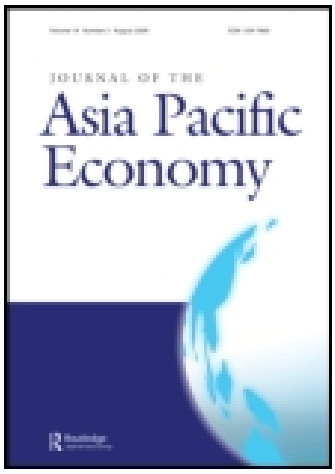


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# Testing Twin Deficits Hypothesis using VARs and Variance Decomposition

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# Testing Twin Deficits Hypothesis using VARs and Variance Decomposition

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ABSTRACT *This paper examines the twin deficits hypothesis in the ASEAN countries. The major findings of this paper are the following. (1) Long run relationships are detected between budget and current account deficits. (2) The Keynesian view fits well for Thailand since the causality runs from budget deficit to current account deficit. For Indonesia, the causality runs in an opposite direction while the empirical results indicate that a bidirectional pattern of causality exists for Malaysia and the Philippines. (3) We also found support for an indirect causal relationship that runs from budget deficit to higher interest rates, and higher interest rates leading to the appreciation of the exchange rate, which in turn leads with the widening of the current account deficit. The results of the variance decompositions and impulse response functions suggest that the consequences of large budget and current account deficits become noticeable only over the long run.*

KEY WORDS: Twin deficits, cointegration, variance decomposition

JEL CLASSIFICATIONS: F30, H60

## Introduction

The widening of current account imbalances in a number of the Association of Southeast Asian Nations (ASEAN) countries over the past two decades has generated policy concerns. Analysts consider growing fiscal and current account imbalances to be the cause of macroeconomic imbalances and hence a nuisance to long-term economic progress of a country. Several authors have addressed this issue from the point of view of macroeconomic stability (e.g. Edwards, 2001). The 1997 Asian financial crisis sensitized observers to the adverse effects arising from capital inflows. For example, a surge in foreign capital leads to an accumulation of exchange reserves by the central bank of the host country, which brings about an undesirable increase in money

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supply. Besides, capital inflows (short-term debts) are volatile and, in fact, countries that are too dependent on such capital to finance current account deficits find that the gap between investment and savings becomes destabilized when capital inflows are reversed. Thus, large capital inflows followed by a sudden reversal can cause large fluctuations in macroeconomic variables such as domestic savings, exchange rate, interest rate, current account deficit and monetary growth.

Over the years, researchers have explored the link between budget deficit and current account deficit. An example is the so-called 'twin deficits hypothesis' that emerged during the 'Reagan fiscal experiment' of the 1980s. It marked a period of strong appreciation of the dollar and an unusual shift in current account, not in favor of the United States.[1] This close connection between a budget deficit and a current account deficit, however, is not unique to the United States. In Europe, Germany and Sweden faced similar problems in the early part of the 1990s when the rise in the budget deficits was accompanied by a real appreciation of their national currencies and in turn adversely affected the current accounts of these countries (see Ibrahim & Kumah, 1996).

Developing countries are no exception. Most have experienced similar problems with an international debt crisis erupting in 1982. Countries such as Indonesia, Malaysia, Thailand and the Philippines were all affected deeply and directly during the 1982–83 recession. Their currencies were tied closely to the US dollar and, during the appreciation of the dollar, they priced themselves out of the world markets and the worsening of the balance-of-payment situation generated an economic crisis. Indeed, several studies have documented that the unsustainable budget deficit during the debt crisis widened the current account deficit (see Laney, 1984). The emergence of the current account deficit and the budget deficit phenomena in many countries in the past decade or so has rekindled the debate on the problem of twin deficits. Thus, the aim of this paper is to investigate the twin deficits hypothesis for Indonesia, Malaysia, Thailand and the Philippines (ASEAN-4 hereafter) – that persistent budget deficits have been the prime 'cause' of the escalating current account deficits observed in the late 1980s and more recently in 1990–96.[2]

This article differs from existing literature in the following ways. First, much of the empirical research has focused on the twin deficits in the developed countries, namely the US. We chose the ASEAN countries because the issue seems to be relevant to these economies. The studied countries lapsed into severe financial crises and some are still undergoing structural adjustments in the aftermath of the currency crisis. Further, we observed that most of the crisis-inflicted countries recorded large current and budget deficits in the late 1980s and the first half of the 1990s. Thus, making an inquiry based on time-series data is feasible. The experience of these countries should contribute to the scant literature on the link between the two deficits in the emerging economies.

Second, the relationship between budget deficit and current account has been the subject of a number of papers; the interrelationship between budget deficit, current account deficit and other mediating variables (e.g. interest rates and exchange rates)

has received less attention. These variables have neither received much attention nor been fully analyzed. These mediating variables, as we will show later using recent advancements in time series econometric, allow us to map out the transmission mechanism in the twin deficits issue.[3] Third, the issue of parameter stability is addressed in this paper, an issue omitted by most authors of comparative studies. Previous studies have presumed that the cointegrating relationship is stable; that is, the cointegration coefficients are time invariant. This may not be the case as it is unlikely that the relationship between twin deficits remained unchanged over the last few decades. To assess the issue more formally, we relied on the procedures developed by Zivot & Andrews (1992) and Gregory & Hansen (1996). These methods allow the break to be determined endogenously.

The rest of this paper is structured as follows. The next section describes the simple theoretical framework of national accounting for analyzing the causal relationship of the twin deficits. Relevant literature in the research area is presented in the section after. In the fourth section, the twin deficit hypothesis is tested and empirical results are presented. Finally, the fifth section contains the concluding remarks and discusses some of the policy implications of the findings.



## Current Account and Fiscal Balance in National Accounts

A wide range of models has emerged in the literature but in most cases the analytical results that suggest a fiscal deficit are likely to lead to a worsening of the current account. The national account identity provides the basis of the relationship between the two deficits. The model starts with the national income identity for an open economy that can be represented as:

$$Y = C + I + G + X - M \tag{1}$$

where $Y$ = gross domestic product ($GDP$), $C$ = consumption, $I$ = investment, $G$ = government expenditure, $X$ = exports and $M$ = imports. Defining current account ($CA$) as the difference between export ($X$) and import ($M$), and by simply rearranging the variables in equation (1), we obtain

$$CA = Y - (C + I + G) = S - I \tag{2}$$

where $(C + I + G)$ is the domestic absorption. This relationship means that the external account has to equal the difference of national savings and investment. It implies that the current account is closely related to savings and investment decisions in an economy. In an open economy, total savings ($S$) equal domestic investment ($I$) plus current account ($CA$), that is

$$S = I + CA \tag{3}$$

Equation (3) states that an open economy can source domestically and internationally for the necessary funds for investments to enhance its income. In other words, external

borrowings allow for investments at levels beyond those that could be financed through domestic savings. From a policy perspective, this relationship implies that policies supporting investments have a negative impact on the current account, while policies that reduce consumption (private or public) have a positive impact on current account because they increase national savings.

National savings can be decomposed further into private ($S_{\mathrm{p}}$) and government savings ($S_{\mathrm{g}}$). Using $S_{\mathrm{p}} = Y - T - \mathrm{C}$ and $S_{\mathrm{g}} = T - \mathrm{G}$, where $T$ is the government revenue, and substituting them into equation (3) yields

$$S_p = I + CA + (G - T) \tag{4}$$

or

$$S_P = I - CA - (G - T) \tag{5}$$

Assuming savings-investment balance for simplicity, equation (5) states that a rise in the budget deficit will increase the current account deficit if private savings is equal to investment.[4] Thus, it is clear from equation (5) that external account and fiscal balance are interrelated, or twinned. That is, for a given private savings and investment, government budget and the current account should move in the same direction and by the same amount.

