The sustainability of Fiji's budget deficit: an econometric analysis

Paresh Kumar Narayan and Seema Narayan

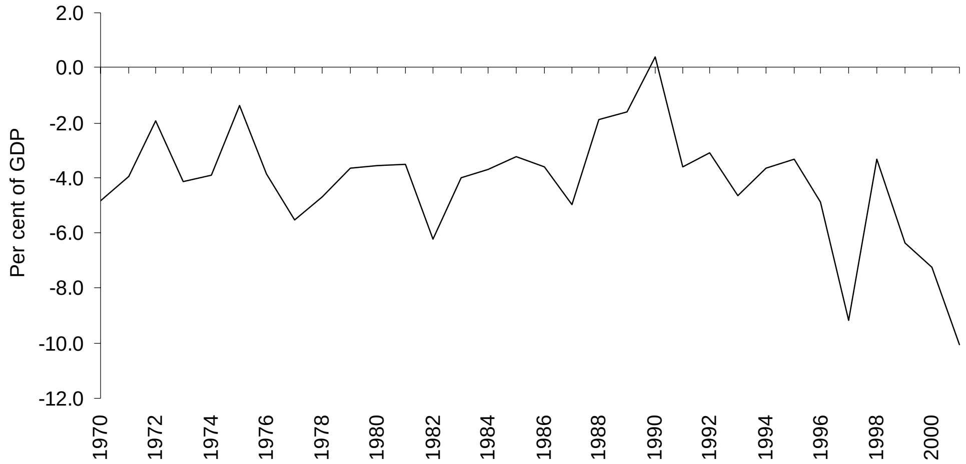
The sustainability of Fiji's budget deficit is examined here within the framework of inter-temporal budget constraint theory, where government revenue is modelled as a function of government expenditure. An error-correction mechanism test for cointegration finds that government revenue and expenditure are cointegrated, which provides some support for the position that Fiji's budget deficit is sustainable in the long run. It is argued that more government expenditure on capital investment will ensure a broader revenue base and reduce the risk of a budget deficit explosion.

Paresh Kumar Narayan and **Seema Narayan**, Department of Economics, Monash University.

The behaviour of a country's budget deficit has been an important topic in macroeconomics since Hamilton and Flavin's (1986) article. It is seen as a key indicator of a country's economic performance. In this light, the behaviour of the budget deficit is of interest to both policymakers and investors. Temporary budget deficits present few problems as the imbalances may be the result of dealing with a recession or a natural disaster, or some other short-term event. However, large and expanding budget deficits pose a problem that is likely to induce a policy response, such as tighter fiscal policies in the form of expenditure restraints.

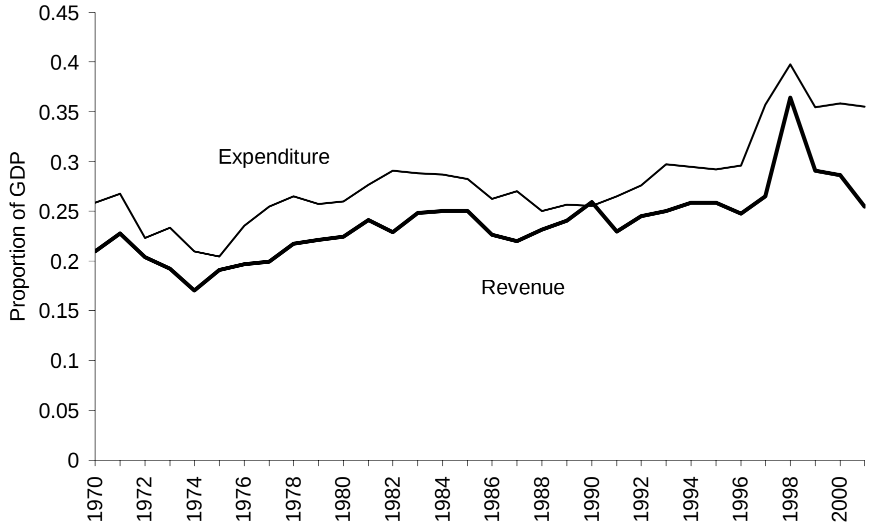
Essentially, the concern with budget deficits relates to the inter-temporal solvency condition, that is, the present value of debt of different maturities. If, for instance, expenditure (including interest payments) and revenue are not moving together over the long run, the government will have an incentive to default on the debt, eroding the confidence of investors. Given that Fiji's budget has been in deficit for a long period (see Figures 1 and 2), we investigate whether the deficits are 'too large'. Fiji's budget has been in deficit except for 1990. Over the 1970–89 period the budget deficit was fairly stable, fluctuating between –1.5 per cent and –6.0

Figure 1 **Fiji's real budget deficit as a proportion of real GDP, 1970–2001** (per cent of GDP)



Source: Reserve Bank of Fiji, *Quarterly Review*, Suva (various issues); International Monetary Fund, *International Financial Statistics*, Washington, DC (various issues).

