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Cointegration Test on ASEAN Currencies Before and During the Currency Turmoil.

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ABSTRACT

The impact of the Southeast Asian currency turmoil on some ASEAN countries demonstrates the need to understand the regional currency movements. In view of the growing interest in the Southeast Asian currency turmoil, this paper investigates the relationship between the main ASEAN currencies namely, Thai Bhat, Malaysian Ringgit, Singapore Dollar, Indonesia Rupiah and the Philipines Peso by applying the cointegration test to determine the long run dynamics between the currencies. The causality test is also performed to determine the influence of each currency on each other. The results show that the currencies are non-stationary and at most there are four cointegrating vectors for the periods before and during the turmoil. The Granger causality test shows that Malaysian currency seems to have the most significant causalities on the ASEAN currencies during the turmoil. However, the variance decomposition and the multivariate vector autoregression reveal that the past information of each currency contributed the most to its forecast error.

ABSTRAK

Kesan daripada krisis mata wang yang melanda beberapa negara ASEAN menunjukkan kepentingan bagi memahami pergerakan mata wang serantau. Selaras dengan peningkatan minat ke atas krisis mata wang Asia Tenggara, kertas ini mengkaji hubungan di antara beberapa mata wang utama negara-negara ASEAN iaitu Bhat Thai, Ringgit Malaysia, Dollar Singapura, Rupiah Indonesia dan Peso Filipina dengan menggunakan ujian kointegrasi bagi menentukan dinamik jangka panjang di antara mata wang tersebut. Keputusan menunjukkan yang matawang-matawang tersebut adalah tidak pekun dan terdapat sekurang-kurangnya empat vektor kointegrasi untuk tempoh sebelum dan semasa krisis mata wang. Ujian sebab-akibat Granger menunjukkan yang mata wang Malaysia seolah-olah menjadi penyebab yang signifikan ke atas mata wang ASEAN yang lain. Walau bagaimanapun, penguraian varians serta autoregresi vektor multivariat menunjukkan yang maklumat lepas mengenai setiap mata wang banyak menyumbang terhadap kesilapan ramalan masing-masing.

INTRODUCTION

Understanding the behavior of currency movement has captured interest of many finance researchers. The increasing border-less trade in recent years further enhanced the need to investigate the behavior of currency movement for investment decision making. Early efforts have been focused on determining the foreign exchange market efficiency as well as forecasting tools to predict future movement of currencies. These studies are mostly concentrated on the developed countries' currencies although more efforts are being directed towards the developing countries in light of their increasing importance in the global trade economy.

The Southeast Asia currency turmoil that has badly affected some ASEAN countries demonstrates the need to understand the regional currency movement for investment decision making and risk management purposes. In view of the growing interest in the Southeast Asia currency turmoil, this paper attempts to shed some lights on the event by providing an understanding on the regional currencies' behaviors before and during the turmoil. It will look at the immediate relationship between the main ASEAN currencies, namely Thai Bhat (THB), Malaysian Ringgit (MYR), Singapore Dollar (SGD), Indonesian Rupiah (IDR) and Philipines Peso (PHP) prior to and during the turmoil. Using the cointegration test, this study attempts to determine the long-run dynamics between the currencies. The causality test is performed to determine the influence of each currencies on each other. The outcomes are expected to provide some information on the currency turmoil in Southeast Asia.

BACKGROUND STUDIES

One of the earlier studies on currency behavior was by Baillie and Bollerslev (1989). They run the multivariate test due to Johansen (1988) to determine whether a group of exchange rates are cointegrated. They found that the nominal dollar spot exchange rates are cointegrated. Further analysis of deviations from the cointegrating relationship suggests that they possess long memory and may possibly be well described as a fractionally integrated process. Therefore, the influence of shocks to the equilibrium exchange rates may only vanish at the long horizon.

Byers and Peels (1992) study the behavior of 6 spot exchange rates in the inter-war period of January 1921 to February 1925 and the post-war era. Using the data between the inter-war period and post-war period, similar empirical results are found between both periods. All of the exchange rates had innovations that could be described by ARCH processes. In addition, there is strong evidence that volatility movement spilled over from one market to another. The time series of some of the 6 exchange rates are best described by low order integrated moving average error processes. However, unlike the

post-war era, no convincing evidence of either bivariate or multivariate cointegration is found for the 6 exchange rates during the inter-war period.