Finally, it is also important to show that the external account has to equal the capital and financial account or $CA = B_{t+1} - B_t$, where the capital and financial account is given as the change of an economy's net foreign asset ($B$). Thus, a country may accumulate foreign assets or sell domestic assets to foreigners. Therefore, countries that experience large inflows will record a current account deficit of the same size if we ignore the changes in foreign exchange reserves.

## Relevant Literature

Previous literature has mainly centered on the discussion on the twin deficits issue based on two major theoretical models. However, these are not the only possible outcomes between the two deficits. In fact, four testable hypotheses arise from the twin deficits phenomena. The first testable hypothesis is based on the Keynesian (conventional) proposition. Based on the well-known Mundell–Fleming framework, the Keynesian proposition demonstrated that an increase in budget deficit would induce upward pressure on interest rates, causing capital inflows and exchange rates to appreciate. The appreciated exchange rate would make exports less attractive and increase the attractiveness of imports, subsequently worsening the current account under a flexible exchange rate system. Under a fixed exchange rate regime, the budget deficit stimulus would generate higher real income or prices and this would worsen the current account balance. Hence, running a budget deficit ultimately will widen the current account deficit under both fixed and flexible exchange rate regimes although the transmission mechanisms under the two regimes may differ.

Hence, the Keynesian proposition can be summarized as follows. First, a positive relationship exists between current account and budget deficit. Second, there exists a unidirectional Granger causality that runs from the budget deficit to the current account deficit. Researchers who have used the modern statistical time series technique include authors like Piersanti (2000) and Leachman & Francis (2002). They found strong evidence to support the Keynesian view. Such evidence is consistent with the twin deficits hypothesis.[5] In addition, Abell (1990) showed that the link between the two deficits is indirect. He showed that the causality runs from budget deficit to higher interest rate, to foreign capital inflow, to an appreciation of the exchange rate and finally to trade deficit.

Second, Buchanan (1976) rediscovered the Ricardo proposition known as the Ricardian Equivalence hypothesis (hereafter REH) in the seminal work of Barro (1974).[6] According to this view, an intertemporal shift between taxes and budget deficits does not matter for the real interest rate, the quantity of investment or the current account balance. In other words, the absence of any Granger causality between the two deficits would be in accordance with the REH. The empirical evidence in Enders & Lee (1990), Evans & Hasan (1994) and Kaufmann *et al.* (2002) concluded that there is no link between the two deficits and hence is supportive of REH.

Third, a unidirectional causality that runs from current account to budgetary variable may also exist. This outcome occurs when the deterioration in current account leads to a slower pace of economic growth and hence increases the budget deficit. This is especially true for a small open developing economy that highly depends on foreign capital inflows (e.g. foreign direct investment) to finance its economic developments. In other words, the budgetary position of a country will be affected by large capital inflows or through debt accumulations and with that a country will eventually run into a budget deficit. The experience of Latin American countries and to some extent the East Asian countries illustrates this point (see Reisen, 1998).[7] This reverse causality running from current account to budget deficit is termed as 'current account targeting' by Summers (1988), where he pointed out that external adjustment may be sought via a budget (fiscal) policy. The articles by Anoruo & Ramchander (1998) on the Philippines, India, Indonesia and Korea, Khalid & Teo (1999) on Indonesia and Pakistan and Alkswani (2000) on Saudi Arabia found sufficient evidence to support this hypothesis. According to them, this will occur if the government of a country utilizes its fiscal stance to target the current account balance.

Finally, a bidirectional causality between the two deficits may also exist. In other words, a budget deficit Granger-causes a current account deficit and vice versa. The evidence provided by Darrat (1988), Kearney & Monadjemi (1990) and Normandin (1999), among others are consistent with this hypothesis. The above discussion suggests four direct possible links between budget and current account deficits. Following authors such as McCoskey & Kao (1999), we defined twin deficits as a long run (positive) relationship between current account and budget balance, including some other factors (e.g. interest rates, investments, exchange rates). Additionally, we required the budget and current account deficits to enter into the cointegrating space.

To sum up, the body of literature does not yield a consensus on the causal link between the two deficits. Likewise, evidence on the impact of the deficits on interest rates, exchange rates and others are mixed. In this article, we tested the hypothesis with the aid of the Toda & Yamamoto (1995) Granger-causality test. It is worth noting that the literature does not provide a single model to test the twin deficits hypothesis. Most studies rely on a simple bivariate model (e.g. Piersanti, 2000; Kouassi *et al*., 2004). Several studies (e.g. McCoskey & Kao, 1999; Abell, 1990; Anoruo & Ramchander 1998) have extended the model to include more variables (e.g. dependency ratio, money supply, interest rate, exchange rate, inflation and income) making it a more realistic dynamic setting. This is interpreted as the current account being determined by factors other than government deficits.

In this study, we considered only two additional variables as the intermediating variables – interest rates and exchange rates, given the short data span and the fact that the vector autoregressive (VAR) methodology can only take a limited number of variables for a sample size such as ours.[8] Both interest rate and exchange rate were added to the model so as not to neglect important channels. If the long-run model is determined by other than the variables specified, then their omission should prevent us from finding evidence of cointegration. Therefore, we examined twin deficits phenomena by extending the bivariate model to include exchange rates and interest rates.

The addition of the exchange rate into the model does not need much explanation. An increase in budget deficit should cause deterioration in the current account and the inflows of foreign capital lead to an appreciation of the domestic currency (see also Ibrahim & Kumah, 1996). The effect of deficit financing on interest rate however is controversial, and no conclusive evidence has been reached; see among others Bradley (1986) for a brief summary on the issue. But the emerging consensus is that the budget deficit will impact supply and demand of loans and will have an influence on interest rate that, in turn, impacts current account balances. It is worth mentioning that most of the countries under investigation have liberalized capital flows and maintained a soft peg with the US dollar for most of the observation period. In order to maintain the peg, a higher budget deficit should have an effect on interest rate through higher risk premium (see also Kaufmann *et al*., 2002).

## Empirical Investigation

### *Data description*

Quarterly data from post Bretton Woods (1976:1 to 2000:4) was utilized in the analysis but the sampling period differed for each country depending on the availability of data. For Malaysia, the data ended in 1998:2 before the hard peg of the ringgit to the US dollar in September 1998.[9] All the data, seasonally unadjusted and expressed in nominal terms, were obtained from several *International Financial Statistics* (*IFS*) issues published by the International Monetary Fund (IMF). The variables employed

in the study were the current account (*CAD*), budgetary variables (*BD*), nominal exchange rate (*EX*) denominated in the US dollar and short-term interest rate (*IR*).[10] Both the CAD and BD are expressed as ratios of the nominal GDP. The IFS provided CAD denominated in the US dollar while the BD and the nominal GDP are measured in domestic currency. For consistency, all variables are expressed in domestic currency. Data for GDP are available on an annual basis and, hence, quarterly GDP data for this study were extrapolated from the annual series employing the approach suggested by Gandolfo (1981).

We computed the partial correlation between the two deficits for the full sample to impart an overall impression on the twin deficits hypothesis in the ASEAN countries. The correlation ranges from 0.93 (Thailand) to 0.85 (the Philippines) and hence the impression we get is that BD is positive correlated CAD. Casual observation from the plots of both of the series, however, does not provide clear evidence on the twin deficit hypothesis that increases in the budget deficit lead current account deficit, especially in the 1990s. As such we relied on a statistical procedure outlined in the following section to reveal the relationship between the two deficits. To conserve space, we decided not include the plots of BD and CAD in the text.



