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Causal Relationships between Current Account Imbalances and Budget Deficits in Pacific Island Countries: A Panel Cointegration Study

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Abstract

Resorting to panel data investigation, this study seeks to test the causal relationships between current account imbalances and budget deficits in Pacific island countries. The study findings are that current account imbalances and budget deficits are cointegrated, although there is no long run causality relationship between current account deficit and budget deficit and money supply. However, in the short run, there is a bi-directional relationship between current account deficit and budget deficit. The study suggests some policy measures.

Keywords: budget deficit, current account deficit, panel data analysis, Pacific island countries.

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I. INTRODUCTION

With a general decline in external aid inflows resulting in decreasing annual budgetary support, ever since the changes in donors' priorities following the end of the Cold War in the late 1980s, Pacific island countries (PICs) have been struggling with stagnant revenues and rigidities in public expenditure. Aside from budget deficits, due to the open nature of their economies, PICs have been experiencing external current account deficits as well. The objective of this paper is to examine the relationship between current account deficits and government budget deficits with a view to obtaining a better appreciation of the relationships for formulating appropriate macroeconomic policies. Due to data constraints, our study is confined to six major PICs, which include Papua New Guinea (PNG) along with three other Melanesian countries (Fiji, Solomon Islands and Vanuatu) and two Polynesian countries (Samoa and Tonga).

The paper is organised as follows: the second section presents the trends in the two deficits experienced by Fiji, Papua New Guinea (PNG), Samoa, Solomon Islands, Tonga and Vanuatu, whereas the third section reviews recent empirical research findings on twin deficits. The fourth section outlines the modeling strategy and the fifth section reports the results of panel data analysis**.** The final section presents the conclusions with policy implications.

II. A REVIEW OF CURRENT ACCOUNT AND BUDGET DEFICITS IN PICs

The selected six PICs present a high degree of diversity in regard to land area and population (Table 1). However, they share many commonalities. The latter include a high degree of dependency on a narrow range of exports with heavy reliance on one or two commodities. Further, all PICs suffer from common structural constraints to growth: communal land tenure system, which restricts the marketability of land as an economic commodity, thereby inhibiting land related activities; isolation from major markets; proneness to natural disasters of all kinds; and external economic shocks. Foreign aid, which formed a proportion of GDP as high as 43% in Samoa and 33% in Vanuatu in 1990, declined over the next twelve years. With decline in aid inflows, budget deficits were high during the five-year period (1990-94). The five-year average budget deficit in Samoa was as high as 10% of GDP (Table 2). The adverse effects of two cyclones of 1991 and 1992 in terms of fall in tax revenue receipts and related rehabilitation expenditures were responsible for Samoa's budget deficits. Reform measures including downsizing government departments and sale and discontinuance of some of the state owned enterprises during 1995-2004 in Samoa improved the fiscal performance (Leigh 2006, Asian Development Bank 2007).

Table 1: Key Indicators of Selected Pacific Island Countries

Pacific Island Countries	Land Area Sq.km	Population ('000) 2004	GDP per capita (US $) 2004	Aid % of GDP 1990	Aid (% of GDP) 2002	Average Growth Rate (%) 1990-1999	Average Growth Rate (%) 2000-2004
Fiji	18,300	840	2,258	3.9	1.8	3.0	2.0
PNG	463,000	5,772	604	12.8	7..2	5.6	2.1
Samoa	2944	184	1,379	42.6	14.5	1.2	4.3
Solomon Islands	28,900	466	636	21.7	11.0	3.8	-2.1
Tonga	748	102	1,678	26.3	16.4	1.6	3.1
Vanuatu	12,200	207	1,151	33.0	11.7	3.9	0.2

Source: ADB (2006), IMF (2006), Jayaraman (2006), UNESCAP (2006)

Table 2: PICs: Budget, Trade and Current Account Deficits(% of GDP)

PICs	Budget Deficit Averages			Trade Deficits Averages			Current Account Deficit Averages			Broad Money Supply (M2)			Growth Rates (in percent)		
	1990-94	1995-99	2000-04	1990-94	1995-99	2000-04	1990-94	1995-99	2000-04	1990-94	1995-99	2000-04	1990-94	1995-99	2000-04
Fiji	3.2	3.2	5.1	14.4	11.6	17.0	2.1	0.2	7.0	55.2	46.5	42.9	2.9	3.0	2.0
PNG	3.7	0.8	1.5	-14.7	-21.0	-26.5	-3.8	-4.6	-4.3	33.5	33.3	23.9	8.9	2.4	2.1
Samoa	10.5	0.2	1.3	68.3	38.7	41.4	13.2	-5.0	0.2	40.2	33.3	38.8	-1.5	3.9	4.3
Solomon Islands	6.1	0.9	5.8	0.9	-2.1	1.1	6.6	-1.1	-1.4	28.3	30.0	29.0	4.2	3.3	-2.1
Tonga	0.0	1.1	1.1	30.0	-2.1	35.1	-1.5	6.7	2.2	26.2	33.8	43.2	1.8	1.4	3.1
Vanuatu	4.6	3.2	2.7	30.3	20.2	23.8	7.2	8.8	4.6	106.4	108.3	104.2	6.7	1.0	0.2