Figure 2 **Fiji's total expenditure and revenue as a proportion of GDP, 1970–2001** (proportion of GDP)



Source: Reserve Bank of Fiji, *Quarterly Review*, Suva (various issues); International Monetary Fund, *International Financial Statistics*, Washington, DC (various issues).

per cent of real GDP. However, in the post 1989 period there has been a sharply increasing trend in the budget deficits. Does the behaviour of the deficit indicate boundless growth of government debt? The answer to this question will give an indication whether Fiji's budget deficits are sustainable over the long run.

In answering the above question, this study differs from previous studies in four ways. First, we investigate budget deficit sustainability for a small developing economy for the first time, hence the results could add to the understanding of deficit sustainability. For instance, without detailing all the empirical results we find that despite a period (1987–2001) of sustained political instability in Fiji, the budget deficit has not exploded to unmanageable proportions. Except for a study on Taiwan (Wu 1998), all previous studies of the sustainability issue covered developed countries. Second, we use a test for cointegration not used previously in the literature. We use the error correction mechanism (ECM) test of Banerjee et al. (1998) as extended by Pesaran et al. (2001). The test has been shown to function efficiently in small sample sizes such as in the present study. As a check on the robustness of the results we also apply the conventional Engle and Granger (EG) (1987) test for cointegration. Third, we depart from the previous literature in that, to ascertain the robustness of the long-run results, we use four different estimators: the autoregressive distributed lag (ARDL) approach advocated by Pesaran and Pesaran (1997); the dynamic ordinary least squares (DOLS) approach proposed by Stock and Watson (1993); the Phillips and Hansen (1990) fully modified (PHFM) ordinary least squares approach; and the Engle and Granger (1987) ordinary least squares approach. Fourth, we are explicitly concerned about the stability of the long-run model. Some recent studies (Liu and Tanner 1995; Bravo and Silvestre 2002) on the sustainability of budget deficits have assumed that the parameters are stable. However, we believe that parameter stability is an empirical issue that warrants investigation. To accomplish this task we use the Hansen (1992) suite of tests for parameter stability.

The paper presents the empirical results of tests of government revenue and expenditure for unit roots for the 1970–2001 period. To ascertain whether the two variables are integrated, the Augmented Dickey and Fuller (ADF) (1979, 1981) and the Phillips and Perron (PP) (1988) tests are used. This is a crucial step, for the application of the cointegration tests and the derivation of the long-run estimators require all variables to be integrated of order one. Once we have established that the variables are integrated of order one, we use the ECM and EG tests to examine the extent of cointegration between the two variables. Implications are then drawn from the results about the sustainability of Fiji's budget deficits.

Overview of the literature

The bulk of the literature on the sustainability of budget deficits is concerned with the US economy (see, *inter alia*, Hamilton and Flavin 1986; Wilcox 1989; Kremers 1988, 1989; Trehan and Walsh 1988, 1991; Husted 1992; Haug 1991, 1995; Tanner and Liu 1994). Hamilton and Flavin (1986) investigated the long-run relationship between government revenue and government expenditure over the 1962–84 period. They found that the deficit follows a stationary stochastic process, consistent with the sustainability of the deficit—the idea that government satisfies (is able to live within) its inter-temporal budget constraint. However, Wilcox (1989) extended Hamilton and Flavin's model by allowing for a non-constant real interest rate and stochastic violations of the borrowing constraint and found that US fiscal policy was unsustainable. Studies following

Hamilton and Flavin (1986) and Wilcox (1989) were more sophisticated in that they used cointegration tests in investigating the deficit issue. Trehan and Walsh (1988) used a longer span of data (1890–1983) than previous studies and modelled the US government's borrowing constraint within the context of cointegration techniques. They reached the conclusion that government expenditure and revenue do have a long-run relationship in the United States. However, the authors cautioned about the low power of their cointegration test.

Hakkio and Rush (1991) investigated the deficit sustainability issue for the United States using a long time series and an approach based on the Engle and Granger (1987) cointegration test. Hakkio and Rush were concerned about the effects of possible breaks in the data. To this end, they contended that it is important to consider whether government expenditure and revenue are cointegrated over sub-periods. They found cointegration for the whole period of their analysis but not for the sub-period starting from the mid 1970s.

The most recent research on US budget deficit sustainability has been carried out by Tanner and Liu (1994). They distinguished their analysis from previous studies by allowing for shifts in the intercept terms of the cointegration and stationarity tests. By allowing for shifts they intended to capture any breaks in the fiscal process. Their results show that in the presence of breaks, expenditure and revenue are cointegrated with a coefficient not statistically different from unity. On the basis of their results they conclude that the US government does not violate its inter-temporal budget constraint.

Apart from the studies on the United States economy, others have investigated the sustainability issue for some European countries, Canada and Taiwan. Bravo and Silvestre (2002) searched for evidence of budget deficit sustainability for ten European countries based on the Engle and Granger (1987) and Johansen (1988) and Johansen and Juselius (1990) approaches. They found evidence of cointegration between government revenue and expenditure for only five of the ten countries. None of these countries had a unity coefficient on expenditure, leading the authors to conclude that there was only evidence of a weak form of budget deficit sustainability for five countries, while for the remaining five countries' budget deficits were unsustainable. Smith and Zin (1991) investigated the long-run relationship between government expenditures and revenues for Canada and found evidence consistent with the idea that government was not violating its intertemporal budget constraint. Wu (1998) used the Gregory and Hansen (1996) test for cointegration between government expenditure and revenue in Taiwan and found evidence of cointegration.