*Unit root tests*

Standard unit root tests were performed for each series, first on levels and then first differences. The ADF (Said & Dickey, 1984) test failed to reject the null hypothesis of a unit root for all variables at any obvious significance levels. While the ADF test maintained the null hypothesis of non-stationarity of the time series under investigation, the Kwiatkowski *et al*. (1992) semi-parametric unit root test (KPSS test hereafter) uses a null hypothesis of stationarity against the alternative hypothesis of a unit root. The results of the KPSS test strongly reject the $I(0)$ null at 95 percent confidence level. Meanwhile, the KPSS statistics further strengthened this conclusion by failing to reject the null hypothesis at the usual confidence levels while the ADF statistics strongly reject the unit root null in favor of stationarity after taking first difference. Thus, these univariate unit root tests yield results that are consistent with the notion that all the variables are non-stationary in level but stationary in first difference (i.e. $I(1)$. To conserve space, only the results of the KPSS tests are shown in Table 1.

While it is possible that hysteresis (unit root) of current account, fiscal balance, and the other variables are found, it is also possible that the tests applied above simply reach a wrong conclusion For example, Engle (1998) argued that many of the unit root tests (including the KPSS) are prone to type 1 error. The possibility remains that the failure to reject the non-stationarity in level of the current account and budget deficit is that there may be macroeconomic disturbance, such as shocks due to policy changes, currency crisis or rapid fluctuation of world prices for primary commodities. The timing of any such regime shift is likely to be unknown a *priori*.

**Table 1.** KPSS and structural break unit root tests

| | Test Statistics | | | | |
|---|---|---|---|---|---|
| | $\eta_\mu$ | $\eta_\tau$ | ZA(A) | ZA(B) | ZA(C) |
| Indonesia | | | A: Level | | |
| CAD | 0.616(1)* | 0.411(1)* | −5.12[1997:2]* | −4.92[1996:1]* | −5.26[1997:2]* |
| BD | 0.639(1)* | 0.157(1)* | −12.31[1987:4]* | −11.82[1985:4]* | −12.25[1988:1]* |
| IR | 0.874(1)* | 0.172(1)* | −3.25[1997:1] | −2.83[1998:2] | −4.42[1997:2] |
| EXC | 2.325(3)* | 0.162(3)* | −5.01[1996:4]* | −4.94[1997:2]* | −4.88[1997:3]* |
| Malaysia | | | | | |
| CAD | 0.743(1)* | 0.264(1)* | −1.79[1997:3] | −1.75[1997:2] | −2.08[1983:1] |
| BD | 1.113(2)* | 0.206(2)* | −11.73[1981:1]* | −11.68[1981:2]* | −11.71[1981:2]* |
| IR | 1.773(1)* | 0.261(1)* | −2.51[1988:1] | −2.96[1993:1] | −2.91[1993:3] |
| EXC | 2.047(2)* | 0.254(2)* | −3.91[1997:1] | −3.78[1996:2] | −3.73[1996:3] |
| Philippines | | | | | |
| CAD | 1.018(2)* | 0.220(1)* | −4.82[1998:1]* | −5.53[1996:4]* | −5.46[1996:4]* |
| BD | 0.486(1)* | 0.202(2)* | −7.89[1998:3]* | −7.75[1998:3]* | −8.58[1998:4]* |
| IR | 0.592(1)* | 0.304(1)* | −4.69[1983:1] | −4.59[1984:1]* | −5.37[1985:2]* |
| EXC | 2.388(3)* | 0.321(3)* | −3.92[1982:3] | −3.67[1982:4] | −3.73[1982:4] |
| Thailand | | | | | |
| CAD | 0.636(4)* | 0.236(3)* | −6.27[1997:1]* | −6.41[1997:1]* | −6.44[1997:2]* |
| BD | 0.676(4)* | 0.273(4)* | −8.26[1986:3]* | −9.06[1987:3]* | −9.13[1987:4]* |
| IR | 1.128(1)* | 0.210(1)* | −3.86[1998:2] | −2.81[1997:1] | −2.80[1997:1] |
| EXC | 1.248(5)* | 0.165(5)* | −6.58[1996:4]* | −6.33[1997:1]* | −6.27[1997:1]* |
| | | | B: First Differences | | |
| Indonesia | | | | | |
| ΔCAD | 0.095(1) | 0.027(1) | −14.69[1997:2]* | −14.22[1996:4]* | −14.80[1997:2]* |
| ΔBD | 0.026(1) | 0.016(1) | −21.83[1985:4]* | −21.64[1985:3]* | −21.87[1988:2]* |
| ΔIR | 0.039(1) | 0.038(1) | −10.07[1997:1]* | −11.91[1998:2]* | −12.03[1997:2]* |
| ΔEXC | 0.074(3) | 0.039(3) | −9.92[1997:4]* | −8.95[1997:1]* | −10.38[1998:1]* |
| Malaysia | | | | | |
| ΔCAD | 0.180(1) | 0.086(1) | −6.28[1997:3]* | −6.13[1996:4]* | −6.16[1997:3]* |
| ΔBD | 0.023(2) | 0.015(2) | −16.30[1981:1]* | −16.30[1981:2]* | −16.22[1981:2]* |
| ΔIR | 0.185(1) | 0.064(1) | −8.12[1993:3]* | −7.66[1992:2]* | −8.12[1993:4]* |
| ΔEXC | 0.403(2) | 0.126(2) | −11.01[1997:1]* | −9.28[1996:2]* | −12.79[1997:1]* |
| Philippines | | | | | |
| ΔCAD | 0.203(2) | 0.089(2) | −14.17[1997:2]* | −13.92[1997:2]* | −14.29[1997:2]* |
| ΔBD | 0.030(1) | 0.022(1) | −14.95[1998:3]* | −14.85[1998:3]* | −14.92[1998:4]* |
| ΔIR | 0.026(1) | 0.021(1) | −12.46[1984:3]* | −12.48[1984:2]* | −12.59[1984:1]* |
| ΔEXC | 0.091(3) | 0.094(3) | −9.96[1984:3]* | −9.54[1983:1]* | −10.81[1984:4]* |
| Thailand | | | | | |
| ΔCAD | 0.108(3) | 0.043(3) | −11.05[1996:1]* | −10.94[1997:3]* | −11.74[1997:2]* |
| ΔBD | 0.062(4) | 0.047(4) | −14.10[1986:3]* | −14.41[1987:4]* | −14.27[1986:2]* |
| ΔIR | 0.188(1) | 0.072(1) | −9.52[1997:2]* | −10.94[1997:2]* | −11.35[1997:2]* |
| ΔEXC | 0.156(5) | 0.065(5) | −13.02[1997:2]* | −10.68[1997:1]* | −13.51[1997:3]* |

*Notes:* The $\eta$, ZA(A), ZA(B), ZA(C) statistics are referred to KPSS and Zivot & Andrews (1992, ZA). The subscripts $\mu$ and $\tau$ indicate the models that allow for a drift term and both a drift and a deterministic trend, respectively. Asterisk (*) denotes statistically significant at 5 percent level. Figures in ( ) indicate the lag length while [ ] refers to the breaking date. The KPSS test critical values is obtained from Kwiatkowski *et al*. (1992, Table 1, p. 166) while the critical values of ZA(A) [-4.80], ZA(B) [-4.42] and ZA(C) [-5.08] are obtained from Zivot & Andrews (1992, Tables 2, 3, and 4, pp. 256–257). KPSS tests the null hypothesis that the series is stationary against the alternative hypothesis of a unit root. ZA(A), ZA(B) and ZA(C) tests added to the same hypothesis and the possible presence of structural breaks in the data generating process (DGP) endogenously. The estimation and the calculation of the KPSS were carried out in E-Views version 5.0 while the ZA test statistics are conducted using RATS 5.02.

