FULL TITLE : Testing Twin Deficits Hypothesis: Using VARs and Variance Decomposition

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Abstract: This paper examines the twin deficits hypothesis in Indonesia, Malaysia, the Philippines and Thailand (ASEAN-4 countries). The major findings of this paper are: (1) Long run relationships are detected between budget and current account deficits. (2) We found that the Keynesian reasoning fits well for Thailand since a unidirectional relationship exists which runs from budget deficit to current account deficit. For Indonesia the reverse causation (current account targeting) is detected 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 lead to the appreciation of the exchange rate and this leads to the widening of current account deficit. (4) 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.

Keywords: Twin deficits, Cointegration, Variance Decomposition
JEL classification: F30, H60.

1. Introduction

Analysts and politicians have shown concern over the state of the current account imbalances in the last two decades. They consider growing fiscal and current account imbalances to have been the cause of macroeconomic imbalances and are important to the 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; Megarbane, 2002). In attempts to study the current account imbalances numerous researchers have explored the possible link between budget deficit and current account deficit. An example in the history is the so-called 'twin deficits hypothesis' which erupted during the 'Reagan fiscal experiment' in 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]. The large deficits are viewed as harmful to the domestic and world economies. This close connection between current account and budget deficits, however, is not unique to the United States. In Europe, Germany and Sweden faced similar problems that emerged in the early part of the 1990s when the rise in the budget deficits was accompanied by a real appreciation of their national currencies. This adversely affected the current accounts of these countries (see Ibrahim and Kumah, 1996).

Developing countries are no exceptions. Most have also experienced problems with external debts in the early 1980s. Several authors have documented that the unsustainable budget deficit during this period widened the current account deficit. Indeed, authors like Laney (1984) argued that the relationship between these two variables is even much stronger in developing economies. The emergence of the current account deficit and the budget deficit phenomena in many countries in the past decades 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 (hereafter ASEAN-4)-that persistent budget deficits have been the prime 'cause' of the escalating current account deficits observed in the late 1980s and most of the 1990s[2].

This article differs from the existing literature in the following ways. First, most of the earlier studies have focused on the twin deficits hypothesis in the developed countries. We chose the ASEAN-4 because the issue seems to be relevant to these economies and that they finance their investment mainly from foreign sources. All the countries under investigation lapsed into severe financial crises and some are still undergoing structural and economic adjustments in the aftermath of the currency crisis. Further, we observed that most of the crisis-affected countries (including those in this study) recorded large current and budget deficits for most part of the 1990s. The experience of the ASEAN-4 will contribute to the debate on the link between budget and current account deficits, the twin deficits issue particularly for developing countries, which is scarce in the literature.

Second, to the best of our knowledge, no previous work has attempted to address the twin deficits hypothesis for the ASEAN-4 countries, with the exception of Anoruo and Ramchander (1998) and Khalid and Teo (1999)[3]. This is surprising since the size of the current account deficits in these crisis-affected countries were large. In addition, we extended the bi-variate twin deficits issue to include two additional variables. The mediating variables, namely the interest rates and exchange rates, are known to influence the twin deficits process. These mediating variables, as we will show later, allow us to map out the transmission mechanism among the four variables[4].

The remainder of this paper is structured as follows. Section 2 describes the simple theoretical framework of national accounting for analyzing the causal relationship of the twin deficits. The relevant literature in the research area is presented in Section 3. In Section 4, we test the twin deficit hypothesis and present our empirical results. Finally, Section 5 provides the concluding remarks and the discussion of the policy implications.