Theoretical background

Following Hakkio and Rush (1991), the long-run relationship between government expenditure and revenue in Fiji is examined within the framework that, over time, a government faces a budget constraint. The question is whether in running budget deficits the government violates this constraint on an intermittent or consistent basis. A simple government budget constraint for the period t is given by

$$G_t + (1 + r_t)B_{t-1} = R_t + B_t \qquad (1)$$

where G_t is government spending on goods and services plus transfer payments; $(1+r_t)B_{t-1}$ is the interest payments and principal that must be paid on existing debt; R_t is government revenue; and B_t is the funds raised by issuing new debt.

Collecting the like terms together, the budget constraint (Equation 1) can be written

$$B_t - B_{t-1} = G_t - R_t + r_t B_{t-1} \tag{2}$$

The budget constraint is written as ratios of GDP by dividing both sides of Equation 2 by GDP. The resultant is

$$b_t - b_{t-1} = g_{t-1} - t_t + \frac{r_t - \rho_t}{1+\rho_t} b_{t-1} \tag{3}$$

Here the lower case letters denote the ratio of the corresponding upper-case letters to GDP, and ρ_t is the growth rate between t–1 and t.

Solving Equation 3 forward by combining each single-period budget constraint associated with periods t+1, t+2, t+3…, gives the government's inter-temporal budget constraint

$$b_0 = \sum_{t=1}^{\infty} \mu_t (r_t - g_t) + \lim_{\mu \to \infty} \mu_n b_n \tag{4}$$

where b_0 is the outstanding stock of bonds; and μ_t is the discount factor and

$$\mu_t = \prod_{s=1}^{t} \beta_s \text{ and } \beta_s = 1/(1+i_s).$$

To derive a testable equation, the interest rate is assumed to be stationary with unconditional mean equal to r, and both sides of Equation 3 are added and subtracted with ib_{t-1} to obtain

$$e_t + (1+r)b_{t-1} = r_t + b_t \tag{5}$$

where $e_t = g_t + (r_t - r)b_{t-1}$.

After mathematical manipulation and imposing r_t and e_t to be integrated of order one or I(1), the following regression equation is derived

$$r_t = \alpha + \delta_1 g_t + e_t \tag{6}$$

The necessary condition (weak form) for the economy to satisfy its intertemporal budget constraint is when the error term, e_t, is stationary or if it is integrated of order zero, I(0). On the other hand, in the absence of a cointegration relationship between government revenue and government expenditure the economy is seen as violating its intertemporal budget constraint, and therefore defaults on its debts (see Hakkio and Rush 1991). The absence of cointegration is also a clue that the budget deficit is 'too large' (Tanner and Liu 1994). It follows that evidence of cointegration is tantamount to the budget deficit being sustainable, but only in a weak sense. Deficit sustainability in a weak sense means that the two series—government revenue and government expenditure—are moving together over the long run but the coefficient on government expenditure (given by δ_1 in Equation 6) is less than one. This is the same as saying that to generate one dollar of revenue the economy needs to spend more than a dollar. The amount of revenue generated from a one dollar increase in government expenditure is given by δ_1 in Equation 6. Provided that the two series are moving together (cointegration) the closer the coefficient is to one, the stronger is the sustainability of the budget. Moreover, the empirical results should be considered together with the country's political and economic situation in reaching a conclusion regarding the strength of budget sustainability because a country's expenditure and revenue are contingent on the political and economic climate.

The necessary and sufficient condition (strong form) for the economy to fulfil its intertemporal budget constraint is the existence of a vector (α,δ) such that ε_t is a stationary process[1] and (α,δ)=(0,1). Put differently, if government revenue and government expenditure are cointegrated with cointegrating vector δ=(1,-1), then the economy is perceived as satisfying the strong form of the intertemporal budget constraint in the long run (Hakkio and Rush 1991).

Econometric analysis

Unit roots

To ascertain the order of integration we apply the Augmented Dickey-Fuller (ADF) (1979, 1981) and Phillips and Perron (PP) (1988) unit root tests. Testing for the presence of unit roots of individual series using the ADF test is based on the auxiliary regression

$$\mu_t \qquad (7)$$

The ADF auxiliary regression tests for a unit root in y_t, where y_t is each of the variables in the models 1 and 2, at time t; t denotes the deterministic time trend; Δy_{t-1} is the lagged first differences to accommodate serial correlation in the errors, μ_t; and α, δ, β and ψ are the parameters to be estimated. The null and the alternate hypotheses for a unit root in y_t are

$$: \beta = 0$$

$$: \beta < 1$$

While relevant critical values are available from various sources, we use the approximate critical values compiled by MacKinnon (1991).