Lim (1992) applies the cointegration and error correction method to test 3 models - theory of purchasing power parity, Fischer's open rational expectation and the analysis described by Allen and Stein (1989), to determine the long run exchange rate between the US and other G-10 countries. The results show that none of the models satisfactorily explain the dynamics of real exchange rates. However, there are some evidence which show that the fundamental determinants of the real exchange rates include variables such as productivity, terms of trade, real domestic and foreign interest rates.

Diebold, Gardeazabal and Yilmaz (1994) extend the study to examine an immediate implication of Baillie and Bollerslev's (1992 and 1994) finding that cointegration implies an error-correction representation yielding forecasts superior from a martingale benchmark. They find that in the out-of-sample forecasting exercise, the martingale model is superior than the error-correction model. Also, applying the improve cointegration tests, they find that evidence for cointegration to be less strong than previously thought.

Kahya, Kuotmos and Nuven (1994) investigate the behavior of exchange rate volatility during appreciation and depreciation for US dollar against Canadian dollar, French franc, Deutsche mark Italian lira Japanese yen and British pound. They discover that in all instances, the volatility of exchange rate rates is asymmetric. The volatility is found to be much higher for US dollar against the European Monetary System (EMS) during dollar depreciations. However, the volatility for non-EMS dollar exchange rates is higher during dollar appreciations. Evidence is also found that exchange rate changes are related to volatility.

Using the cointegration test, Lajaunie and Naka (1992) employ time series data to test the efficiency of Tokyo foreign exchange based on the procedures developed by Phillips and Ouliaris (1990), Johansen and Juselius (1990) and Johansen (1991). Cointegration is found to be absent as manifested by the absent of long-run equilibrium. This suggests that the Tokyo spot market is consistent with the efficient market hypothesis. Karfakis and Parikh (1994) investigate the market efficiency hypothesis for 5 major exchange rates of Australian dollar, before and after the float. Applying the cointegration methodology proposed by Johansen and Juselius (1990), they discover that cointegration exists in foreign exchange markets when the interdependence among exchange rates is accounted for.

DATA AND METHODOLOGY

This study uses daily noon spot rates (Pacific time) of five major ASEAN currencies - Bhat, Ringgit, Dollar, Rupiah and Peso, against the US dollar. It covers the period from January 1996 to December 1997 which is then divided

into two sub-periods to represent the period before and during the currency turmoil. Data from January to June 1997 represent the former while the later is represented by the data from July to December 1997. The time frames are chosen to demonstrate the immediate market reactions before and during the currency turmoil. These data are obtained from the Pacific Commerce database accessible via the internet.

The Augmented Dickey-Fuller (ADF) (1979) unit root test is used in examining the stationarity of the data series. It consists of running a regression of the first difference of the series against the series lagged once, lagged difference terms, and optionally, a constant and a time trend. This can be expressed as:

$$\Delta y_t = \beta_1 y_{t-1} + \beta_2 \Delta y_{t-1} + \beta_3 \Delta y_{t-2} + \beta_4 + \beta_5 t \qquad (1)$$

The test for a unit root is on the coefficient of y_{t-1} in the regression. If the coefficient is significantly different from zero then the hypothesis that y contains a unit root is rejected. Rejection of the null hypothesis implies stationarity.

The long run relationship between the currencies is examined based on the cointegration procedure proposed by Johansen-Juselius (1990). The procedure begins with the following least square estimating regressions

$$\Delta X_t = \alpha_1 + \sum_{i=1}^{p-1} \Gamma \Delta X_{t-i} + \mu_{1t} \qquad (2)$$

$$\Delta X_{t-p} = \alpha_1 + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + \mu_{2t} \qquad (3)$$

Defining the product moment matrices of the residuals as $S_{ij} = T_1 \sum_{t=1} T\mu_{it}\, \mu_{jt}$ (for i,j = 1,2), Johansen (1988) shows that the likelihood ratio test statistic for the hypothesis of at most equilibrium relationships is given by:

$$-2 \ln Q_r = -T \sum_{i=r+1}^{p} \ln(1-\lambda_i) \qquad (4)$$

where $\lambda_1 > \lambda_2 > \ldots\ldots \lambda_p$ are the eigenvalues that solve the following equation

$$|\lambda S_{22} - S_{21} S_{11} S_{12}| = 0 \qquad (5)$$

The eigenvalues are also called the squared canonical correlations of μ_{2t} with respect to μ_{1t}. The limiting distribution of the -2lnQ, statistic is given in terms of a p-r dimensional Brownian motion process, and the quantiles of

the distribution are tabulated in Johansen and Juselius (1990) for p-r + 1,....,5 and in the Osterwald-Lenum (1992) for p-r + 1,.....10.