2. Current Account and Fiscal Balance in National Accounts

The national account identity provides the basis of the relationship between budget deficit and current account deficit. 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 = export and M = import. Defining current account *(CA)* as the difference between export *(X)* and import *(M)*, and rearranging the variables equation 1 becomes:

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

where $(C + I + G)$ are the spending of domestic residents (domestic absorption). In a closed economy savings *(S)* equals investment *(I)* and given that $Y - C = S$, we have:

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

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 the policy perspective, this relationship implies that policies supporting investments have a negative impact on the current account, while policies that

reduce consumption (private on public) have a positive impact on current account. National savings can be further decomposed into private (S_p) and government savings (S_g)

$$S_p = Y - T - C \tag{4}$$

and

$$S_g = T - G \tag{5}$$

where T is the government revenue. Using equations 4 and 5 and substituting into equation 3 yield:

$$S_p = I + CA + (G\text{-}T) \tag{6}$$

or

$$CA = S_P - I - (G - T) \tag{7}$$

Equation 7 states that a rise in the government (budget) deficit will increase the current account deficit if and only if, the rise in government deficit decreases total national savings. Supposing that current tax revenues are held constant and $(S_p - I)$ remains the same, an increase in temporary government spending will cause government deficit to rise $(G - T)$ and will affect the current account positively. In this way the government deficit resulting from increased purchase reduces the nation's current account surplus, which in other words suggests the worsening of external balances.

3. Relevant Literature

Previous literature has mainly centered 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, Keynesian 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. In other words, running a budget deficit ultimately will widen the current account deficit under both fixed and flexible exchange rate regimes although the transmission mechanisms 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 budget deficit to current account deficit. Researchers who have used the modern statistical time series technique include authors like Vamvoukas (1999), Piersanti (2000) and Leachman and Francis (2002). They found strong evidence to support the Keynesian view. These evidences are consistent with the twin deficits hypothesis[5]. In addition, Abell (1990) showed that the link between the two deficits is indirect rather than direct. Indeed, 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 relationship between the two deficits would be in accordance with the REH. The empirical evidence in Miller and Russek (1989),

Enders and Lee (1990), Evans and 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 also may 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 their 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 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 budget (fiscal) policy. The articles by Kearney and Monadjemi (1990) on OECD countries, Anoruo and Ramchander (1998) on the Philippines, India, Indonesia and Korea and Khalid and Teo (1999) on Indonesia and Pakistan support this hypothesis. Recently, Alkswani (2000) reported the reverse causation between the two deficits for Saudi Arabia. According to them, this will occur if the government of a country utilized their budget (fiscal) stance to target the current account balance.

Finally, a bi-directional causality between the two deficits may also exist. In other words, budget deficit Granger causes current account deficit and vice-versa. The empirical evidence provided by Kearney and 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[8]. Following authors like McCoskey and 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. The Ricardian Equivalence, however, ensures that current account does not belong in the long run relationship.

The twin deficits relationship has been extensively investigated in the US and other developed countries. The body of evidence, however, does not yield a consensus on the causal relationship between the two deficits. Therefore, the role of fiscal deficit on current account deficit is not without controversy. In this article we tested the hypotheses with the aid of the Toda and Yamamoto (1995) Granger-causality test using data from the ASEAN-4 countries.

4. Empirical Investigation

4.1 Data Description

Quarterly data from post Bretton Woods (1976:1 to 2000:4) is utilized in the analysis but the sampling period differs by each country depending on the availability of data. For Malaysia, the data ended in 1998:2 before the hard peg of the exchange rate to the US dollar in September 1998[9]. All the data, seasonally unadjusted and expressed in nominal terms, are obtained from several *International Financial Statistics* issues published by the International Monetary Fund (IMF). The variables employed in the study are 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 is measured in domestic currency. For consistency, we expressed all the variables in domestic currency. Data for GDP are available on an annual basis and hence, the quarterly GDP data for this study were extrapolated from the annual series employing the approach suggested by Gandolfo (1981)[11]. Appendix 1 briefly describes this procedure.

4.2 Unit Root Tests

Overall, we found that the variables contain the unit root or *I(1)*. 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 in each country.