To ensure the robustness of the ADF test results, we also apply the PP test for unit roots. The PP test is also based on Equation 7, but without the lagged differences. While the ADF test corrects for higher order serial correlation by adding lagged difference terms to the right-hand side, the PP test makes a non-parametric correction to account for residual serial correlation. Monte Carlo studies suggest that the PP test generally has greater power than the ADF test (see Banerjee et al. 1993:113).

Cointegration

The Error Correction Mechanism (ECM) test for cointegration: The main advantage of the ECM test is that it has a limit distribution that does not depend on nuisance parameters. Thus, it does not suffer in finite samples from possibly invalid common factor restrictions. Banerjee et al. (1998) show that when other popular cointegration tests such as the Johansen (1988), Johansen and Juselius (1988, 1990) and Hansen (1990) approaches are exposed to invalid restrictions, the power properties of these tests may be very poor in comparison with the ECM test, which does not impose those restrictions. The ECM test can be described using a simple data-generating process (Banerjee et al. 1998)

(8)

(9)

where α, λ and x_t are $k\times1$ vectors of parameters and explanatory variables. The regressand y_t is a univariate process, β is a scalar and T is the sample size. Here, the tests for cointegration rely upon an estimate of the parameter β. Under the assumption that x_t is strictly exogenous, non-linear least squares (NLS) can be applied to Equation 8, producing consistent and asymptotically efficient estimates of α, β and λ. However, it has been shown by Banerjee et al. (1993) that by adding x_{t-1} to Equation 8 one can achieve a parameter-free distribution for the estimator of β. Then ordinary least squares (OLS) can be used to estimate β. This is because under the alternative hypothesis of cointegration, the true cointegrating slope λ is implicitly estimated when x_{t-1} is included as an additional regressor. In order to correct for serial correlation, Banerjee et al. (1998) follow the recommendation in Phillips and Loretan (1991) to augment the model with leads of

Δx_t. Thus, it follows that an unrestricted dynamic model can be specified which takes the form

$$\Delta y_t = \lambda' \Delta x_t + \beta y_{t-1} + \theta' x_{t-1} + \sum_j^n \alpha_j \Delta x_{t+j} + \epsilon_t = \alpha' \Delta x_t + \phi' w_{t-1} + \sum_j^n \alpha_j \Delta x_{t+j} \in_t \qquad (10)$$

where $w_t' = (y_t, x_t')$ and $\phi' = (\beta, \theta')$. Since $\beta(1-\lambda') = \phi'$, the non-cointegrating restriction β=0 implies θ=0 and so the ECM test can be based upon either the OLS estimator of β in Equation 10 or on its *t* ratio. Banerjee et al. (1998) show that the t-ratio form of the ECM test may have better power properties than the normalised bias form, particularly when the common-factor restrictions are grossly violated. The approximate critical values for the t-test are provided in Pesaran et al. (2001). Pesaran et al. (2001) develop a bounds testing procedure whereby the asymptotic distribution of their statistics is obtained for cases in which all regressors are purely $I(1)$ as well as when the regressors are purely $I(0)$ or mutually cointegrated.

Engle and Granger test for cointegration: The first step in this test involves estimating the potential cointegrating relationship between two variables x_t and y_t using the regression model

$$y_t = \eta_0 + \eta_1 x_t + \xi_t \qquad (11)$$

The second step is to examine the stationarity properties of the OLS residuals from Equation 11. Denote OLS residuals by $\hat{\xi}$, so that $\hat{\xi} = y_t - \hat{\eta}_0 - \hat{\eta}_1 x_t$, where $\hat{\eta}_0$ and are the OLS estimates of and . If the residuals from the cointegrating regression are stationary, this indicates that y_t and x_t are cointegrated with cointegrated vector $(1, -\eta_1)$. Engle and Granger (1987) use the ADF test to detect the stationarity properties of the residuals. The ADF statistic is employed to test whether the estimated residual, e_t, is stationary and is based on

$$\Delta\hat{\xi}_t = \phi\hat{\xi}_{t-1} + \sum_{i=1}^{k} \psi_i \Delta\hat{\xi}_{t-1} + \mu_{tk} \qquad (12)$$

We use the general-to-specific procedure to select the lag length for the ADF cointegration test.

Long-run estimators

ARDL: To estimate the long run elasticities we use the augmented autoregressive distributed lag (ARDL) model. The ARDL $(p, q_1, q_2, ..., q_k)$ model can be written as follows (Pesaran and Pesaran 1997; Pesaran et al. 2001)

$$\Omega(L,p)y_t = \alpha_0 + \sum_{i=1}^{k} \beta_i(L,q_i)x_{it} + \delta' w_t + \mu_t \qquad (13)$$

where

$$\Omega(L,p) = 1 - \Omega_1\delta_1 L^1 - \Omega_2\delta_2 L^2 - ... - \Omega_p L^p, \qquad (14)$$

$$\beta_i(L,q_i) = \beta_{io} + \beta_{i1}L + \beta_{i2}L^2 + ... + \beta_{iqi}L^{qi}$$
$$i = 1,2,\ldots,k \qquad (15)$$

Here, y_t is the dependent variable; α_0 is a constant; L is a lag operator such that $Ly_t = y_{t-1}$ and w_t is a $s \times 1$ vector of deterministic variables such as seasonal dummies, time trends, or exogenous variables with fixed lags. The x_{it} in Equation 13 is the i independent variable where i=1,2,…,k. In the long-run, we have

$$y_t = y_{t-1} = ... = y_{t-p};$$

$$x_{it} = x_{i,t-1} = ... = x_{i,t-q}$$

where $x_{i,t-q}$ denotes the q^{th} lag of the i^{th} variable.