Equation (4) is usually referred to as the trace test which may be rewritten as:

$$L_{terace} = -T \sum_{i=r+1}^{p} \ln(1-\lambda_i) \quad (6)$$

where λ_{r+1},.....λp are the p-r smallest squared canonical correlation or eigenvalue. The null hypothesis is that there are at most r cointegrating vectors. The other test for cointegration is the maximal eigenvalue test based on the following statistic:

$$L_{max} = -T.\ln (1 - \lambda_{r+1}) \quad (7)$$

where the λ_{r+1} is the $(r+t)^{th}$ largest squared canonical correlation or eigenvalue. The null hypothesis is there are r cointegrating vectors, against the alternative of r + 1 cointegrating vectors. Johansen and Juselius (1990) indicate that the trace test may lack the power relative to the maximal eigenvalue test. Based on the power of the test, the maximal eigenvalue test statistic is often preferred.

The causality test based on Granger (1969) approach is conducted to see any influence between the currencies. The Granger approach to the question whether X causes Y is to see how much of the current Y can be explained by the past values of Y and then to see whether adding lagged values of X can improve the explanation. Y is said to be Granger-caused by X if X helps in the prediction of Y, or equivalently if the coefficients on the lagged Xs are statistically significant. The strength of the Granger cause relations is also conducted using variance decomposition and multivariate autoregression for each of the currency.

FINDINGS

Table 1 presents the summary statistics of all the currencies against the US dollar during the period understudy. With the exception of SGD, the other four currencies are very volatile during the turmoil as compared against the period before the turmoil. The high level of volatility is demonstrated by the increased level of standard deviation between both periods. In terms of the coefficient of variations, THB is the most volatile currency among the five currencies before the turmoil. However, during the turmoil, IDR becomes the most volatile currency against the greenback. Much of this can be associated to the excessive speculative activities before and during the turmoil.

TABLE 1. Summary Statistics

All-period: 1996:1 - 1997:12					
	MYR	IDR	PHP	THB	SGD
Mean	2.6050	2492.4889	27.3172	27.3139	1.4363
High	3.5200	3716.76	35.2000	40.0000	1.6000
Low	2.4700	2293.33	26.1200	22.6000	1.4000
Std. Dev.	0.2347	328.2475	2.4658	3.9413	2.04696
% Coef. var.	9.0096	13.1695	9.0265	14.4297	3.2695
Sub-period: 1996:1- 1997:6: Before the turmoil					
	MYR	IDR	PHP	THB	SGD
Mean	2.5081	2354.98	26.2391	25.4475	1.4154
High	2.5628	2447.31	26.3800	26.2000	1.4510
Low	2.9710	2293.33	26.1200	22.6000	0.0125
Std. Dev.	0.0221	39.49	0.0724	0.4179	1.3980
% Coef. var.	0.8811	1.6769	0.2759	1.7094	0.8831
Sub-period: 1997:7- 1997:12: During the turmoil					
	MYR	IDR	PHP	THB	SGD
Mean	2.9698	3010.238	31.3769	39.3418	1.5149
High	3.5150	3716.758	35.2000	40.0000	1.6030
Low	2.4890	2429.850	26.3500	28.3000	1.4300
Std. Dev.	0.3042	412.1924	2.8492	3.2881	0.0458
% Coef. var.	10.2431	13.6930	9.0806	9.5746	3.0233

Table 2a presents the results of the unit root test. It shows that none of the series is able to reject the null hypothesis of unit root. In all cases the ADF test statistic is smaller than the critical value. This implies that all series have unit root I(0) and need to be differenced once to achieve stationarity, that is, they are I (1) processes. Table 2b shows results of unit root tests on the first difference of the series. The hypothesis of a unit root is rejected for all of the series. Therefore, all the series are I (1) process.

Table 3 presents results from the Johansen cointegration test among the currencies. The maximum eigenvalue test confirms the none zero vector among the currencies. The null hypothesis that there is no cointegration relationship among the currencies is therefore rejected, at most for four cointegrating vectors before the turmoil and during the turmoil.