Source: ADB 2006; Authors' calculations

Fiji’s fiscal policies during 1990-1999 were relatively conservative. As a result, the country experienced modest budget deficits. However, expansionary fiscal policies after 2001, as part of countercyclical measures to offset the fall in private sector investment, led to greater levels of budget deficits (D’Hoore 2006). On the other hand, Tonga had a consistent pattern of low fiscal deficits throughout the period (Singh 2006). The Solomon Islands, after recording low budget deficits during 1995-1999, began to incur higher deficits mainly because of fall in revenues after the inter-island based ethnic unrest. Fiscal deficits were much less during 1995-1999 and thereafter, compared to relatively higher deficits during 1990-1995 (Ginting and Porter 2006).

The improved fiscal performance in PNG was due to fiscal consolidation measures (Marciniak 2006). In Vanuatu, fiscal deficits have been hovering around 3% of GDP. Mismanagement of pension funds in the state sponsored Vanuatu National Provident Fund institution in early 1997 and subsequent bailing out measures came in the way of reducing the deficit to a sizeable extent from the previous average level of 4.6% of GDP. Improvements in budgeting and pruning of non-essential expenditures gave rise to a better fiscal performance in the recent five-year period (Creane 2006).

A review of PICs' fiscal performance during last 15 years, despite conscious efforts towards public sector reforms shows that unforeseen exogenous shocks, such as natural disasters including cyclones, and man-made disasters such as political instability in Fiji and Vanuatu, and ethnic and provincial rivalries in the Solomon Islands interrupted the implementation of the ongoing fiscal reform programmes. Consequently, such interruptions endangered the long-term objective of achieving flexibility in terms of running budget surpluses in good years and deficits in lean years.

In regard to external accounts, all PICs experienced deficits with the exception of PNG, which has a wider range of exports including minerals, notably fossil fuel, and natural gas (Browne 2006). PNG was benefited by rise in world prices of mineral exports during this period. For Solomon Islands and Tonga being dependent on agricultural exports, deterioration in their terms of trade led to ever increasing trade deficits. Due to contraction in sugar production since 1996 and consequent fall in its exports as well as discontinuance of garment export quotas to the USA under the Multifibre Arrangement since the end of 2004, Fiji's annual current account deficits were rising in recent years. In the case of Samoa, there has been a marked decline in its limited exports of agricultural products. Although in the case of Samoa and Tonga inward remittances have been a substantial support, imports of both capital and consumer goods have been on the rise, resulting in current account deficits (Asian Development Bank 2007).

III. A Brief Review of Past Empirical Studies

A survey of studies on the linkages between current account deficits in the balance of payments and budget deficits begins with the standard treatment of external current account deficits, which is based on the national accounting identity (Daniel, *et al.*, 2006).

The external current account balance is derived as follows:
$CA = (S_{priv}-I_{priv}) + (S_{pub}-I_{pub})$

where CA = external current account balance;

S_{priv} = private sector savings
I_{priv} = private sector investment
S_{pub} = public sector saving
I_{pub} = public sector investment

While (S_{pub}-I_{pub}) represents the overall fiscal balance, (S_{priv}-I_{priv}) is the private savings and investment balance.

Assuming investment/savings gap remains stable overtime, external current account deficit would be equal to budget deficit. This identity provides a basis for modeling the hypothesised long run relationship between current account trade deficits and budget deficits. However, we do not have any indication of the direction of linkages, both behavioural and temporal.

Under fixed exchange regime, in the Johnson's monetary approach to balance of payments model with or without capital mobility, any excess domestic absorption and in our case with private and savings gap being stable, excess government expenditure over its revenues would spill into excess demand for overseas goods and services, resulting in trade/current account deficit. Under freely floating regimes, with either partial or free capital mobility, in the Mundell-Fleming open economy model, there is interaction between budget deficit and trade deficit directly through domestic absorption and indirectly through monetary channels. As budget deficit rises, aggregate demand would increase and domestic interest rate would also rise; and if the domestic interest rate is higher than world interest rate there will be a capital inflow, resulting in the rise of real exchange rate; exports would fall and trade/current account would deteriorate. Thus, our modeling strategy has to incorporate both real and monetary variables.

A review of past empirical studies on both developed and developing countries shows conflicting results. A few studies (Chen and Haug, 1993; Evans, 1988, 1993; Evans and Hasan, 1994) on the US and Canadian economies concluded that there was an absence of linkage between budget and external deficits. Their conclusion indicated the possibility of existence of Ricardian equivalence proposition that economic agents anticipate budget deficits would be funded by debt, which would be financed by rise in future tax rates; accordingly they would adjust consumption towards maximising the inter-temporal welfare by increasing current savings rather than current consumption; and that there would be no effect on domestic interest rates, total savings, investment, price level and income. Earlier study by Normandin (1994), however, showed that Ricardian equivalence proposition could be rejected for the Canadian economy but not for the US economy. Darrat (1988) in his study on the US economy noted the existence of bi-directional causality between two deficits.