Zivot & Andrews (1992) have developed methods to endogenously search for a break point and test for the presence of a unit root when the process has a broken trend. The selection of the possible break point ($T_B$) is viewed as the outcome of an estimation procedure designed to fit $y_t$, which it is fully determined by the data. The breakpoint selection procedure then relies on identifying the breakpoint that produces the lowest value over all possible breakpoints of the relevant one-sided unit root $t$-statistics for testing $\omega = 1$ in the appropriate autoregression and denoted as a general form of $t_{\inf}(\lambda)$, where $\lambda$ stands for the break fraction in the sample. In this paper, the estimation is done for all three models; however, the most general form specification of Model C will only be documented for the sake of presentation. In general, Model C can be expressed as:

$$y_t = \gamma + \varphi DU_t(\lambda) + \vartheta DT_t(\lambda) + \delta t + \rho y_{t-1} + \sum_{j=1}^{k} c_j \Delta y_{t-j} + \varepsilon_t \qquad (1)$$

where $t = 1,2..., T$, $\lambda = T_B/T$,$T_B$ is the break data, $DU_t$ $(\lambda) = 1$ if $t > T\lambda$ or 0 otherwise and $DT_t$ $(\lambda) =$ t-T$\lambda$ if $t > T\lambda$ or 0 otherwise. The latter dummy variable is the one that accounts for a structural break at time $T_B$. For this purpose, two dummies will be included in this case. The simpler alternatives of the stationarity around a segmented trend (Model B) or that with a shift in mean (Model A) is feasible through the elimination of $DU_t(\lambda)$ and $DT_t(\lambda)$ from equation (1) respectively. For these two hybrid versions, only one dummy will be included in the estimation process. The empirical results are also presented in Table 1.

The results of Zivot–Andrews sequential unit root tests reported in Table 1 reveal that significant structural breaks are detected especially for CAD and BD. The tests place the breaks in the 1997 crisis and in the mid-1980s, following the fall in commodity prices. Thus, the evidence is strongly supportive of the unit root null. Given the unanimity of all the results from these tests, it is unlikely that we have reached a wrong conclusion. Additionally, these results are in line with most of the recent empirical work (e.g. McCosky & Kao, 1999; Baharumshah *et al*., 2003).[11]

*Cointegration*

Given the common integrational properties of all the series under investigation, the next step was to test for the presence of cointegration for the four-dimensional vector [BD IR EX CAD] in each country. The Johansen procedure employs two likelihood ratio (LR) test statistics to determine the number of cointegrating vectors: the trace test and the maximal eigenvalue ($\lambda$-max) test. As this procedure has become standard practice in empirical work, a detailed explanation of the tests is not presented here. Interested readers may refer to Johansen (1988) and its extension in Johansen & Juselius (1990) for a complete discussion on the procedure. The importance of applying a correction factor for the cointegration procedure in the small sample is

now well known. This adjustment is necessary to reduce the tendency of the test to falsely reject the null hypothesis of no cointegration in a relatively short span of data. We relied on the correction factor suggested by Reinsel & Ahn (1992) to the estimated maximum eigenvalue and trace statistics. The correction factor suggested is the multiplication of the test statistic by $(T\text{-}pk)/T$, where $T$ is the sample size, $p$ is the number of variables, and $k$ is the lag length for the VAR model.

Before applying the technique, the optimum lag order ($k$) for the vector autoregressive (VAR) to be applied in each cointegration test was determined. We determined the lag order using the information provided by the Akaike Information Criterion (AIC) and the vector autocorrelation test. Results of the Johansen cointegration procedure are presented in Table 2 Panel A.[12] The null hypothesis of no cointegrating vector ($r = 0$) was soundly rejected at 5 percent significance level for Indonesia, Malaysia and Thailand. On the other hand, both the tests failed to reject the null hypothesis of non-cointegration in the case of the Philippines. For the trace test, the null hypothesis ($H_0$: $r = 0$) was tested against the alternative ($H_a$: $r \geq 1$). We obtained results that are consistent with the ($\lambda$-max) test. On the basis of these test results, we can interpret that a unique cointegrating relationship has emerged in three out of the four ASEAN countries (with and without the correction factor). In other words, there is at least a stochastic trend shared among the four variables in the system for Malaysia, Indonesia and Thailand. For the case of the Philippines, one may conclude that the data do not support the twin deficit hypothesis. However, this conclusion might be misleading if the long-run relationship among the variables has shifted over time, due to structural change. We will return to this issue later.

At this point it is important to find out if each of the variables in the four-dimensional VAR enters significantly in the cointegrating relationship. By using a zero restriction on each of the variables derived from the Johansen procedure, we were able to ascertain that the variable enters in the cointegrating space. It is possible to test the validity of the twin deficits hypothesis in the long run. The LR statistics, not presented, but available upon request, reveal that all four variables enter significantly in the long run relationship. This indicates that omission of any one of these variables may bias the empirical results. Additionally, it suggests that there is a stable long run relationship between the two deficits. A test conducted by simultaneously excluding the interest rate and exchange rate was rejected by the data at a high significance level. We further investigated the simultaneous exclusion of the budget and current account deficits in the cointegrating regression. The statistical evidence was strongly rejected by the data, implying that the REH failed to hold for the ASEAN countries. The results, however, can be seen as evidence indicating that twin deficits are closely linked.

The results of the Johansen procedure are sensitive to structural breaks in the long run cointegrating relationship. Additionally, several authors have argued that the relationship between the two deficits may have changed as more recent data are used in the analysis. To allow for this possibility, we applied the Gregory & Hansen (1996) cointegration test with breaks. Briefly, under this procedure, a dummy variable is included to account for a shift in the cointegrating regression. The minimum ADF

**Table 2.** Cointegration tests

| | | $\lambda_{max}$ | | | Trace | | |
|---|---|---|---|---|---|---|---|
| Null | Alternative | Unadjusted | Adjusted | 95% C.V. | Unadjusted | Adjusted | 95% C.V. |
| | | A: Johansen's Multivariate cointegration tests | | | | | |
| | | Indonesia | | | | | |
| | | $k$ =4 $r$=1 | | | | | |
| r = 0 | r = 1 | 42.103* | 35.36* | 31.000 | 69.668* | 59.521* | 58.930 |
| r<= 1 | r = 2 | 15.314 | 12.838 | 24.350 | 27.564 | 23.154 | 39.330 |
| r<=2 | r = 3 | 10.472 | 8.796 | 18.330 | 12.250 | 10.290 | 23.830 |
| r<=3 | r = 4 | 1.778 | 1.493 | 11.540 | 1.778 | 1.493 | 11.540 |
| | | Malaysia | | | | | |
| | | $k$ =3 $r$=1 | | | | | |
| r = 0 | r = 1 | 49.159* | 42.604* | 23.920 | 66.576* | 56.832* | 39.810 |
| r<= 1 | r = 2 | 8.638 | 7.486 | 17.680 | 17.417 | 15.095 | 24.050 |
| r<=2 | r = 3 | 7.229 | 6.266 | 11.030 | 8.7788 | 7.608 | 12.360 |
| r<=3 | r = 4 | 1.549 | 1.342 | 4.160 | 1.549 | 1.342 | 4.160 |
| | | Philippines | | | | | |
| | | $k$ =5 $r$=0 | | | | | |
| r = 0 | r = 1 | 20.970 | 16.550 | 27.100 | 39.080 | 30.860 | 47.200 |
| r<= 1 | r = 2 | 15.280 | 12.060 | 21.000 | 18.120 | 14.300 | 29.700 |
| r<=2 | r = 3 | 2.828 | 2.233 | 14.100 | 2.839 | 2.242 | 15.400 |
| r<=3 | r = 4 | 0.011 | 0.009 | 3.800 | 0.011 | 0.009 | 3.800 |
| | | Thailand | | | | | |
| | | $k$ =5 $r$=1 | | | | | |
| r = 0 | r = 1 | 42.993* | 34.395* | 23.920 | 59.035* | 47.228* | 39.810 |
| r<= 1 | r = 2 | 13.089 | 10.471 | 17.680 | 16.042 | 12.8336 | 24.050 |
| r<=2 | r = 3 | 2.434 | 1.947 | 11.030 | 2.9532 | 2.363 | 12.360 |
| r<=3 | r = 4 | 0.519 | 0.415 | 4.160 | 0.519 | 0.415 | 4.160 |
| | | B: Gregory and Hansen (1996) Cointegration Test | | | | | |
| Philippines | | C | | | C/T | | C/S |
| | | −5.631* | | | −5.470 | | −3.024 |
| | | (1986:4) | | | (1986:4) | | (1986:4) |