4.3 Cointegration

The determination of the number of cointegrating vectors is based on the use of two likelihood ratio (LR) test statistics: the trace test and the maximum eigenvalue test. As the Johansen procedure is well known in the time series literature a detailed explanation is not presented here. Interested readers may refer to Johansen and Juselius (1990) for a complete discussion on the procedure. The importance of applying a correction factor for the Johansen procedure in small samples is now well known. The correction factor 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. In this study, we relied on the correction factor suggested by Reinsel and Ahn (1992) to the estimated maximum eigenvalue and trace statistics. The correction factor suggested is the multiplication of the test statistic by *(T-pk)/T*, where T is the sample size, p is the number of variables, and k is the lag length for the VAR model.

Results of the Johansen cointegration procedure (with and without the adjustment factor) are presented in Table 1 Panel A[12]. The hypothesis of no cointegrating vector (r=0) is 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. On the basis of these test results, we conclude that a unique cointegrating relationship has emerged in three out of the four ASEAN countries (with and without the correction factor).

At this point it is important to find out if each of the variables enters in the cointegrating relationship significantly. By using these restrictions it is possible to test the validity of the twin deficits hypothesis in the long run. The LR statistics reveal that all the four variables enter in the long run relationship significantly. This finding implies that omission of any one of these variables may bias the empirical results. Additionally, it suggests that there is a long run relationship between budget and current account deficits. Also, simultaneous exclusion of both interest rate and exchange rate is tested and rejected by the data. Additionally, we tested for the simultaneous exclusion of the budget and current account deficits and the statistical evidence is rejected by the data, implying that the Ricardian equivalence does not hold for the studied countries. These results are not reported here but will be made available upon request.

Literature on the subject has demonstrated that the results of the Johansen procedure are sensitive to structural breaks in the long run cointegrating relationship. To allow for the possibility of the cointegrating relationship we applied the Gregory and Hansen (1996) cointegration test with break. Briefly, under this procedure, a dummy variable is included to account for a shift in the cointegrating regression. The minimum ADF statistic

endogenously determines the break point and is compared to critical values supplied by Gregory and 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 1 provides the summary of the result under three hypothetical models. Note that we only present the result of the Gregory and Hansen (1996) tests in cases where Johansen's procedure fails to detect the long run relationships. In what follows, only the case of the Philippines has been reexamined. Panel B clearly shows the existence of cointegration with a break for the Philippines from the one break shift model. To sum, there is strong evidence of a unique long run relationship between external deficit and its determinants for all the countries.

[Insert Table 1]

4.5 Granger Causality Analysis

Toda and 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 and Doran (1996) had shown that Seemingly Unrelated Regression (SUR) could easily compute the MWALD test. The procedure is widely used in the empirical work and in this study, we relied on the Toda-Yamamoto tests to make the causal inference among the variables in the VAR model.

It is evident from Table 2 that the null hypothesis of non-Granger causality between budget deficit and current account deficit (BD→CAD) is easily rejected at 5 percent significance level for all the countries except for Indonesia. In fact, there exists feedback on the causal relationship between the two variables (BD↔CAD) for Malaysia, Indonesia and the Philippines. This two-way causality between the two deficits was also found in Anoruo and Ramchander (1998) and Khalid and Teo (1999). Moreover, Khalid and Teo (1999) argued that a high correspondence between the two deficits is more likely to occur in the developing rather than the developed economies[15]. For Indonesia we found a direct causality running from current account to budget deficit and also an indirect reverse causation between the two deficits. To reinforce our findings, we also conducted the test using the vector error correction model (VECM) framework. The causal inference based on the VECM tallies with that of the Toda-Yamamoto test.

[Insert Table 2]

The endogeneity of two deficit variables in most of the countries warrants us to investigate 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→IR→EX→ CAD) (see Volcker, 1984 and Abell, 1990)[16]. As shown in Table 2, 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→IR→EX→

CAD) in the case of Indonesia does not contradict the reverse causality (CA→BD) as reported as we found a two-way causality between the two deficits in Indonesia.