The long-run equation with respect to the constant term can be written as follows

$$y = \alpha_o + \sum_{i=1}^{k} \beta_i x_i + \delta' w_t + v_t$$

$$\Omega = \frac{\alpha_0}{\Omega(1,p)} \tag{16}$$

The long-run coefficient for a response of y_t to a unit change in x_{it} is estimated by

$$\beta_i = \frac{\hat{\beta}_i(1,\hat{q}_i)}{\hat{\Omega}(1,\hat{p})} = \frac{\hat{\beta}_{i0} + \hat{\beta}_{i1} + \ldots + \hat{\beta}_{i\hat{q}}}{1 - \Omega_1 - \hat{\Omega}_2 - \ldots - \hat{\Omega}_{\hat{p}}},$$

$$i=1,2,\ldots,k \tag{17}$$

Here, $\hat{p}$ and , i=1,2,…,k are the selected (estimated) values of p and q_i, i=1,2,…,k. Similarly, the long-run coefficients associated with the deterministic/exogenous variables with fixed lags are estimated by

$$\hat{\delta} = \frac{\hat{\delta}(\hat{p},\hat{q}}{1-\hat{\Omega}_1 -} \tag{18}$$

Here, $\hat{\delta}(\hat{p},\hat{q}_1,\hat{q}_2,...,\hat{q}_k)$ denotes the ordinary least squares estimate of δ in Equation 13; the selected ARDL model. The error correction (EC) representation of the ARDL $(\hat{p},\hat{q}_1.\hat{q}_{2,...,}\hat{q}_k)$ model can be obtained by writing Equation 13 in terms of the lagged levels and the first differences of $y_t, x_{1t}, x_{2t,...}, x_{kt}$ and w_t

$$\Delta y_t = \Delta\alpha_0 - \sum_{j=1}^{\hat{p}-1} \Omega_j^* \Delta y_{t-j} + \sum_{i=1}^{k} \beta_{i0} \Delta x_{it}$$

$$- \sum_{i=1}^{k} \sum_{j=1}^{\hat{q}_i - 1} \beta_{ij}^* \Delta x_{i,t-j}$$

$$+ \delta' \Delta w_t - \Omega(1,\hat{p}) ECM_{t-1} + \mu_t \tag{19}$$

Dynamic ordinary least squares (DOLS): The procedure advocated by Stock and Watson (1993) involves estimation of long-run equilibria via dynamic OLS (DOLS), which corrects for potential simultaneity bias among regressors. It resembles the ideas inherent in Hansen (1988), Phillips and Loretan (1991), Phillips and Hansen (1990), Saikkonen (1991) and Park (1992). DOLS entails regressing one of the I(1) variables on other I(1) variables, the I(0) variables, and lags and leads of the first differences of the I(1) variables. The essence of incorporating the first difference variables and the associated lags and leads is to obviate simultaneity bias and small sample bias inherent among regressors. Standard hypothesis testing can be undertaken using robust standard errors derived via the procedure recommended by Newey and West (1987).

The DOLS is based on an alternative representation of the system which assumes the following particular *a priori* normalisation that can be obtained in any system with r cointegrating vectors

$$\Delta X_t^1 = \kappa_t^1$$

$$X_t^2 = \Phi_0 + \Phi X_t^1 + \kappa_t^1 \tag{20}$$

where $x_t' = [x_t^{1'} | x_t^{2'}]$, the dimensions of X_t^1 and X_t^2 being $(p-r)\times 1$ and $(r \times 1)$, respectively. The error processes are deemed stationary and by incorporating both leads and lags of ΔX_t^1 in Equation 20 and estimating the normalised cointegrating vectors, ϕ, by OLS, one can obtain an estimator asymptotically equivalent to MLE.

Fully Modified OLS (FMOLS): The procedure, developed by Phillips and Hansen (1990), has two direct advantages. Apart from correcting for endogeneity and serial correlation effect it also asymptotically eliminates the sample bias. There are two conditions considered essential for the appropriateness of the FMOLS. First, there is only one integrating vector. Second the explanatory variables are not cointegrated among themselves. Assuming these provisions are met, the econometric model is of the following form

$$y_t = \sigma_0 + \sigma_1' X_t + \mu_t,\ t = 1,2,\ldots,n \qquad (21)$$

where y_t is an $I(1)$ variable and X_t is a (k×1) vector of $I(1)$ regressors that are not cointegrated among themselves. By assumption, x_t has the following first difference stationary process

, (22)

where η is a k×1 vector of drift parameters, λ_t is a k×1 vector of $I(0)$ variables. It is also assumed that is strictly stationary with zero mean and a finite positive-definite covariance matrix, Σ.