*Notes:* $k$ is the lag length and $r$ is the cointegrating vector(s). Chosen $r$: number of cointegrating vectors that are significant under both tests. The unadjusted and the adjusted statistics are the standard Johansen statistics and the statistics adjusted for small sample correction factor according to Reinsel & Ahn (1992) respectively. Critical values for both the trace and maximum eigenvalue tests are tabulated in Osterwald-Lenum (1992). The critical values are obtained from Table 1 (p. 109) of Gregory & Hansen (1996) for $m$ =3. Asterisks (*) denotes statistically significant at 5 percent significance level.

statistic endogenously determines the breakpoint and is compared to critical values supplied by Gregory & Hansen (1996). The procedure offers four different models corresponding to the four different assumptions concerning the nature of the shift in the cointegrating vector.[13]

Panel B in Table 2 provides a summary of the results under three hypothetical models. Note that we only present the results of the Gregory & Hansen (1996) tests in cases where Johansen's procedure failed to detect the long run relationships. The

**Table 3.** Normalizing the cointegrating vectors

| Variables | CA | BD | IR | EXC |
|---|---|---|---|---|
| Indonesia | −1.000 | 0.465 | 0.005 | 0.276 |
| Malaysia | −1.000 | 0.488 | −0.059 | 0.367 |
| Philippines | −1.000 | 0.317 | −0.012 | 0.018 |
| Thailand | −1.000 | 0.439 | −0.015 | 0.033 |

*Notes:* The estimated coefficients were obtained by normalizing the current account variable from the Johansen's multivariate cointegration tests except for the Philippines where the parameter normalization is estimated based on the Gregory & Hansen result.



breaking points are determined by the tests and are expressed in proportion to the sample size. In what follows, only the case of the Philippines has been re-examined. Panel B clearly shows the existence of cointegration with a break for the Philippines from the one break shift model. The test statistics indicate that the break is likely to be in 1986:4. To summarize, there is strong evidence of a unique long run relationship between external deficit and its determinants for all the countries under investigation.

Next, we proceeded with the estimation of the long run parameters of the model by normalizing CAD. There is only one significant vector detected in each case and so we do not have the problem of identification of the equation that presents the current account. Table 3 reports the long run parameters of the model. The results show a positive and significant relationship between BD and CAD. This is an important result especially in regard to the debate on the twin deficits hypothesis. According to this finding, a rise in budget deficit would also be followed by an increase in external balance. Both interest rates and exchange rates carry the expected sign. The response of CA to changes in exchange rate is found to be larger than interest rates in all the studied countries.

*Granger causality analysis*

In the presence of cointegration, there always exists a corresponding error correction representation. In other words, if a VAR system is cointegrated, the Granger causality test may be conducted in the environment of VECM. Otherwise, the analyses may be conducted as a standard first difference vector autoregressive (VAR) model. The relevant error correction terms (ECTs) must be included in the VAR to avoid misspecification and omission of the important constraints. However, the workhorses of testing the non-causality such as ECM and VECM when the variables are cointegrated are cumbersome and sensitive to the values of nuisance parameters in finite samples and therefore 'the virtues of simplicity and ease of application have been largely lost' (Rambaldi & Doran, 1996, p. 3). In addition, the formulation does have its drawbacks in that it is implicitly dependent upon a pre-test of integration and cointegration (Lütkepohl & Reimers, 1992).

One way to circumvent this problem is to posit a VAR in which variables appear purely in their level form. Toda & Yamamoto (1995) have proposed the modified WALD (MWALD) for testing *Granger non-causality* that allows causal inference to be conducted in the level VARs that may contain integrated and (non-) cointegrated processes and require the determination of the true lag length of the model.[14] This procedure imposes (non-) linear restrictions on the parameters of VAR models without having to pretest for unit root and cointegrating rank. Rambaldi & Doran (1996) had shown that Seemingly Unrelated Regression (SUR) could easily compute the MWALD test. In what follows, we relied on the Toda–Yamamoto tests to make the causal inference among the variables in the VAR model.

Once the optimum lag length ($k$) has been found and the congruency of the VAR duly examined through the standard diagnostics test, the causality test was formulated as a zero restriction on the coefficient of the lags of the other variables by $\chi^2$-test statistics. The outcomes of the Granger causality test on Toda–Yamamoto augmented lags method are shown in Table 4. It is evident from Table 4 that the null hypothesis of non-Granger causality between budget deficit and current account deficit (BD → CAD) is easily rejected at the 5 percent significance level for all the countries except

**Table 4.** Granger non-causality results

| Dependent Variable | CAD | BD MWALD ($\chi^2$-statistics) | IR | EXC |
|---|---|---|---|---|
| A: Indonesia ($k$ =4 $d$ =1) | | | | |
| CAD | — | 1.992(0.574) | 6.067(0.107) | 11.359(0.010)* |
| BD | 8.816(0.032)* | — | 0.492(0.921) | 8.293(0.040)* |
| IR | 2.296(0.513) | 23.583(0.000)* | — | 0.493(0.920) |
| EX | 4.979(0.173) | 3.182(0.364) | 25.652(0.001)* | — |
| B: Malaysia ($k$ = 3 $d$ = 1) | | | | |
| CAD | — | 8.263(0.041)* | 2.694(0.441) | 16.294(0.001)* |
| BD | 10.714(0.013)* | — | 0.647(0.885) | 27.973(0.000)* |
| IR | 0.221(0.974) | 19.391(0.000)* | — | 6.369(0.094) |
| EX | 4.832(0.184) | 3.271(0.352) | 11.969(0.007)* | — |
| C: Philippines ($k$ = 5 $d$ = 1) | | | | |
| CAD | — | 12.358(0.030)* | 3.843(0.527) | 13.693(0.017)* |
| BD | 14.838(0.011)* | — | 8.502(0.131) | 6.749(0.239) |
| IR | 5.814(0.213) | 13.499(0.020)* | — | 10.344(0.066) |
| EX | 5.168(0.270) | 1.117(0.891) | 1.706(0.789) | — |
| D: Thailand ($k$ = 5 $d$ = 1) | | | | |
| CAD | — | 12.140(0.032)* | 13.615(0.018)* | 28.779(0.000)* |
| BD | 7.823(0.166) | — | 3.776(0.582) | 4.033(0.545) |
| IR | 4.904(0.427) | 12.045(0.034)* | — | 5.948(0.311) |
| EX | 6.482(0.262) | 8.729(0.120) | 20.769(0.000)* | — |

*Note:* Figures in parentheses are the $p$-value. Asterisk (*) denotes statistically significant at 5 percent level. $k$ = optimum lag and $d$ = maximum order of integration.

