follows an *I(0)* process. This inference so far, supports the mean-reverting property of the Asian-10 countries fiscal positions and they are indeed on the sustainable path for the period of 1970-2003.

[Insert Table 2]

4.4 SURADF Evidence

A pitfall of these panel unit root tests is that it biased towards stationarity if only one or few series in the panel are strongly stationary leading to erroneous conclusion that the whole panel are stationary (Taylor and Sarno, 1998 and Breuer *et al*., 2001). They added that these panel unit root tests are meaningful only when the univariate tests fails to reject the unit root null. As reported earlier, we found the evidence that all the individual univariate unit root tests are indeed the realization of an *I(1)* process. In this case, we do not exclude any countries for the SURADF estimation.

Furthermore, they demonstrated that the probability of stationarity for the panel increased as the number of *I(0)* composition increased within the panel. One way to resolve the ambiguity is to apply more powerful test. In this sense, we turn to the SURADF test, a test shown by Breuer *et al.* (2001, 2002) to perform well with a mixed order of integration in the panel and then tests for individual unit roots within the panel. As reported in Table 3, the null of non-stationarity is rejected in only four countries from ten Asian countries – Korea, Malaysia, Singapore and Thailand at the 10 percent significance level. There is little evidence to support the sustainability of fiscal position in the Asian-10 countries.

Indeed, the empirical evidences are in sharp contrast compared to Table 2. This is not surprising as the earlier panel unit root procedures are based on a joint test of the null hypothesis while the SURADF tests each member country individually within a system approach. In our view, the earlier panel based unit root test built upon the joint testing principles fail to account for heterogeneity among the panel members. Such the joint tests also maybe uninformative for the researcher as the rejection of the null hypothesis will not help to determine how many or which of the series in the panel are stationary. Hence, they maybe quite misleading in that while increasing the number of series in the panel will undoubtedly increase the power of the test, it will also increase the probability of adding a subset of stationary series to the panel members that may leads to the falsely conclusion of stationarity for the whole panel.

5. Conclusion

Sustainable of fiscal position represents a stable state in which the deficit generates no forces of its own to change its trajectory and been able to generate necessary funds by borrowing. Although such a policy is feasible in the short run, the ability of the economy to service its debt by resorting to further borrowing in the long run is likely to be questioned once the deficit becoming persistent. In this sense, unsustainability of fiscal deficit can pose serious threat on the prospect for long-term growth.

In contrast to most previous empirical analyses, this paper presents an alternative test procedure that exploits the power of the panel data analysis without imposing uniformity across the panel under either the null or the alternative hypotheses for the mean-reversion pattern of fiscal positions in ten Asian countries. We also employ numbers of alternative panel unit root tests and univariate estimators in effort to obtain inferences that are robust to problems associated with non-stationary macroeconomics data.

The empirical analysis leads to the following conclusions. First, the univariate unit root and stationarity tests reveal the evidence of non-stationary fiscal positions for all the Asian-10 countries. Second, by adopting the *commonly used* panel unit roots techniques, we found the favorable evidence of mean-reverting behavior for the cluster of Asian-10 countries. This contradicting finding could be attributed to the low statistical power of the univariate unit root procedures. Third, using the series specific unit root test for the panel data, we found that four countries (Korea, Malaysia, Singapore and Thailand) are on sustainable path in governing their fiscal policies. For the remaining countries, we find the evidence of violation of the government intertemporal budget constraint. This finding also suggests that the stationary of the panel extracted from the *commonly used* panel unit roots techniques are driven by a small number of countries in the panel.

The growing of fiscal imbalances in the post-crisis period for most of Asian countries could put upward pressure on interest rates, the demand for domestic assets fall, the currency appreciate and widens the external deficit — what economists refer as the twin deficit hypothesis. These further cause the macroeconomic imbalances and retard the long-term economic progress of a country (Edwards, 2001 and Megarbane, 2002). One viable option that these countries could adopt is fiscal consolidation and prudent fiscal policies for reducing public debt, improving operation of monetary and exchange rate policies and facilitating private sector-led growth. Consolidation in fiscal policy assists long-term growth since countries with low deficits and debt levels can exercise more options over expenditure priorities and allocate more resources to productive sectors. The effectiveness in managing the public policy would stabilize and stimulate the economy as a whole.

Therefore, assessing, monitoring, maintaining and sustaining stable fiscal imbalances are a prerequisite condition for the macroeconomic stability and sustainability of an economy. With the increasing interest of interdependence in Asian region, the government fiscal financial strategy is an important information for the evaluating the characteristic for suitability toward a greater degree of economic and monetary cooperation while promoting long run sustainable growth among the country members.