In regard to developing countries, Laney (1984) in his study of 58 countries observed the presence of causal linkage running from fiscal balance to external balance in the case of developing countries, which was absent in the case of developed countries. Similarly, Khalid and Teo (1999) noted the existence of a long run-cointegrating relationship between fiscal and trade deficits in respect of a group of developing countries, while recognizing the absence of such a relationship in regard to another group of developed countries.

Thus, we note the evidence collected by empirical studies is inconclusive. The results differed across countries but more significantly they differed with the employment of different econometric techniques and model specification for the same country data (Onafowara and Owoye, 2006). Past studies devised models employing variables to represent domestic absorption, which included industrial production index and variables to represent monetary influences, which included interest rate and real exchange rate.

IV. Modeling Strategy

Data Description

The PICs suffer from severe data constraints. National income data of the selected six PICs are available only from the mid 1980s. Hence, our study covers a 17-year period (1988-2004). The model, incorporating the real and monetary variables, therefore remains simple and is written as:

$$CAD = f(BD, RGDP, M2)$$

$$CAD_t = \beta_0 + \beta_1 BD_t + \beta_2 RGDP_t + \beta_3 M2_t + \varepsilon_t \qquad (1)$$

where

CAD = Current account deficit (percent of GDP);
RGDP = real GDP (index number); and
BD = budget deficit (percent of GDP);
M2 = broad money supply (percent of GDP)
ε_t = white noise error term

RGDP represents domestic absorption. *M2* as percent of GDP captures monetary influences, which would include changes in interest rate, inflation and consequent changes in real interest affecting trade volume. The data series are drawn from a single source, namely Asian Development Bank (2006). Due to the data constraint, we resort to the panel data techniques to estimate Equation (1). All variables are duly transformed into logarithmic form prior to estimation.

Panel Unit Root and Stationary Tests

In this study, we adopt the Maddala and Wu (1999), Hadri (2000), Levin *et al*. (2002) and Im *et al.* (2003) panel unit root and stationarity tests in order to obtain conclusive evidence with regard to the order of integration of the series under investigation. The null hypothesis of these tests is that the panel series has a unit root (non-stationary) except for the HADRI test. The HADRI test is similar to the KPSS type unit root test, with a null hypothesis of stationarity in the panel (see Appendix 1).

Panel Cointegration

We proceed to examine whether there exists any long run equilibrium relationship between the variables under investigation. Towards this purpose, we resort to Pedroni (1999, 2001, 2004) and Kao (1999) panel cointegration tests. Pedroni considers seven different statistics, four of which are based on pooling the residuals of the regression along the within-dimension (panel test) of panel and the other three are based on pooling the residuals of the regression along the between-dimension (group test) of the panel. The within-dimension tests take into account common time factors and allow for heterogeneity across countries. The between-dimension tests are the group mean cointegration tests, which allow for heterogeneity of parameters across countries. Meanwhile, Kao (1999) proposed DF and ADF-type tests for ε_{it} where the null is specified as no cointegration. In this study, we only report the ADF-type test. The details of these tests are discussed in Appendix 1.

Panel Fully Modified OLS (FMOLS) Estimates

For obtaining the long run estimates of the cointegrating relationship, we adopt the panel group mean Fully Modified OLS (FMOLS) following the work by Pedroni (2000). The FMOLS procedure accommodates the heterogeneity that is typically present both in the transitional serial correlation dynamics and in the long run cointegrating relationships. The FMOLS estimator is described in Appendix 1.

Granger Causality Tests

To test for panel causality, we estimate a panel based vector error correction model (VECM) with a dynamic error correction term based on Holtz-Eakin *et al*. (1988, 1989). The empirical models are represented as follows:

$$\Delta CAD_{it} = \pi_{1j} + \sum_{p=1}^{m} \pi_{11ip} \Delta CAD_{it-p} + \sum_{p=1}^{m} \pi_{12ip} \Delta BD_{it-p} + \sum_{p=1}^{m} \pi_{13ip} \Delta RGDP_{it-p} + \sum_{p=1}^{m} \pi_{14ip} \Delta MS_{it-p} + \mu_{1i} ECT_{it-1} + \zeta_{1it} \quad \text{(2a)}$$

$$\Delta BD_{it} = \pi_{2j} + \sum_{p=1}^{m} \pi_{21ip} \Delta BD_{it-p} + \sum_{p=1}^{m} \pi_{22ip} \Delta CAD_{it-p} + \sum_{p=1}^{m} \pi_{23ip} \Delta RGDP_{it-p} + \sum_{p=1}^{m} \pi_{24ip} \Delta MS_{it-p} + \mu_{2i} ECT_{it-1} + \zeta_{2it} \quad \text{(2b)}$$

$$\Delta RGDP_{it} = \pi_{3j} + \sum_{p=1}^{m} \pi_{31ip} \Delta RGDP_{it-p} + \sum_{p=1}^{m} \pi_{32ip} \Delta CAD_{it-p} + \sum_{p=1}^{m} \pi_{33ip} \Delta BD_{it-p}$$
$$+ \sum_{p=1}^{m} \pi_{34ip} \Delta MS_{it-p} + \mu_{3i} ECT_{it-1} + \zeta_{3it} \qquad (2c)$$