Indonesia. In fact, there exists feedback on the causal relationship between the two variables (BD $\leftrightarrow$ CAD) for Malaysia and the Philippines. This two-way causality between the two deficits was also found in Anoruo & Ramchander (1998) and Khalid & Teo (1999).[15] For Indonesia we found a direct causality running from CAD account to BD and also an indirect reverse causation between the two deficits. Such evidence is contrary to what found in the literature for the US and other developing economies. Nonetheless, Anoruo & Ramchander (1998) found that trade deficits cause fiscal deficits for most of the developing economies of Asia, including Indonesia. This result may be attributed to the fact that the government spending leads have deleterious effects of trade imbalances.

Further analyses were carried out to ascertain the robustness of the basic results. To this end, we relied on the causal inference using the vector error correction model (VECM) framework as described in Engle & Granger (1987). An advantage of this approach is that it allows us to distinguish between short and long-run causality (see Granger, 1991). The short-run causality test is usually based on $\chi^2$ (or $F$) statistics while the long-run causality test is based on $t$-statistics. The causal inference based on the VECM tallies with that of the Toda–Yamamoto long-run Granger causality test reported earlier. We also found the support of the short-run feedback causal relationship between BD and CAD in all cases except for Thailand, where the causality runs from BD to CAD and not vice versa.

The endogeneity of two deficit variables in most of the countries warrants investigating the indirect causality that may exist in the twin deficits nexus. This is important as it allows one to map out the role of the causing variables (interest and exchange rates) as well as the indirect causal relationship in the twin deficits hypothesis. Specifically, we seek the causal chain that runs from budget deficits to interest rate, to capital flows, to exchange rate and finally to the current account deficits (BD $\rightarrow$ IR $\rightarrow$ EX $\rightarrow$ CAD) (see Volcker, 1984 and Abell, 1990). As shown in Table 4, this indirect causality between budget and external balances is detected in all the ASEAN-4 countries except for the Philippines. It is noteworthy to point out here that the indirect causal relationship between budget deficit and current account deficit (BD $\rightarrow$ IR $\rightarrow$ EX $\rightarrow$ CAD) in the case of Indonesia does not contradict the reverse causality (CA $\rightarrow$ BD).

We have demonstrated the role of interest rates and exchange rates in explaining the twin deficits nexus. Overall, our finding is consistent with that reported in Volcker (1984) and Abell (1990) but differs from them in the following ways. First, we found that the causal relationship between budget and current account deficits works through two channels: one directly between budget deficit and current account deficit and the other through interest rate and exchange rate. Second, our results demonstrate the 'vicious circle' phenomena since a feedback relationship exists between the twin deficits. The only exception is Thailand, where we did not detect a causal relationship running from CA $\rightarrow$ BD either directly or indirectly. To strengthen the evidence found in the causality analysis, the dynamic analysis of the system will be examined in the next section.

*The dynamic analysis: GVDCs and GIRFs*

Although the Granger causality presented in the previous section provided a rich framework for which causality may be tested, they are strictly within the sample test. They here refers to the tests conducted before the GVDCs and the IRFs tests. Authors like Masih & Masih (1996) do argue that VECM is a test within the sample size while the GVDCs and the IRFs measured the strength of the variables while providing the dynamic properties of the system beyond the sample. In order to gauge the relative strength of the variables and the transmission mechanism responses, we now shock the system and partition the forecast error variance decomposition (FEVD) for each of the variables in the system. However, it is well established that the results of FEVD based on Choleski's decomposition are generally sensitive to the ordering of the variables and the lag length (see for example, Lütkepohl, 1991). The results of the conventional FEVD are predetermined by the manner in which the system variables are ordered. To overcome this shortcoming, the generalized variance decomposition (GVDCs) provided by Lee *et al*. (1992) and Lee & Pesaran (1993) was applied here. Similarly, we conducted the generalized impulse response functions (GIRFs), based on the work by Pesaran & Shin (1998).

Results of the GVDC from 1 to 24 quarters for the system are given in Table 5. The major findings may be summarized as follows. First, it can be seen that the shocks in the current account contribute more in explaining the forecast error variance in budget deficit for Malaysia, Indonesia and the Philippines. For example, innovations in the current account explained 24 percent of Malaysia's and 9 percent of Indonesia's budget deficit variance at the 24-quarter horizon. Meanwhile, the budget deficit has a greater impact on the current account in Thailand with the same horizon. Thus, these results strengthen the causality chain presented earlier and lend further support to the body of literature that suggests that budget deficit does indeed have a causal relationship with current account.

Second, the proposition of the current account deficit that can be attributed to innovations in other variables (budget deficit, interest rate and exchange rate) ranges from 20 percent to 47 percent. This proposition is 47 percent for Thailand, 33 percent for Indonesia, 29 percent for the Philippines and 20 percent for Malaysia. This indicates that a large fraction of the current account deficit is attributed to shocks originating from the other macroeconomic variables at the 24-quarter horizon. The budget deficit also exhibits similar qualitative patterns. We may conclude that, in the short-run (say 1–4 quarters), movement in the twin deficits is largely due to their own shocks, but in the long run, they become increasingly interconnected with other macroeconomic variables.

Third, the exchange rate is relatively the leading variable, being the most exogenous of all in Malaysia and Thailand after the 24-quarter horizon. In contrast, interest rate and budget deficit emerged as the most exogenous variables in the Philippines and Indonesia for the same horizon. For example, 75 percent (83 percent) of the variation

**Table 5.** Variance decomposition

| Percentage of variations in | Horizon | Due to innovation in: ΔCAD | ΔBD | ΔIR | ΔEXC |
|---|---|---|---|---|---|
| | | A: Indonesia | | | |
| Quarters Relative Variance in: ΔCAD | | | | | |
| | 1 | **85.480** | 0.932 | 2.183 | 11.405 |
| | 4 | **70.746** | 0.708 | 3.824 | 24.723 |
| | 8 | **67.681** | 0.707 | 4.486 | 27.126 |
| | 24 | **67.553** | 0.715 | 4.071 | 27.661 |
| Quarters Relative Variance in: ΔBD | | | | | |
| | 1 | 7.198 | **90.211** | 0.090 | 2.501 |
| | 4 | 7.891 | **85.936** | 0.862 | 5.311 |
| | 8 | 8.226 | **85.134** | 1.282 | 5.358 |
| | 24 | 9.108 | **83.246** | 1.412 | 6.234 |
| Quarters Relative Variance in: ΔIR | | | | | |
| | 1 | 0.443 | 5.419 | **91.878** | 2.260 |
| | 4 | 0.606 | 10.660 | **85.353** | 3.381 |
| | 8 | 0.911 | 19.647 | **74.665** | 4.776 |
| | 24 | 1.943 | 25.423 | **65.497** | 7.137 |
| Quarters Relative Variance in: ΔX | | | | | |
| | 1 | 3.183 | 6.948 | 1.371 | **88.498** |
| | 4 | 2.687 | 11.528 | 4.910 | **80.876** |
| | 8 | 3.014 | 9.152 | 14.547 | **73.287** |
| | 24 | 3.081 | 5.894 | 21.238 | **69.787** |
| | | B: Malaysia | | | |
| Quarters Relative Variance in: ΔCAD | | | | | |
| | 1 | **85.674** | 8.760 | 3.251 | 2.315 |
| | 4 | **81.710** | 10.186 | 4.755 | 3.350 |
| | 8 | **80.721** | 10.858 | 4.455 | 3.965 |
| | 24 | **80.218** | 11.196 | 4.363 | 4.223 |
| Quarters Relative Variance in: ΔBD | | | | | |
| | 1 | 4.653 | **94.658** | 0.647 | 0.042 |
| | 4 | 11.556 | **82.326** | 3.688 | 2.430 |
| | 8 | 16.599 | **70.776** | 7.213 | 5.412 |
| | 24 | 24.048 | **54.231** | 12.725 | 8.996 |
| Quarters Relative Variance in: ΔIR | | | | | |
| | 1 | 6.566 | 7.070 | **76.134** | 10.230 |
| | 4 | 5.908 | 17.518 | **63.188** | 13.386 |
| | 8 | 6.020 | 20.970 | **59.938** | 13.072 |
| | 24 | 6.190 | 22.782 | **58.064** | 12.964 |
| Quarters Relative Variance in: ΔEX | | | | | |
| | 1 | 2.333 | 0.173 | 7.705 | **89.789** |
| | 4 | 1.008 | 0.080 | 8.217 | **90.694** |
| | 8 | 0.708 | 0.076 | 8.627 | **90.589** |
| | 24 | 0.498 | 0.070 | 8.960 | **90.471** |