TABLE 2a. Augmented Dickey-Fuller Test

Before Turmoil			During Turmoil		
Currency	ADF Test Statistic	Critical Value (5%)	Currency	ADF Test Statistic	Critical Value (5%)
IDR	-0.2377	-2.8697	IDR	-1.13207	-2.891800
MYR	-2.3286	-2.8697	MYR	-0.7021	-2.891800
PHP	-0.4954	-2.8697	PHP	-1.6128	-2.891800
SGD	-1.2216	-2.8697	SGD	-0.8398	-2.891800
THB	-2.0156	-2.8697	THB	-1.2788	-2.891800

TABLE 2b. Augmented Dickey-Fuller Test

Before Turmoil			During Turmoil		
Currency	ADF Test Statistic	Critical Value (5%)	Currency	ADF Test Statistic	Critical Value (5%)
IDR	-11.7428	-2.8697	IDR	-5.5195	-2.8922
MYR	-8.092	-2.8697	MYR	-4.7784	-2.8922
PHP	-12.0195	-2.8697	PHP	-6.01839	-2.8922
SGD	-9.2846	-2.8697	SGD	-6.5849	-2.8922
THB	7.928	-2.8697	THB	-7.1747	-2.8922

The results on the direction of causation based on 2 days lag are shown in Table 4. Before the turmoil, there are significant causalities for PHP on IDR, MYR and SGD, IDR on PHP and SGD, and MYR on SGD at 10% significant level. During the turmoil, the result shows that there are significant causalities for MYR on IDR, PHP and SGD; IDR on PHP and THB; THB on PHP; and SGD on THB.

The strength of the Granger cause relations can be measured from the variance decomposition. Table 5 shows the variance decomposition. It shows the variance decomposition for 10 days period. The overall results show that the past information of each currency contributed most to its own forecasting error.

The results on multivariate vector autoregression are shown in Table 6. One feature of the multivariate vector autoregression estimate before the turmoil is that, except for Philippine's lag on Malaysia, all currencies have significant relationship on its own past information and not to other currencies past information. After the turmoil, all the currencies have significant relationship on its own past information. The results also show that MYR and THB's one lag have significant relationship on IDR and SGD, and PHP respectively.

TABLE 3. Johansen Cointegration Test

Eigenvalue	Likelihood Ratio	5 percent Critical Value	1 Percent Critical Value	Hypothesized No. Of (CE(s)
		Before Turmoil		
0.303489	456.9473	68.52	76.07	None**
0.281390	325.6606	47.21	54.46	At most 1**
0.210513	205.7121	29.68	35.65	At most 2**
0.171595	119.9089	15.41	20.04	At most 3**
0.132443	51.57295	3.76	6.65	At most 4**
		During Turmoil		
0.389999	160.9304	68.52	76.07	None**
0.360941	115.4552	47.21	54.46	At most 1**
0.295433	74.26149	29.68	35.65	At most 2**
0.221858	42.04563	15.41	20.04	At most 3**
0.186307	18.96783	3.76	6.65	At most 4**

** significant at 5% level.

CONCLUSIONS

The aim of this paper is to assess the relationship between five Southeast Asian currencies, namely Thailand Bhat, Malaysian Ringgit, Singapore Dollar, Indonesia Rupiah and Philipines Peso. The objective is to determine the immediate reactions by the respective currencies before and during the currency turmoil. The cointegration and causality tests are conducted in addition to the variance decomposition and the multivariate vector autoregression.

The results on the unit root test indicate that all the series of each currency are non-stationary and in I (1) process. The Johansen cointegration test reveals that at most there are four cointegrating vectors before and during the turmoil. The Granger causality test shows that Malaysian currency seems to have the most significant causalities on the ASEAN currencies during the turmoil. However, the variance decomposition and the multivariate vector autoregression estimates reveal that the past information of each currency contributed most to its forecast error. Given the increasing global trade in the region, these findings are useful for future investment decision and risk management in view of the high volatility of the ASEAN currencies.