$$\Delta MS_{it} = \pi_{4j} + \sum_{p=1}^{m} \pi_{41ip} \Delta MS_{it-p} + \sum_{p=1}^{m} \pi_{42ip} \Delta CAD_{it-p} + \sum_{p=1}^{m} \pi_{43ip} \Delta BD_{it-p}$$
$$+ \sum_{p=1}^{m} \pi_{44ip} \Delta RGDP_{it-p} + \mu_{4i} ECT_{it-1} + \zeta_{4it} \qquad (2d)$$

where Δ is the lag operator, p denotes the lag length. Here all variables are as previously defined. Using the specification in Equation 2 allows one to test causality direction. For example, in short run BD does not Granger cause CAD where, $H_0 : \pi_{12ip} = 0$ for all i and p while $\mu_{1i} = 0$ in Equation (2a)[1]. The rejection implies that BD $\longrightarrow$ CAD. Similar analogous restrictions and testing procedure can be applied in testing the hypothesis that CAD does not Granger cause movement in BD where the null hypothesis H_0: $\pi_{22ip} = 0$ for all i and p while $\mu_{2i} = 0$ in Equation (2b).

V. EMPIRICAL RESULTS

Panel Unit Root and Stationary Results

The results, which are summarized in Table 3, show that the series of the variables are of an *I(1)* process as the pooled data are stationary in their first differences.

Table 3: Panel Unit Root Tests Results

(Variables in logs)

	Test Statistics					
	LLC	**IPS**	**MW (ADF)**	**MW (PP)**	**HADRI**	**Conclusion**
			A: Level			
Model Specification: Individual Effects						
CAD	-1.076	-1.141	16.554	17.372	1.894	-
	(0.140)	(0.126)	(0.167)	(0.136)	(0.029)	
BD	-1.041	-0.349	8.525	18.380	2.462	-
	(0.148)	(0.363)	(0.742)	(0.104)	(0.007)	
RGDP	-0.270	1.857	4.678	5.072	4.692	-
	(0.393)	(0.968)	(0.967)	(0.955)	(0.000)	

[1] The F-test or Wald χ^2 of the explanatory variables (in first differences) indicates the short run causal effects ($\pi_{12ip} = 0$ for all i and p) while the long run causal (μ_{1i} =0) relationship is implied through the significance of the lagged ECT which contains the long run information.

MS	0.676	-0.464	11.363	13.472	5.434	-
	(0.750)	(0.321)	(0.498)	(0.335)	(0.000)	
Model Specification: Individual Effects and Individual Linear Trends						
CAD	-0.302	-0.490	6.720	17.138	3.637	-
	(0.381)	(0.312)	(0.875)	(0.144)	(0.000)	
BD	0.598	-0.887	15.558	17.802	2.977	-
	(0.274)	(0.187)	(0.212)	(0.122)	(0.001)	
RGDP	-1.085	0.958	10.052	10.348	6.885	-
	(0.138)	(0.832)	(0.611)	(0.584)	(0.000)	
MS	-0.759	-0.259	12.579	11.352	3.726	-
	(0.223)	(0.399)	(0.400)	(0.499)	(0.000)	
B: First Differences						
Model Specification: Individual Effects						
ΔCAD	-3.817	-6.375	39.112	55.236	0.200	*I(1)*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.420)	
ΔBD	-6.262	-2.577	67.051	63.110	0.126	*I(1)*
	(0.000)	(0.005)	(0.000)	(0.000)	(0.449)	
ΔRGDP	-5.214	-3.761	37.614	44.562	0.664	*I(1)*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.253)	
ΔMS	-6.136	-5.877	53.361	62.664	0.963	*I(1)*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.167)	
Model Specification: Individual Effects and Individual Linear Trends						
ΔCAD	-3.683	-5.387	25.753	74.738	0.397	*I(1)*
	(0.000)	(0.000)	(0.011)	(0.000)	(0.345)	
ΔBD	-4.521	-2.715	49.050	45.442	1.118	*I(1)*
	(0.000)	(0.003)	(0.000)	(0.000)	(0.131)	
ΔRGDP	-5.269	-4.027	35.794	36.857	0.677	*I(1)*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.249)	
ΔMS	-4.771	-4.913	45.212	48.510	0.576	*I(1)*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.282)	

Notes: IPS, LLC and HADRI indicated the Im *et al.* (2003), Levin et al. (2002) and Hadri (2000) panel unit root and stationary tests. MW (Fisher-ADF) and MW (Fisher-PP) denotes Maddala and Wu (1999) Fisher-ADF and Fisher-PP panel unit root test. The IPS, LLC, MW (Fisher-ADF) and MW (Fisher-PP) examines the null hypothesis of non-stationary while HADRI tests the stationary null hypothesis. The four variables were grouped into one panel with sample N=17, T=6. The parenthesized values are the probability of rejection. Probabilities for the MW (Fisher-ADF) and MW (Fisher-PP) tests are computed using an asymptotic χ^2 distribution, while the other tests follow the asymptotic normal distribution.