**Table 5.** Variance decomposition (Continued)

| Percentage of variations in | Horizon | Due to innovation in: ΔCAD | ΔBD | ΔIR | ΔEXC |
|---|---|---|---|---|---|
| | | C: Philippines | | | |
| Quarters Relative Variance in: ΔCAD | | | | | |
| | 1 | **88.773** | 2.363 | 0.375 | 8.489 |
| | 4 | **81.694** | 8.691 | 0.456 | 9.159 |
| | 8 | **77.650** | 9.252 | 0.583 | 12.515 |
| | 24 | **71.484** | 13.351 | 0.697 | 14.469 |
| Quarters Relative Variance in: ΔBD | | | | | |
| | 1 | 4.105 | **93.803** | 1.313 | 0.779 |
| | 4 | 4.701 | **90.502** | 3.056 | 1.741 |
| | 8 | 8.668 | **77.895** | 8.491 | 4.946 |
| | 24 | 13.154 | **72.121** | 9.067 | 5.657 |
| Quarters Relative Variance in: ΔIR | | | | | |
| | 1 | 0.849 | 5.626 | **92.570** | 0.956 |
| | 4 | 1.064 | 9.259 | **85.854** | 3.824 |
| | 8 | 1.477 | 10.549 | **81.604** | 6.371 |
| | 24 | 1.717 | 14.441 | **75.261** | 8.581 |
| Quarters Relative Variance in: ΔEX | | | | | |
| | 1 | 4.075 | 4.065 | 13.492 | **78.368** |
| | 4 | 5.847 | 7.981 | 10.147 | **76.026** |
| | 8 | 7.254 | 10.928 | 7.872 | **73.946** |
| | 24 | 10.559 | 15.508 | 6.960 | **66.973** |
| | | D: Thailand | | | |
| Quarters Relative Variance in: ΔCAD | | | | | |
| | 1 | **68.804** | 25.486 | 0.198 | 5.513 |
| | 4 | **54.312** | 39.506 | 0.883 | 5.299 |
| | 8 | **51.941** | 40.077 | 0.663 | 7.320 |
| | 24 | **53.185** | 36.672 | 0.510 | 9.632 |
| Quarters Relative Variance in: ΔBD | | | | | |
| | 1 | 6.028 | **87.255** | 4.533 | 2.184 |
| | 4 | 12.138 | **74.348** | 7.465 | 6.049 |
| | 8 | 13.749 | **72.779** | 6.714 | 6.758 |
| | 24 | 12.299 | **78.704** | 4.630 | 4.367 |
| Quarters Relative Variance in: ΔIR | | | | | |
| | 1 | 0.455 | 3.116 | **95.916** | 0.513 |
| | 4 | 1.259 | 5.552 | **92.164** | 1.025 |
| | 8 | 2.612 | 11.580 | **84.702** | 1.107 |
| | 24 | 3.760 | 15.982 | **79.099** | 1.159 |
| Quarters Relative Variance in: ΔEX | | | | | |
| | 1 | 7.728 | 0.381 | 7.896 | **83.996** |
| | 4 | 6.732 | 1.770 | 8.612 | **82.886** |
| | 8 | 6.437 | 1.834 | 8.492 | **83.237** |
| | 24 | 5.705 | 1.833 | 7.197 | **85.264** |

Note: The figures in bold represent their own shock.

in interest rate (budget deficit) is explained by its own shock in the Philippines (Indonesia) after the 24-quarter horizon. Fourth, the budget deficit explained 14 percent (Philippines) to 25 percent (Indonesia) of the variance forecast errors of interest rate at the 24-quarter horizon. This finding supports the view that budget deficit does affect domestic interest rates. It turns out that interest rate appears not to be a weakly exogenous variable and it impact on current accounts in these small open economies is small. Finally, for the Philippines, both current account deficit and budget deficit have about the same explanatory power at all horizons. These as well as other results from the dynamic analysis are summarized in Table 5.

Given the system of a four-dimensional variable with the four countries, we may construct illustrations of up to 48 possible scenarios for each of the variables in the four countries taken separately (ignoring their own shocks) of impulse response paths in a particular index from shocks to their own and other indexes. Note that the GIRFs are the continuity process of the empirical evidences obtained from GVDCs. Due to space constraints, the results from the GIRFs are available upon request.

The GIRFs experiment suggests that the life of the exogenous shocks is different among the ASEAN-4 countries. Specifically, countries like the Philippines exhibit a response that has yet to stabilize even after 50 quarters of a period while Malaysia offers the quickest transitory pattern in converging to the long run time path. Over the period, it is clear that the four-dimensional system of Malaysia behaves in a transitory manner with the effects from the shock in each particular variable being dampened after about one and a half years of the period. For the remaining countries, the life of such shocks stood at about 20–25 quarters. Therefore, the evidence in this study illustrates that twin deficits can be mutually interdependent and the twin deficits structure is much more complex than that suggested by the standard bivariate analysis.

## Concluding Remarks

This study focuses on the twin deficits hypothesis in the ASEAN-4 countries. The empirical evidence based on an array of time-series econometrics leads to some tentative conclusions. First, budget deficit, interest rate, exchange rate and current account are found to be cointegrated (with a break for the Philippines), suggesting that there exists an equilibrium long-run relationship binding all these variables. Second, there are two major channels through which budget deficit affects the current account in these countries. The first is the direct causal link from budget deficit to current account deficit, and the second is the indirect channel that runs from budget deficit to higher interest rate; higher interest rates lead to appreciation of the currency and this in turn worsens the current account deficit. This chain of causal relationship is predicted by the standard theory and is found in all the ASEAN countries except the Philippines.

These results do support the twin-deficits hypothesis, although we find that the strength of the relationship between the two deficits varies across the ASEAN countries. For example, an unambiguous strong support for the Keynesian view is

found only for Thailand over the short-and long-run horizons. Thus, it is clear that budget cuts (fiscal discipline) correct the current account deficit directly as well as indirectly through interest and exchange rates for the case of Thailand. A somewhat different picture emerged for Indonesia, a country that experienced severe financial and political turmoil during the financial crisis. We found that the current account led to budget deficit and hence supported Summers' (1988) view of current account targeting. There is evidence to suggest that the Indonesian authorities utilized budget deficit to target their current account balances for the sample period under investigation. For the remaining ASEAN economies (Malaysia and the Philippines), the outcome supports a two-way causality between the twin deficits.