TABLE 4. Pairwise Granger Causality Test

Null Hypothesis	OBS	F-Statistic	Probability
Before Turmoil			
MYR does not Granger Cause IDR	367	0.02305	0.97722
IDR does not Granger Cause MYR		0.24130	0.78573
PHP does not Granger Cause IDR	367	4.15784	0.01639
IDR does not Granger Cause PHP		3.94732	0.02014
SGD does not Granger Cause IDR	367	1.01339	0.36401
IDR does not Granger Cause SGD		2.81798	0.06104
THB does not Granger Cause IDR	367	0.43853	0.64533
IDR does not Granger Cause THB		0.09331	0.91093
PHP does not Granger Cause MYR	367	2.67799	0.07006
MYR does not Granger Cause PHP		0.88256	0.41461
SGD does not Granger Cause MYR	367	0.42518	0.65398
MYR does not Granger Cause SGD		3.03591	0.04926
THB does not Granger Cause MYR	367	1.25660	0.28586
MYR does not Granger Cause THB		1.49244	0.22620
SGD does not Granger Cause PHP	367	1.01847	0.36218
PHP does not Granger Cause SGD		2.84637	0.05935
THB does not Granger Cause PHP	367	0.15819	0.85375
PHP does not Granger Cause THB		0.18667	0.82980
THB does not Granger Cause SGD	367	1.12862	0.32462
SGD does not Granger Cause THB		0.10544	0.89996
During Turmoil			
MYR does not Granger Cause IDR	96	5.79597	0.00427
IDR does not Granger Cause MYR		0.33916	0.71327
PHP does not Granger Cause IDR	96	1.66262	0.19535
IDR does not Granger Cause PHP		2.48459	0.08900
SGD does not Granger Cause IDR	96	0.68777	0.50529
IDR does not Granger Cause SGD		0.26262	0.76962
THB does not Granger Cause IDR	96	0.22329	0.80032
IDR does not Granger Cause THB		2.65304	0.07588
PHP does not Granger Cause MYR	96	0.49790	0.60945
MYR does not Granger Cause PHP		6.96804	0.00153
SGD does not Granger Cause MYR	96	1.41293	0.24872
MYR does not Granger Cause SGD		3.63218	0.03036
THB does not Granger Cause MYR	96	0.87253	0.42136
MYR does not Granger Cause THB		1.54192	0.21951
SGD does not Granger Cause PHP	96	2.25344	0.11087
PHP does not Granger Cause SGD		0.34034	0.71243
THB does not Granger Cause PHP	96	3.87325	0.02430
PHP does not Granger Cause THB		0.31927	0.72749
THB does not Granger Cause SGD	96	0.33647	0.71517
SGD does not Granger Cause THB		3.32634	0.04034

TABLE 5. Variance Decomposition

Before Turmoil						
Variance Decomposition of IDR						
Period	S.E.	IDR	MYR	PHP	SGD	THB
1	6.877627	100.0000	0.000000	0.000000	0.000000	0.000000
2	7.999194	99.94121	0.000365	0.000617	0.042412	0.015397
3	9.294369	99.71146	0.007688	0.228456	0.035581	0.016812
4	10.21441	99.42891	0.010814	0.496125	0.046243	0.017910
5	11.04281	98.64244	0.016147	0.936741	0.081148	0.023522
6	11.75853	98.34427	0.021746	1.470116	0.135265	0.028604
7	12.40660	97.63526	0.028338	2.097958	0.205747	0.032694
8	12.99809	96.84708	0.035748	2.793649	0.288606	0.034918
9	13.54686	95.99700	0.044099	3.543126	0.380449	0.035329
10	14.06084	95.10299	0.053419	4.331057	0.478240	0.034291
Variance Decomposition of MYR						
1	0.004303	0.611518	99.38848	0.000000	0.000000	0.000000
2	0.005935	1.136220	98.32511	0.432090	0.027437	0.079138
3	0.007102	1.505404	98.05743	0.328040	0.021343	0.087788
4	0.008064	1.869756	97.66836	0.257140	0.019446	0.185300
5	0.008885	2.201876	97.18624	0.214088	0.027157	0.370643
6	0.009608	2.504526	96.63513	0.195231	0.044324	0.620785
7	0.010254	2.774240	96.04548	0.194572	0.068891	0.916818
8	0.010840	3.011547	95.43974	0.2.6515	0.099066	1.243137
9	0.011375	3.217452	94.83497	0.226690	0.133317	1.587571
10	0.011867	3.393925	94.24298	0.251814	0.170440	1.940843
Variance Decomposition of PHP						
1	0.013139	1.353346	0.053997	98.59266	0.000000	0.000000
2	0.016105	2.155644	0.315109	97.31730	0.207228	0.004718
3	0.018745	3.029279	0.384173	96.33193	0.167016	0.087599
4	0.020844	4.008867	0.421500	95.25626	0.142435	0.170938
5	0.022658	5.036074	0.441434	94.12009	0.121068	0.281333
6	0.024256	6.097163	0.450200	92.94650	0.105796	0.400344
7	0.025694	7.170618	0.451746	91.75702	0.095782	0.524835
8	0.027008	8.243113	0.448202	90.56911	0.089914	0.649663
9	0.028221	9.303509	0.441041	89.39642	0.087124	0.771911
10	0.029353	10.34391	0.431303	88.24886	0.086479	0.889452
Variance Decomposition of SGD						
1	0.002293	0.002151	1.439755	0.618350	97.93974	0.000000
2	0.003046	0.009576	1.933795	0.871748	97.10067	0.084216
3	0.003610	0.016913	1.860975	0.802098	97.18795	0.132063
4	0.004066	0.032082	1.727634	0.706468	97.35229	0.181525