Panel Cointegration Results

From the panel cointegration results in Table 4, we find strong evidence to reject the null hypothesis of no cointegration for six out of the seven statistics provided by Pedroni (1999, 2001, 2004). Similarly, we reject the null hypothesis of no cointegration using the ADF-type statistics from Kao (1999) panel cointegration tests suggesting that the four-dimension model of twin deficits for the PICs is in fact cointegrated. Thus, we find CAD, BD, RGDP and MS are cointegrated in the multi-country panel setting for the sample period.

Table 4: Panel Cointegration Results

A: Pedroni Residual Cointegration test	
Panel cointegration statistics (within-dimension)	
Panel v-statistic	-2.927 (0.005)
Panel PP type ρ-statistic	1.157 (0.204)
Panel PP type *t*-statistic	-3.612 (0.001)
Panel ADF type *t*-statistic	-2.835 (0.007)
Group mean panel cointegration statistics (between-dimension)	
Group PP type ρ -statistic	2.238 (0.032)
Group PP type *t* –statistic	-9.209 (0.000)
Group ADF type *t*- statistic	-2.721 (0.009)
B: Kao Residual Cointegration test	
ADF	-2.208 (0.014)

Notes: The number of lag truncations used in the calculation of the seven Pedroni statistics is 2 while Kao ADF statistic is 3. Probability values are in parentheses.

Fully Modified OLS Estimates

The long run estimates for the panel of PICs are presented in Table 5. In the equation with CAD as dependent variable, it is seen that all the estimated coefficients are positive and statistically significant. These were consistent with the theoretical foundations of the twin deficits model. Since the variables are in log forms, values of the estimated coefficients denote the elasticity magnitudes: one percent rise in BD gives rise to 0.07 percent increase in CAD. This supports the conventional view that there exists strong correlation between CAD and BD, **an** evidence of twin deficits hypothesis. The elasticity estimate of CAD with respect to RGDP is 0.04, indicating one percent increase in RGDP leads to 0.04 percent rise in CAD. The elasticity estimate of CAD with respect to MS is 0.61.

Table 5: Fully Modified OLS Estimates

(Variables in logs)

	BD	**RGDP**	**MS**
Panel Group	0.070 (3.890)*	0.040 (24.220)*	0.610 (5.510)*

Notes: The values in parentheses are t-statistics. Asterisk (*) shows significance at 5 percent level.

Table 6: Panel Granger Causality Results

(Variables in logs)

Dependent Variables	**ΔCAD**	**ΔBD**	**ΔRGDP**	**ΔMS**	*ECT*	
	χ^2-statistics (p-value)				**Coefficient**	**t-ratio**
ΔCAD	-	12.904 (0.011)	8.372 (0.078)	21.410 (0.000)	-0.034	-0.205
ΔBD	15.953 (0.003)	-	3.161 (0.531)	3.262 (0.514)	0.002	0.001
ΔRGDP	5.869 (0.209)	7.532 (0.110)	-	4.867 (0.301)	-0.302*	-2.380
ΔMS	1.949 (0.745)	3.256 (0.515)	7.123 (0.129)	-	0.149	1.771

Notes: Parenthesized values are the probability of rejection of Granger non-causality. Δ is the first different operator. Estimations are based on the pooled data for 1988-2004 and 6 Pacific Island Countries (N=6, T=17) with three lags. Asterisk (*) shows significance at 5 percent level.

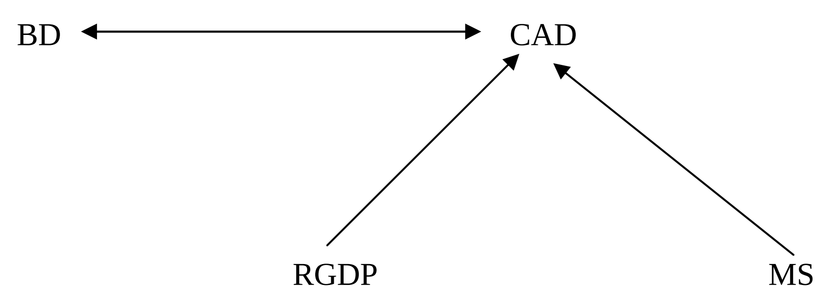
Granger Causality Results

The empirical results presented in Table 6 are summarized as follows. First, we observe that the coefficient of the error correction term (ECT) is not statistically significant, indicating the absence of a long run causality relationship running from MS, RGDP and BD to CAD. Second, there appears to be a significant short run causal relationship running from MS, RGDP and BD to CAD based on the *Chi-square* statistics of the coefficients of the three variables.

Third, we also find short run causality running from CAD to BD. Thus, the results indicate the existence of a bi-directional relationship between the two variables. This suggests that internal deficit is not the prime cause of the external deficit and it is seen that the reverse causation running from external to internal deficits is much stronger in terms of significance. This is in conformity with the findings of various studies on developing countries undertaken by Anoruo and Ramchander (1998), Khalid and Teo

(1999) and Lau and Baharumshah (2006). Indeed, Khalid and Teo (1999) noted that a high connection between the two deficits is more likely to occur in the developing rather than the developed economies.