Third, we observed that budget deficits directly affect interest rates in the domestic market. These in turn lead to an appreciation of the exchange rate, which influences the price of imports and exports and contributes to the deterioration of the current account. And when this cycle starts it is difficult to stop due to the vicious circle of the large fiscal deficit and the widening in the external imbalances. Of course, this type of causal chain assumes that the Marshall–Learner condition holds. The statistical evidence illustrates that the twin deficits can be mutually interdependent and that the causality pattern of the twin deficits is much more complex than that suggested by the standard bivariate analysis. We view the finding as supporting the fact that interest and exchange rates may be used to affect the external imbalance in the ASEAN countries.

From a policy perspective, the results indicate that exchange rates Granger-cause current account deficits directly and interest rates seem to cause current account deficits through the exchange rate. Empirical evidence suggests that a rise in interest rate (say due to an increase in budget deficit) causes the exchange rate to appreciate and the appreciation of the currency in turn causes a current account deficit. Additionally, the empirical evidence suggests that to maintain external stability, there is a need to improve fiscal flexibility – the capacity to alter the level as well as the mix of spending quickly and responsively to policy shifts. We note that most of the ASEAN countries are running large deficits in the post-crisis era. Hence if they are not properly managed, the twin deficits phenomena will emerge in the future.

The variance decompositions and impulse response function experiments suggest that the consequences of a large budget deficit and current account deficit become noticeable only over the long-term. For instance, about 15–20 quarters are required to resolve the disequilibrium shocks. As such, these lags carry with themselves the risk that policymakers in these countries believe that a large budget deficit has no real consequence on the economy. Yet the empirical results in this paper suggest otherwise: a larger budget deficit contributes towards unsustainability in the current account.

Many studies have argued that the way to reduce chronic current account deficits is to raise national savings by reducing the budget deficit and increasing the rate of private savings. Such a policy would directly decrease budget deficits and would indirectly reduce the external deficits due to a reduction in imported goods induced by a decline in private income. Unfortunately, the feedback causal relationship between these two variables, as observed in many of the ASEAN countries, suggests that the

authorities cannot simply rely on curtailing the budget deficit to manage the current accounts. The real solution to the problem lies with a coherent package consisting of both fiscal and monetary policies. Policy measures that focus on productivity improvement, exchange rate and monetary stance will complement the budget-cut.

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**Notes**

1. In the period 1980–85, the budget deficit in the US rose from US$74 billion in 1980 to a total of US$212 billion in 1985. In the same period, the dollar appreciated and in turn led to a deterioration in current account balance from a surplus of US$6.0 billion in 1980 to a deficit of US$124 billion by the year 1985. It is widely believed that the US current account deficit rose mainly because of skyrocketing budget deficits. The dramatic increase in the budget and current account deficits is commonly referred to as the 'twin deficits'.
2. Milesi-Ferretti & Razin (1996) and the Monetary Authority of Singapore (1997) pointed out that the presence of a budget deficit is also an explanation for the current account deficits in most of the ASEAN countries. Therefore, the choice of the countries in this study is not without merit.
3. The importance of the mediating variables in the twin deficits nexus is emphasized in Abell (1990) and Anoruo & Ramchander (1998). The role of the dollar in causing the trade deficit is a key part of the widely accepted doctrine that links trade deficit to the US budget deficit.
4. As pointed by the referee, $S = I$ may not be true for most of the sample countries.
5. Some earlier works that attempted to resolve the issue include Hutchison & Pigott (1984) and Bachman (1992). These studies also identified a causal relationship running from budget to current account deficits
6. The term Ricardian Equivalent first introduced by Buchanan (1976) implies that budget deficit could not cause current account deficit (see Barro, 1989). For details on REH, see Seater (1993) and the reference therein.
7. For instance, in the 1980s much of the Latin American countries' domestic investments were growing more rapidly than the domestic savings. This had an adverse effect on current account. The budget (fiscal) position had exacerbated the private sector imbalances.
8. An anonymous referee raised the issue of the potential price effect on the economy following an expansionary fiscal policy. The analysis should also include a price variable in the VAR model; however, doing so would affect the degree of freedom, given the sample period. We hope that the omission will not greatly influence the results.
9. According to IMF, Indonesia and Thailand transformed their officially declared exchange rate regimes in the direction of a greater flexibility system as a result of the crisis. Only the Philippines retained the pre-crisis independent float system. See also Hernández & Montiel (2003) for details. Preliminary results based on data ended 2000:4 did not yield satisfactory results and in the subsequent analysis, we have excluded the post-September 1998 period.
10. The short-run nominal interest rates used are as follows: Malaysia and the Philippines – 3-month treasury bill rates, Indonesia – interbank call loan rate while discount rates were used for Thailand.

11. We would like to express our gratitude to an anonymous referee for providing us this insight.
12. Most of the computations were done with EVIEWS MICROFIT and PcGIVE. The multivariate generalization of AIC yielded VAR (5) for the Philippines and Thailand, VAR (3) for Malaysia and VAR (4) for Indonesia. Despite different lag structures in each country, the residuals did not exhibit any form of serial correlation or ARCH effects satisfying the normal specification criteria for the residuals. In addition, the multivariate generalization of AIC remains the best performing criterion as the system dimension increases (see Gonzalo & Pitarakis, 2002).
13. Model 1 = standard cointegration, Model 2 = level shift (C), Model 3 = level shift with trend (C/T) and Model 4 = regime shift (C/S). We followed Gregory & Hansen (1996) to compute the ADF statistics for each breakpoint in the interval, $0.15T$ to $0.85T$ (where $T$ is the number of observations). We chose the breakpoint associated with the smallest negative value where the structural break occurred.
14. They have proven that in the integrated and (non-) cointegrated system, the MWALD test for restrictions on the parameters of a VAR ($k$) has an asymptotic $\chi^2$ distribution when a VAR ($k + d_{\max}$) is estimated, where $d_{\max}$ is the maximum order of integration suspected to occur in the system.
15. Khalid & Teo (1999) argued that a high correspondence between the two deficits is more likely to emerge in developing countries due to the differences in the structure of the economy. As such, the macroeconomic dynamics governing the two deficits may be different from the developed economy.



## Appendix A

The interpolation technique based on Gandolfo (1981) is adopted in this study to convert the annual basis of GDP to quarterly basis. In deriving the interpolation formulae, the observed values are actually integrals. Thus, the rule of thumb is to integrate the quadratic function in order to obtain the quarterly formulae. The quarterly formulae after satisfying each of the conditions in any year $t$ are as follows:

$$y_t^{(1)} = 0.0546875y_{t-1} + 0.234375y_t - 0.0390625y_{t+1} \quad (1)$$

$$y_t^{(2)} = 0.0078125y_{t-1} + 0.265625y_t - 0.0234375y_{t+1} \quad (2)$$

$$y_t^{(3)} = -0.0234375y_{t-1} + 0.265625y_t + 0.0078125y_{t+1} \quad (3)$$

$$y_t^{(4)} = -0.0390625y_{t-1} + 0.234375y_t + 0.0546875y_{t+1} \quad (4)$$

where $y_t$, $y_{t-1}$, $y_{t+1}$ are the current, lag and lead values of the variables in question at time $t$ (annual). In other words, three continuous annual observations of variable $y(t)$ are adopted in each of the equations. In order to calculate the value for the first quarter, we applied the formulae for the first quarter and subsequently for the remaining quarters. For example, one may substitute the GDP values for $y_t$, $y_{t-1}$, $y_{t+1}$ in equation (1) to obtain the calculated value for the first quarter. One advantage of the interpolation technique is being able to generate the higher frequency data series for the time series analysis. Smith (1998), for example uses Monte Carlo experiments to examine the effects of the linearly interpolating technique on the Johansen cointegration framework and found that it does not introduce any bias into the estimates of the cointegrating vectors even within a sample as short as 20 years.

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