Empirical results

The empirical analysis covers the period 1970-2001. The sample size is dictated by data availability. While data on GDP are available from 1965, data on government revenues and expenditures are only available from 1970. All data are sourced from the International Monetary Fund publication, *International Financial Statistics* and the Reserve Bank of Fiji publication, *Reserve Bank of Fiji Quarterly Reviews*. The empirical results are produced using GAUSS 5.0, EVIEWS 4.1 and MICROFIT 4.0.

Table 1 reports the results of the unit root tests. The ADF and PP statistics for the levels of government expenditure as a proportion of Gross Domestic Product (GDP) and government revenue as a proportion of GDP, [*E,R*], do not exceed the critical values (in absolute terms) at the 1 per cent level of significance. However, when we take the first differences of the variables, the ADF and PP statistics are higher than the respective critical values (in absolute terms) at the 1 per cent level of significance. Therefore, we conclude that [*E,R*] are integrated of order one or $I(1)$.

After establishing that both the revenue and expenditure series are integrated of order one, we proceeded with the testing of cointegration relationships between the variables. The results from the ECM and EG cointegration tests are reported in Table 2. There is agreement between the two approaches that there is one cointegrating relationship between government revenue and expenditure at the 1 per cent level of significance. Visual inspection of the data series also indicates co-movement (Figure 2). This leads us to believe that Fiji satisfies the necessary condition of its intertemporal budget constraint.

Once it is established that government expenditure and revenue are cointegrated, the long run coefficient is estimated. The four estimators provide comparable results with the coefficients falling well short of unity. For instance, the results suggest that for every dollar spent by government, the revenue generated is around 0.70 cents. All results are statistically significant at the 5 per cent level or better. Evidence from the long run estimators suggests that Fiji fails to satisfy the sufficient condition of the intertemporal budget constraint. All in all, these results indicate Fiji's ability to satisfy the weak form of the budget constraint but not the strong form.

Constancy of the cointegration space

Hansen (1992) and Pesaran and Pesaran (1997) caution that estimated parameters of a time series may vary over time. Parameter tests are important, since unstable parameters can result in model misspecification, which has the potential to bias the results. To investigate parameter stability we use the Hansen tests.

Figure 1 **Unit root tests**

Variables	ADF statistic	Lag length	ADFCV	PP statistic	Bandwidth	PPCV
R_t	–2.2349	-	–2.9604	–2.1558	2	–2.9604
ΔR_t	–4.6189	2	–2.9781	–11.2357	18	–2.9640
	–2.7768	-	–2.9604	–0.8018	2	–2.9604
ΔE_t	–5.2190	-	–2.9639	–5.2307	5	–2.9639

Source: Authors' calculations.

Table 2 **Tests for cointegration—ECM test and Engle-Granger test**

1. Engle-Granger Test to cointegration

	10 per cent	5 per cent	1 per cent
Critical values	3.134	3.479	4.198
	(R/E)	(E/R)	
ADF statistic	–4.3940	–3.6616	

E_t

2. ECM test

Critical values	10 per cent		5 per cent		1 per cent	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
	–2.57	–2.91	–2.86	–3.22	–3.42	–3.82
	(R/E)		(E/R)			
Test statistic	–4.7855		–3.0002			

Source: Authors' calculations.

Table 3 **Long run results: dependent variable: R_t**

Methodology	Coefficient on G_t	T-statistics
ARDL	0.7098**	2.0196
DOLS	0.7162***	12.5413
P-H	0.6959***	10.1833
E-G	0.7148***	10.5712

Note: ** denotes statistical significance at the 5 per cent level and *** denotes statistical significance at the 1 per cent level.
Source: Authors' calculations.

Hansen (1992) proposes three tests—*SupF*, *Mean F* and L_C— as valid for $I(1)$ processes that all have the same null hypothesis, but differ in their choice of alternative hypothesis. The *Sup F* test is predicated on ideas inherent in the classical Chow *F*-tests. The alternative hypothesis is a sudden shift in regime at an unknown point in time, and amounts to calculating the Chow *F*-statistic. This test statistic takes the following form $SupF=SupF_{t/T}$, where $F_{t/T}$ is the F-test statistic. To perform the *Sup F* test requires truncation of the sample size *T*. We follow the approach in Hansen (1992) and use the subset [0.15*T* , 0.85*T*].

The *Mean F* test is appropriate when the question under investigation is whether or not the specified model captures a stable relationship (Hansen 1992). It is computed as an average of the $F_{t/T}$. Finally, the L_C statistic is recommended if the likelihood of parameter variation is relatively constant throughout the sample.

The results are presented in Table 4. None of the test statistics allow us to reject the null hypothesis of parameter stability. In all the cases the test statistics exceed the 0.05 probability value, indicating no structural breaks in the parameters.