Figure 1: Direction of Causal Relationship



Note: RGDP → CAD and MS→ CAD imply one-way causality while BD ↔ CAD indicates bi-directional causality relationship.

Fourth, RGDP appears to be the initial receiver of any exogenous shocks that disturb the equilibrium of the panel system. This is evidenced in the statistically significant ECT in the RGDP equation in the panel system. The coefficient of ECT in RGDP equation is 0.302 indicating that about 30 percent of the adjustment is completed in a year. This means that PICs need approximately 3.3 years to reach long run equilibrium from the estimated results. The directions of causal relationship obtained from Table 6 are graphically illustrated in Figure 1.

VI. SUMMARY AND CONCLUSIONS

This paper examined whether there exist any causal relationships between current account deficits and budget deficits in PICs by undertaking a panel data analysis of six major economies in respect of which consistent time series of data for 17 years (1988-2004) are available. Panel cointegration tests reveal that there is a significant, strong and positive association between current account deficits, and budget deficits and expansionary monetary policies. The FMOLS estimation results for the panel group as a whole confirm that all the three variables significantly influence current account deficits.

The panel Granger causality results indicate that causality linkage runs from budget deficits, national output and money supply to current account deficits only in the short run. Further, there is also a feedback causality indicated in the short run, which runs from current account deficit to budget deficit. The bi-directional causality between budget and current account deficits is not an unusual phenomenon in the case of countries that are highly dependent on export revenues. While PNG is dependent on export revenues from its mineral exports, including oil and gas, other PICs are dependent on tourism earnings, which affect their GDP, tax revenue and domestic budgets. Thus, we find evidence of a positive relationship between current account deficits and budget deficits as well.

The policy implications are straightforward and clear. In the current context of persistent twin deficits in PICs, the standard remedy (Daniel *et al*, 2006) is fiscal adjustment, which is expected to facilitate external adjustment as well. Giving a broader definition, Daniel *et al*. (2006) clarify that fiscal adjustment would mean a change in fiscal stance, either tightening or loosening, as the situation would warrant in the short run, and fiscal consolidation in the long run, which would mean reducing fiscal deficit and debt accumulation over a planned period. Other long-run measures include: (i) strengthening expenditure control and budget–monitoring; (ii) enhancing the efficiency of revenue systems; (iii) introducing measures to offset the volatility in revenues generated by non-tax revenue receipts and aid inflows; (iv) re-directing aid resources into capacity building investments by streamlining the civil service and reducing recurrent expenditures; (v) enhancing debt-management practices; and (vi) improving foreign exchange earnings and maintaining a competitive real exchange rate so that external debt servicing does not pose undue problems in the long run.

In regard to current account deficits, it is well known that PICs, with the exception of PNG depend on a very narrow range of exports, which include traditional sugar in the case of Fiji, and timber and palm oil in the case of Solomon Islands, and agricultural exports in the case of Samoa, Tonga and Vanuatu. Diversification of commodity exports is required. Since the present communal land tenure system acts as a serious constraint restricting the full agricultural potential to be reached, PICs have to look to other avenues. The latter would include intensifying tourism earnings and exploring new sources such as financial and information technology services, towards maximizing foreign exchange earnings. Another promising area is inward remittance inflows from Pacific islanders, who are currently residents in Australia, New Zealand and North America. Governments of PICs should encourage inward remittances by eliminating/relaxing various restrictions, such as fees and taxes. With the introduction in 2007 of a rolling, seasonal farm labour employment scheme in New Zealand, providing opportunities to unskilled Pacific islanders to work for a temporary period, which is likely to be replicated in Australia, there are bright prospects of greater remittance inflows in the future. Higher quantum of remittance inflows would then contribute to reducing current account deficits.

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Appendix 1

Panel Estimation: Unit Root, Cointegration and Fully Modified OLS

1.Panel Unit Root and Stationary Tests

This note is based on surveys on this subject matter, which include Banerjee (1999), Baltagi and Kao (2000), Baltagi (2005) and Breitung and Pesaran (2008). These tests are also available in the manual of *Eviews* (see http://www.eviews.com). Further, Hlouskova and Wagner (2006) also provide a survey on the performance of the panel unit root and stationarity tests.

Maddala and Wu (1999, MW) developed the test statistics that is based on combining the *p*-values of any given test-statistic for a unit root in each cross-sectional unit (p_i say for the i th cross 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

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

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. The Fisher test is an exact and non-parametric test and may be computed for any arbitrary choice of a test for the unit root in a cross-sectional unit. In this paper, we adopted both the ADF and the Phillips-Perron individual unit root tests in order to construct the MW test statistic.