We have demonstrated the role of interest rate and exchange rate in explaining the twin deficits nexus. Overall, the 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 feedback relationship exist between the twin deficits. The only exception is Thailand, where we did not detect a causal relationship running from CA→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.

4.6 The Dynamic Analysis: GVDCs and GIRFs

Although the Granger causality presented in the previous section provides a rich framework for which causality may be tested, they are strictly within the sample test. 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, Lutkepohl, 1991). To overcome this shortcoming, the generalized variance decomposition (GVDCs) provided by Lee *et al*. (1992) and Lee and Pesaran (1993) is applied here. Similarly, we conducted the generalized impulse response functions (GIRFs), based on the work by

Pesaran and Shin (1998) in this study. Both are obtained from the moving average (MA) representation of the original VAR model. The innovation of the GVDCs will be represented in the percentage form and strength of each variable to their own shocks and others is measured by the value up to 100% conducted using different horizons (1 to 24 quarters).

Results of the GVDC from 1 to 24 quarters for the system are given in Table 3. The major findings may be summarized as follows. First, it can be seen that the shocks in current account contribute more in explaining the forecast error variance in budget deficit for Malaysia, Indonesia and the Philippines. For example, innovations in current account explained for the 24 percent of Malaysia's and 9 percent of Indonesia's budget deficit variance at the 24th quarter horizon. Meanwhile, budget deficit has a greater impact on current account in Thailand at the same horizon. Thus these results strengthen the causality chain presented earlier and lends 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 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 24th 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 are largely due to their own shocks but in the long run, they become increasingly interconnected with other macroeconomic variables.

Third, exchange rate is relatively the leading variable, being the most exogenous of all in Malaysia and Thailand after the 24th quarter horizon. In contrast, interest rate and budget deficit emerged as the most exogenous variable in the Philippines and Indonesia for the same horizon. For example, 75 percent (83 percent) of the variation in interest rate (budget deficit) is explained by its own shock in the Philippines (Indonesia) after the 24-quarter horizon. Fourth, 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. 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 3.

[Insert Table3]

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) 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 made 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 stabilized even after 50 quarters of 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 the twin deficits can be mutually interdependent and the twin deficits structure is much more complex than that suggested by the standard bivariate analysis.

5. Concluding Remarks

This study focuses on the twin deficits hypothesis in the ASEAN-4 countries. The empirical evidence based on the nonstationarity time-series econometrics leads to the following conclusions. First, budget deficit, interest rate, exchange rate and current account are found to be cointegrated (with a break), suggesting that there exists an underlying equilibrium relationship binding all these macroeconomic variables together. Second, there are two major channels through which budget deficit affects the current account of these countries. The first is the direct causal link from budget deficit to current account deficit and second, is the indirect channel that runs from budget deficit to higher interest rate, and 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 3 out of the 4 ASEAN countries – Malaysia, Indonesia and Thailand.

Nevertheless, these results do suggest some support for the twin-deficits hypothesis, although the strength of the relationship varies across 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 tightening) correct

the current account deficit directly as well as indirectly through interest and exchange rates. A somewhat different picture emerged for Indonesia, the country that faced severe financial and political turmoil during the recent financial crisis. We found that current account led to budget deficit and hence supported Summer's 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 countries a two-way causality is detected between the twin deficits, giving credence to both twin deficits and current account targeting propositions in which budget cuts improve current account and this further leads to a further reduction in budget deficit.

Third, budget deficits directly affect interest rates in the domestic market. These in turn would lead to appreciation of the exchange rate, which influences the price of imports and exports and contribute 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 causal chain assumes that the Marshall-Learner condition holds. Therefore, the statistical evidence in this study illustrates that the twin deficits can be mutually interdependent and that the causality pattern of the twin deficits structure is much more complex than that suggested by the standard bivariate analysis.

From a policy perspective, the results indicate that exchange rate Granger-cause current account deficit directly and interest rate seems to cause current account deficit through exchange rate. Empirical evidence suggests that a rise in interest rate (say due to increase in budget deficit) causes exchange rate to appreciate and the appreciation of the currency

causes current account deficit. Finally, 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.