Conclusion

It is usually not difficult for a government to finance a short-term budget deficit. This can be achieved by either borrowing from domestic sources or from abroad, or from a combination of both. The debt, however, will be a burden on future generations in the form of higher taxes. Another avenue for financing a deficit is by increasing the money supply, which will, however, induce an increase in inflation—effectively a form of tax). Selling bonds to the public is also a possibility but, similar to domestic borrowing, this will curtail the funds available for domestic private investment. Substantial concerns arise, however, when the deficits persist and increase. In this case, the ability of the country to service its debts becomes a matter of concern for investors and policy makers. Unsustainable budget deficits signal to investors the possibility of higher taxes or even a financial crisis. From a policy point of view, high and growing budget deficits point to the need for fiscal tightening.

Given the importance of the subject matter, we were motivated to investigate the sustainability of budget deficits in Fiji. We tested for cointegration using the ECM test and found that government revenue and government expenditure are cointegrated over the 1970–2001 period. The finding of cointegration is an indication of 'weak' sustainability of the budget deficits. Empirical evidence supporting a 'strong' form of sustainability is when there is evidence of cointegration between government expenditure and revenue and the coefficient on the expenditure variable is unity. Our results, based on four different estimators of the long run coefficient, failed to find a coefficient of unity. The results suggest that for every dollar spent by government, the revenue generated is around 0.70 cents; hence, we do not find strong evidence that Fiji's budget deficit is sustainable over the long run. There is a danger that the budget deficit could explode if government's revenue performance is not improved or if a large part of government expenditure is going towards unproductive investment. It is true that for a politically and economically stable economy,

Table 4 **Hansen stability test**

	L_C	$Mean_F$	Sup_F
Test statistic	0.4175	2.9147	6.0552
Probability	0.0684	0.1843	0.2000

Source: Authors' calculations.

our results of cointegration and a coefficient of 0.7 would be palatable. However in the case of Fiji, while it is heartening to note that the gap between government expenditure and government revenue has not exploded (as indicated by evidence of cointegration) we are concerned that any adverse economic shocks such as coups will suppress revenues and increase government expenditure, reducing the coefficient from 0.7.[2] We, therefore, caution that Fiji needs to improve on its revenue performance and should endeavour to switch expenditure from consumption to capital items. Fiji's revenue performance has deteriorated, prompting the IMF to recommend an increase in the value added tax from 10 per cent to 12.5 per cent. The IMF policy recommendation was

> …directors [IMF] supported the authorities' [Fiji government's] medium-term fiscal strategy of reducing the government debt-to-GDP ratio to 40 per cent…They recommended that the authorities take early action to reduce the fiscal deficit significantly, working towards a sufficient primary surplus to achieve the consolidation target, and using privatisation proceeds to reduce debt. This will require expenditure restraint, including on wage costs, as well as improved tax collection, while an increase in the value-added tax should be considered to help finance the desired increase in public investment spending (IMF 2002:2).

The recommended increase in the VAT came into effect starting 1 January 2003. The importance of investment to raising economic growth and thus increasing the government's revenue base has been recognised by the Minister for Finance, who, in his 2003 National Budget Address, said

> [e]very year the cost of funding the operations of the public service increases, which leaves less for investing in roads, water and sewerage, construction of new schools, health centres and so on (Kubuabola 2002:28).

Notes

1 A stationary series is one whose mean and variance are not changing over time. This is the same as saying that the series does not have any unit root(s).

2 At least from an economic point of view the most desirable situation for Fiji is to have no coups. The fact that coups are man-made events means they can be avoided. In the light of Fiji's past experience with coups, government revenues fall due to inertia while government expenditures increase due to the need for increasing the police force and military force budgets in order to maintain law and order, reconciliation, etc. It should also be noted that the amount by which the coefficient of 0.7 will fall due to a negative shock (such as coups) will depend on the intensity of the shock. Given the uncertainty regarding the intensity of negative shocks, we are concerned about the sustainability of Fiji's budget deficit.

References

Banerjee, A, Dolado, J.J., Galbraith, J.W. and Hendry, D.F., 1993. *Cointegration, Error Correction and the Econometric Analysis of Non-Stationary Data,* Oxford University Press, Oxford.

Banerjee , A.J., Dolado, JJ. and Mestre, R. 1998. 'Error correction mechanism tests for cointegration in single-equation framework', *Journal of Time Series Analysis*, 19:267–83.

Bravo, A.B.S., and Silvestre, A.L., 2002. 'Intertemporal sustainability of fiscal policies: some tests for European countries', *European Journal of Political Economy*, 18:517–28.

Dickey, D.A. and Fuller, W.A. 1979. 'Distributions of the estimators for autoregressive time series with a unit root', *Journal of the American Statistical Association,* 74:427–31.

——, 1981. 'Likelihood ratio statistics for autoregressive time series with a unit root', *Econometrica*, 49:1057–72.

Engle, R.F. and Granger, C.W.J. 1987. 'Cointegration and error correction representation: estimation and testing', *Econometrica*, 55:251–76.

Gregory, A. and Hansen, B., 1996. 'Residual based tests for cointegration in models with regime shifts', *Journal of Econometrics*, 70:99–126.

Hakkio, C.S. and Rush, M., 1991. 'Is the budget deficit "too large"?', *Economic Inquiry*, 29:425–29.