In addition, the Levin *et al*. (2002) test was build upon their earlier paper of Levin and Lin (1993). This approach is easily describes in the following regression of

$$\Delta x_{it} = \gamma_i x_{it-1} + e_{it.} \text{ for } i = 1,..., N \text{ and } t = 1,...,T \tag{A.2}$$

According to these authors, the panel estimator can be defined as

$$\sqrt{NT}\ (\hat{\gamma} - 1) = \frac{\frac{1}{\sqrt{N}} \sum_{i=1}^{N} \frac{1}{T} \sum_{t=1}^{T} x_{it-1} e_{it}}{\frac{1}{N} \sum_{i=1}^{N} \frac{1}{T^2} \sum_{t=1}^{T} x_{it-1}^2}. \tag{A.3}$$

The following t-statistics van be used to test for the null hypothesis of panel unit root of

$$t_\gamma = \frac{(\hat{\gamma} - 1)\sqrt{\sum_{i=1}^{N} \sum_{t=1}^{T} x_{it-1}}}{\sqrt{\frac{1}{NT} \sum_{i=1}^{N} \sum_{t=1}^{T} e_{1t}^2}}. \tag{A.4}$$

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

$$\Gamma_{\bar{t}} = \frac{\sqrt{N}\{\bar{t}_{NT} - E(t_T \mid \beta_i = 0)\}}{\sqrt{Var(t_T \mid \beta_i = 0)}} \Rightarrow \text{N (0,1), where } \bar{t}_{NT} = \frac{1}{N}\sum_{i=1}^{N} t_{iT} \qquad \text{(A.5)}$$

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, $\beta_i = 0$, $i=1,2\ldots N$.

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

$$y_{it} = \alpha_{it} + \beta_t t + \varepsilon_{it} \qquad \text{(A.6)}$$

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

$$LM = \frac{\sum_{i=1}^{N}\sum_{t=1}^{T} S_{it}^2}{N.T^2\varpi^2} \qquad \text{(A.7)}$$

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.

2. Panel Cointegration Tests

Pedroni panel cointegration test

There are in all seven panel cointegration tests. Detailed description of the formulae for the seven panel cointegration statistics, are given in Pedroni (1999: 660-661).

A. Within-dimension (panel tests):

a) Panel ν-Statistic
b) Panel Phillip-Perron (PP) type ρ-Statistics
c) Panel Phillips-Perron (PP) t-Statistic (non-parametric)
d) Panel Augmented Dickey Fuller (ADF) t-Statistic (parametric)

B. Between-dimension (group tests):

e) Group Phillip-Perron (PP) type ρ-Statistics
f) Group Phillips-Perron (PP) t-Statistic (non-parametric)
g) Group Augmented Dickey Fuller (ADF) t-Statistic (parametric)

These seven statistics are based on the estimated panel cointegration regression residuals of the likely cointegrating vector

$$CAD_{i,t} = \alpha_i + \phi_i t + \beta_1 BD_{i,t} + \beta_2 RGDP_{i,t} + \beta_3 MS_{i,t} + \varepsilon_{i,t} \qquad \text{(A.8)}$$

varying across countries, thus permitting full heterogeneity (β_i), fixed effects (α_i) and individual specific deterministic trends ($\phi_i t$) across individual members of the panel

Pedroni (1999) shows that under appropriate standardization based on the moments of vector of Brownian motion function, each of these statistics converges weakly to a standard normal distribution when both the T and N of the panel grow large. The standardized distributions for the above mentioned seven panel and group statistics can be expressed in the form of

$$\frac{e_{N,T} - \mu\sqrt{N}}{\sqrt{\nu}} \Rightarrow N(0,1) \tag{A.9}$$

where e_{NT} is the respective panel/group cointegration statistic and μ and ν are the expected mean and variance of the corresponding statistics. They are computed by Monte Carlo stochastic simulations and tabulated in Pedroni (1999, Table 2).

Kao panel cointegration test

Unlike Pedroni test, Kao (1999) test specifies cross-section specific intercepts and homogeneous coefficients on the first-stage regressors. In this case, we specified the panel regression model as

$$y_{it} = x_{it}^{'}\beta + z_{it}^{'}\gamma + \varepsilon_{it} \tag{A.10}$$

where y_{it} and x_{it} are I(1) and non cointegrated. For $z_{it} = \{\mu_i\}$ Kao (1999) proposed DF and ADF-type unit root tests for ε_{it} where the null is specified as no cointegration.

The DF-type test can be calculated from this regression of

$$\hat{\varepsilon}_{it} = \rho\hat{\varepsilon}_{it-1} + \nu_{it} \tag{A11}$$

while the augmented version of the pooled specification,

$$\hat{\varepsilon}_{it} = \rho\hat{\varepsilon}_{it-1} + \sum_{j=1}^{p}\varphi_j \Delta\hat{\varepsilon}_{it-j} + \nu_{itp} \tag{A12}$$

where $\hat{\varepsilon}_{it} = \tilde{y}_{it} - \tilde{x}_{it}\hat{\beta}$ and $\tilde{y} = y_{it} - \bar{y}_i$. The OLS estimate of ρ and the t-statistics are given as

$$\hat{\rho} = \frac{\sum_{i=1}^{N}\sum_{t=2}^{T}\hat{\varepsilon}_{it}\hat{\varepsilon}_{it-1}}{\sum_{i=1}^{N}\sum_{t=2}^{T}\hat{\varepsilon}_{it}^{2}} \text{ and } t_\rho = \frac{(\hat{\rho}-1)\sqrt{\sum_{i=1}^{N}\sum_{t=2}^{T}\hat{\varepsilon}_{it-1}^{2}}}{s_\varepsilon}.$$