Notes:

1. In the period 1980-1985, budget deficit in the US rose from $74 billion to a total of $212 billion in 1985. In the same period, the US's real as well as nominal exchange rate depreciated. The depreciation led to deterioration in current account balance from a surplus of $6.0 billion in 1980 to a deficit of $124 billion by the year 1985. It is widely believed that the US current account deficit rose mainly because the skyrocketed budget deficit. The dramatic increases of the budget and current account deficits are commonly referred to as the "twin deficits".

2. Milesi-Ferretti and Razin (1996) and the Monetary Authority of Singapore (1997) pointed out that the presence of budget deficit is also an explanation for the current account deficits in most of the ASEAN countries. Moreover, in the 1980s and early 1990s, ASEAN countries experienced budget deficits and thus their fiscal position had more or less generated the current account deficits. Therefore, the choice of the countries in this study is not without merit.

3. Anoruo and Ramchander looked at the case of Indonesia and the Philippines while Khalid and Teo examined the case for Indonesia.

4. The importance of the mediating variables in the twin deficits nexus is discussed in Abell (1990) and Anoruo and 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.

5. Some earlier works that attempted to resolve the issue include Hutchison and 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 a comprehensive understanding of the Ricardian Equivalence Hypothesis (REH), interested readers could refer to Seater (1993) and the reference therein.

7. For instance, in the 1980s most 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. Cardia (1997) found a contradicting perspective of the REH when she nested the Ricardian equivalence within a non-Ricardian equivalence. A low correlation exists between the two series in the nested and non-nested hypothesis. Moreover, the study did not support any testable hypothesis presented here.

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 and 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 rate used are as follows: Malaysia and the Philippines - 3 month treasury bill rates, Indonesia - interbank call loan rate while discount rates are used for Thailand.

11. A note of caution is warranted here. The available sample period for all the countries considered is about 100 observations which is just about the minimum sample size suggested by Stock (1994) and Toda (1994,1995) as being acceptable for unit root and cointegration testing, respectively.

12. 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 do 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 and 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 and 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 χ^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 and Teo 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.

16. According to Hsiao (1982), in a system with more than two variables, causality between the two variables may exist indirectly due to the presence of other variables.

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Table 1: Cointegration Tests

A: Johansen's Multivariate cointegration tests

Indonesia							
Null	Alternative	k=4 r=1					
		λmax			Trace		
		Unadjusted	Adjusted	95% C.V.	Unadjusted	Adjusted	95% C.V.
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							
Null	Alternative	k=3 r=1					
		λmax			Trace		
		Unadjusted	Adjusted	95% C.V.	Unadjusted	Adjusted	95% C.V.
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							
Null	Alternative	k=5 r=0					
		λmax			Trace		
		Unadjusted	Adjusted	95% C.V.	Unadjusted	Adjusted	95% C.V.
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							
Null	Alternative	k=5 r=1					
		λmax			Trace		
		Unadjusted	Adjusted	95% C.V.	Unadjusted	Adjusted	95% C.V.
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)

Note: 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 and 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 and Hansen (1996) for m=3. Asterisks (*) denotes statistically significant at 5 percent significance level.

Table 2: Granger non-causality Results

Dependent Variable	CAD	BD	IR	EX
	MWALD (χ^2-statistics)			
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.

Table 3: Variance Decomposition

Percentage of variations in	Horizon	due to innovation in:			
		ΔCAD	**ΔBD**	**ΔIR**	**ΔEX**
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 3: Variance Decomposition (continued)

Percentage of variations in	Horizon	due to innovation in:			
		ΔCAD	**ΔBD**	**ΔIR**	**ΔEX**
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 column in bold represent their own shock.

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 condition 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 equation. In order to calculate the value for the first quarter, we apply 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 experiment to examine the effects of linearly interpolating technique on 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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