Hamilton, J. and Flavin, A., 1986. 'On the limitations of government borrowing: a framework for empirical testing', *American Economic Review*, 76:808–19.

Hansen, B.E., 1988. Robust inference in general models of cointegration, Yale University, New Haven (unpublished).

——, 1990. *A powerful, simple test for cointegration using Cochrane-Orcutt*, Working Paper 230, University of Rochester, New York.

——, 1992. 'Tests for parameter stability in regressions with I(1) processes', *Journal of Business and Economic Statistics*, 10:321–35.

Haug, A.A., 1991. 'Cointegration and government borrowing constraints: evidence for the United States', *Journal of Business and Economic Statistics*, 9:97–101.

——, 1995. 'Has federal budget deficit policy changed in recent years', *Economic Inquiry*, 33:104–18.

Husted, S., 1992. 'The emerging US current account deficit in the 1980s: a cointegration analysis', *Review of Economics and Statistics*, 74:159–66.

International Monetary Fund (IMF), 2002. 'IMF concludes 2002 Article IV consultation with Fiji', *Public Information Notice No. 01/101*, September 12, Washington, DC.

Johansen, S., 1988. 'Statistical analysis of cointegrating vectors', *Journal of Economic Dynamics and Control*, 12:231–54.

Johansen, S. and Juselius, K., 1990. 'Maximum likelihood estimation and inference on cointegration with applications to the demand for money', *Oxford Bulletin of Economics and Statistics*, 52:169–210.

Kremers, J., 1988. 'Long run limits on the US federal debt', *Economic Letters*, 28:259–62.

——, 1989. 'US federal indebtedness and the conduct of fiscal policy', *Journal of Monetary Economics*, 29:219–38.

Kubuabola, J.Y., 2002. *2003 Budget Address: securing sustained growth*, Ministry of Finance and National Planning, Suva.

Liu, P. and Tanner, E., 1995. 'Intertemporal solvency and breaks in the US deficit process: a maximum-likelihood cointegration approach', *Applied Economics Letters*, 7:231–35.

MacKinnon, J., 1991. 'Critical values for cointegration tests', in R.F. Engle and C.W. Granger (eds), *Long-run Economic Relationships: readings in cointegration*, Oxford University Press, Oxford:267–76.

Martin, P., 1996. 'The Canadian experience in reducing budget deficits and debts', *Economic Review*, Federal Reserve Bank of Kansas City, 81:11–26.

Newey, W.K. and West, K.D., 1987. 'A simple, positive semi-definite heteroskedasticity and autocorrelation consistent covariance matrix', *Econometrica*, 3:703–8.

Park, J. Y., 1992. 'Canonical cointegrating regressions', *Econometrica,* 60:119–43.

Pesaran, M.H. and Pesaran, B., 1997. *Working with Microfit 4.0: interactive econometric analysis*, Oxford University Press, Oxford.

Pesaran, M.H., Shin, Y. and Smith, R., 2001. 'Bounds testing approaches to the analysis of level relationships', *Journal of Applied Econometrics*, 16:289–326.

Phillips, P.C.B. and Loretan, M., 1991. 'Estimating long-run economic equilibria', *Review of Economic Studies,* 57:99–125.

Phillips, P.C.B. and Hansen, B.E., 1990. 'Statistical inference in instrumental variable regression with I(1) processes', *Review of Economic Studies*, 57:99–125.

Phillips, P.C.B. and Ouliaris, S., 1990. 'Asymptotic properties of residual based tests for cointegration', *Econometrica*, 58:165–93.

Phillips, P.C.B. and Perron, P., 1988. 'Testing for a unit root in time series regression', *Biometrika*, 75:335–59.

Saikkonen, P., 1991. 'Asymptotically efficient estimation of cointegrating regressions', *Econometric Theory*, 7:1–21.

Smith, G.W., and Zin, S., 1991. 'Persistent deficits and the market value of government debts', *Journal of Applied Econometrics*, 6:31–44.

Stock, J.K. and Watson, M., 1993. 'A simple estimator of cointegrating vectors in higher order integrated systems', *Econometrica*, 61:783–820.

Tanner, E. and Liu, P, 1994. 'Is the budget deficit "too large"?: Some further evidence', *Economic Inquiry*, 32(3):511–18.

Trehan, B., and Walsh, C., 1988. 'Common trends, intertemporal budget balance, and revenue smoothing', *Journal of Economic Dynamics and Control*, 12:425–44.

Trehan, B. and Walsh, C., 1991. 'Testing intertemporal budget constraints: theory and application to US federal budget and current account deficits', *Journal of Money, Credit and Banking*, 23:206–23.

Wilcox, D., 1989. The sustainability of government deficits: implications of the present value borrowing constraint, *Journal of Money, Credit and Banking*, 21:291–306.

Wu, J-L., 1998. 'Are budget deficits "too large"?: The evidence from Taiwan', *Journal of Asian Economics*, 9(3):519–28.

Acknowledgments

Helpful comments and suggestions from Professors Russell Smyth, Ron Duncan and Dr Brian Chapman and strong criticisms from an anonymous referee of this journal are acknowledged. Errors and omissions, if any, are our own responsibility.