Table 1: Univariate Unit Root and Stationary Findings

Country	**Test statistics**					
	t_μ	t_τ	η_μ	η_τ	τ_μ	τ_τ
			A: Level			
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)
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)
Nepal	-2.037 (1)	-1.448 (1)	0.620 (1)*	0.369 (1)*	-1.250 (2)	-1.374 (2)
Pakistan	-2.431 (2)	-2.866 (2)	0.790 (2)*	0.225 (2)*	-1.403 (5)	-1.846 (5)
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)
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)
			B: First Differences			
Δ(India)	-5.431 (3)*	-5.342 (3)*	0.124 (1)	0.079 (1)	-4.312 (1)*	-4.603 (1)*
Δ(Indonesia)	-3.835(3)*	-3.774 (3)*	0.046 (1)	0.034 (1)	-3.537 (3)*	-3.864 (3)*
Δ(Korea)	-5.883 (1)*	-5.723 (1)*	0.052 (1)	0.047 (1)	-6.049 (4)*	-5.930 (4)*
Δ(Malaysia)	-4.026 (2)*	-3.949 (2)*	0.061 (1)	0.053 (1)	-4.624 (2)*	-5.893 (2)*
Δ(Nepal)	-3.827 (1)*	-4.144 (1)*	0.035 (1)	0.038 (1)	-3.481 (2)*	-3.986 (2)*
Δ(Pakistan)	-4.665 (2)*	-4.895 (2)*	0.077 (2)	0.053 (2)	-6.061 (5)*	-7.473 (5)*
Δ(Philippines)	-4.839 (1)*	-4.811(1)*	0.053 (1)	0.051 (1)	-4.447 (2)*	-4.376 (2)*
Δ(Singapore)	-5.593 (1)*	-5.840 (1)*	0.052 (2)	0.053 (2)	-8.948 (1)*	-8.189 (1)*
Δ(Sri Lanka)	-4.633 (1)*	-4.550 (1)*	0.036 (1)	0.034 (1)	-4.164 (1)*	-4.621 (1)*
Δ(Thailand)	-4.791 (1)*	-4.728 (1)*	0.059 (3)	0.043 (3)	-4.739 (3)*	-4.736 (3)*

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. Asterisk (*) shows significance at 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. Δ denotes first different operator. All the estimations of the testing principles here are done in E-Views version 5.0.

Table 2: Panel Unit Root and Stationary Findings

	Test Statistics				
	IPS	**HT**	**MW (Fisher-ADF)**	**UB-t**	**HADRI**
A: Model Specification: Individual Effects					
Asian-10	-3.085 (0.001)	-7.814 (0.000)	41.549 (0.000)	-2.436 (0.007)	0.915 (0.180)
B: Model Specification: Individual Effects and Individual Linear Trends					
Asian-10	-2.137 (0.016)	-15.870 (0.000)	34.770 (0.021)	-2.638 (0.004)	0.687 (0.246)

Notes: IPS, HT, UB and HADRI indicated the Im *et al.* (2003), Harris and Tzavalis (1999), Breitung (2000) and Hadri (2000) represented the panel unit root 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-stationary while HADRI tests the stationary null hypothesis. Asian-10 includes the ten individual fiscal positions grouped into one panel with sample N=10, T=34. The parenthesized values are the probability of rejection. The estimation and the calculation of the IPS, HADRI, UB and MW (Fisher-ADF) panel procedures were carried out in E-Views version 5.0 while HT are conducted using GAUSS with the Nonstationary Panel Time Series (NPT) version 1.3 provided by Chiang and Kao (2002). Probabilities for the MW (Fisher-ADF) test are computed using an asymptotic χ^2 distribution while the other tests follows the asymptotic normal distribution.

Table 3: SURADF Estimation and the Critical Values

Country	Test Statistics	Critical Values		
	SURADF	0.01	0.05	0.10
India	-3.619 (1)	-6.725	-5.324	-3.924
Indonesia	-3.168 (1)	-6.817	-5.428	-4.054
Korea	-5.340 (1)*	-5.837	-4.462	-3.752
Malaysia	-4.557 (1)*	-6.934	-5.549	-4.210
Nepal	-3.214 (3)	-6.717	-5.823	-4.511
Pakistan	-3.322 (1)	-6.374	-4.846	-3.601
Philippines	-1.690 (3)	-5.755	-4.319	-3.468
Singapore	-4.561 (3)*	-6.084	-5.143	-3.447
Sri Lanka	-3.331 (1)	-6.785	-5.394	-3.989
Thailand	-4.458 (1)*	-6.380	-4.754	-3.481

Note: The column of SURADF refers to the estimated Augmented Dickey-Fuller statistics obtained through the SUR estimation of the Asian-10 ADF regression. Each of the estimated equation excludes a time trend. The three right-hand-side columns reported the estimated critical values tailored by the simulation experiments based on 34 observations for each series and 10000 replications, following the work by Breuer *et al.* (2002). The error series were generated in such a manner to be normally distributed with the variance-covariance matrix given from the SUR estimation of the Asian-10 panel structures. Each of the simulated fiscal position was then generated from the error series using the SUR estimated coefficients on the lagged differences. (*) denote statistically significance at the 0.10 level. Figures in parentheses indicate the lag length. The estimations and the calculation of the SURADF were carried out in RATS 5.02 using the algorithm kindly provided by Myles Wallace.

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