In this case, $s_\varepsilon^2 = \frac{1}{NT}\sum_{i=1}^{N}\sum_{t=2}^{T}\left(\hat{\varepsilon}_{it} - \hat{\rho}\hat{\varepsilon}_{it-1}\right)^2$. Under the null of no cointegration, Kao (1999) shows that following the statistics,

$$DF_\rho = \frac{\sqrt{N}T(\hat{\rho}-1) + 3\sqrt{N}}{\sqrt{10.2}} \tag{A13}$$

$$DF_t = \sqrt{1.25}t_p + \sqrt{1.875N} \tag{A14}$$

$$DF_\rho^* = \frac{\sqrt{N}T(\hat{\rho}-1)\frac{3\sqrt{N}\hat{\sigma}_v}{\hat{\sigma}_{0v}^2}}{\sqrt{3+\frac{36\hat{\sigma}_v^4}{5\hat{\sigma}_{0v}^4}}} \tag{A15}$$

$$DF_t^* = \frac{t_\rho + \frac{\sqrt{6N}\hat{\sigma}_v}{2\hat{\sigma}_{0v}}}{\sqrt{\frac{\hat{\sigma}_{0v}^2}{2\hat{\sigma}_v^2}+\frac{3\hat{\sigma}_v^2}{10\hat{\sigma}_{0v}^2}}} \tag{A16}$$

where $\hat{\sigma}_v^2 = \hat{\Sigma}_{yy} - \hat{\Sigma}_{yx}\hat{\Sigma}_{xx}^{-1}$ and $\hat{\sigma}_{0v}^2 = \hat{\Omega}_{yy} - \hat{\Omega}_{yx}\hat{\Omega}_{xx}^{-1}$. For ADF can be constructed as

$$ADF = \frac{t_{ADF} + \frac{\sqrt{6N}\hat{\sigma}_v}{2\hat{\sigma}_{0v}}}{\sqrt{\frac{\hat{\sigma}_{0v}^2}{2\hat{\sigma}_v^2}+\frac{3\hat{\sigma}_v^2}{10\hat{\sigma}_{0v}^2}}} \tag{A17}$$

where t_{ADF} is the t-statistics of ρ in equation A12.

3. <u>Fully Modified OLS Estimates</u>

Following Pedroni (2000, 2001), we consider the following cointegrated system for panel data of

$$Y_{it} = \alpha_i + \beta_i X_{it} + \mu_{it} \tag{A.18}$$
$$X_{it} = X_{i,t-1} + e_{it} \tag{A.19}$$

where $i = 1,2,...,N$ countries over the time period of $t = 1,2,...M$. In addition, $Z_{it} = (Y_{it}, X_{it})' \sim I(1)$ and $\zeta_{it} = (\mu_{it}, e_{it})' \sim I(0)$ with covariance matrix of $\Omega_i = \Omega_i^0 + \Gamma_i + \Gamma_i'$, where Ω_0^i is the contemporaneous covariance, Γ_i is the weighted sum of autocovariances while $\Omega_i = L_i L_i'$ in which L_i is the lower triangular decomposition of Ω_i. For simplicity, we assume that Y = CAD while X [BD, RGDP and MS] of Equation 1 and A.8 in this study. The panel FMOLS estimator for coefficient β is given as

$$\beta_{FM}^* = N^{-1}\sum_{i=1}^{N}\left(\sum_{t=1}^{T}(X_{it}-\overline{X}_{it})^2\right)^{-1}\left(\sum_{t=1}^{T}(X_{it}-\overline{X}_{it})Y_{it}^* - T\hat{\gamma}_i\right) \tag{A.20}$$

where

$$Y_{it}^* = \left(Y_{it}-\overline{Y}\right) - \frac{\hat{L}_{21i}}{\hat{L}_{22i}}\Delta X_{it} \text{ and } \hat{\gamma}_i = \hat{\Gamma}_{21i} + \hat{\Omega}_{21i}^0 - \frac{\hat{L}_{21i}}{\hat{L}_{22i}}\left(\hat{\Gamma}_{22i} + \hat{\Omega}_{22i}^0\right).$$

Likewise, the associated t-statistics for the estimator can be constructed as

$$t_{\hat{\beta}_{FM}^*} = N^{-1/2}\sum_{i=1}^{N} t_{\hat{\beta}_{FM,i}^*} \text{ where } t_{\hat{\beta}_{FM,i}^*} = (\hat{\beta}_{FM,i}^* - \beta_0)\left(\hat{\Omega}_{11i}^{-1}\sum_{t=1}^{T}(X_{it}-X_i)^2\right)^{1/2}.$$

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