Continue Table 5

Variance Decomposition of SGD						
Period	S.E.	IDR	MYR	PHP	SGD	THB
5	0.004449	0.052718	1.578940	0.615083	97.51472	0.238542
6	0.004779	0.081024	1.434127	0.537807	97.64373	0.303316
7	0.005068	0.117347	1.302023	0.478238	97.72547	0.376926
8	0.005325	0.162572	1.186886	0.437338	97.75350	0.459705
9	0.005555	0.217237	1.090994	0.415027	97.72488	0.551860
10	0.005762	0.281846	1.015553	0.410761	97.63843	0.653410
Variance Decomposition of THB						
1	0.184190	0.062270	0.744220	0.211952	0.617919	98.36364
2	0.222582	0.192406	0.513410	0.193466	0.867870	98.23285
3	0.254860	0.385702	0.394515	0.470222	1.002207	97.74735
4	0.278609	0.610408	0.358827	0.714865	1.139061	97.17684
5	0.297788	0.855161	0.370289	1.023029	1.245344	96.50618
6	0.313507	1.104409	0.421016	1.342611	1.334824	95.79714
7	0.326703	1.349997	0.503911	1.668302	1.405744	95.07205
8	0.337941	1.584857	0.614642	1.987690	1.460500	94.35231
9	0.347629	1.804862	0.749448	2.293983	1.500608	93.65110
10	0.356062	2.007404	0.905155	2.582154	1.527917	92.97737
Ordering: IDR, MYR, PHP, SGD, THB						
During Turmoil						
Variance Decomposition of IDR						
Period	S.E.	IDR	MYR	PHP	SGD	THB
1	67.34041	100.0000	0.000000	0.000000	0.000000	0.000000
2	94.10894	92.39071	6.394084	0.630616	0.051852	0.532742
3	114.6159	86.82411	10.88693	0.565550	0.250058	1.473354
4	130.9404	82.01645	15.03303	0.444835	0.322599	2.183086
5	144.4656	77.59191	18.95073	0.378531	0.409938	2.668894
6	156.0462	73.56085	22.66216	0.3888816	0.512338	2.875833
7	166.2003	69.87307	26.15891	0.462107	0.638509	2.867406
8	175.2574	66.52594	29.39323	0.579809	0.779026	2.721991
9	183.2574	63.50534	32.32801	0.726523	0.920276	2.519859
10	190.9140	60.79465	34.94130	0.889761	1.047658	2.326632
Variance Decomposition of MYR						
1	0.039732	33.06970	66.93030	0.000000	0.000000	0.000000
2	0.060681	31.52529	67.33548	0.089248	0.772469	0.277511
3	0.075609	30.88305	67.49175	0.061752	0.929812	0.633631
4	0.086984	30.35203	67.69483	0.084016	0.846329	1.022793

Continue Table 5

Variance Decomposition of MYR						
Period	S.E.	IDR	MYR	PHP	SGD	THB
5	0.096245	29.90084	67.72424	0.194684	0.718107	1.462130
6	0.104194	29.51091	67.58697	0.350365	0.612893	1.938857
7	0.111271	29.19025	67.32340	0.507213	0.546093	2.433048
8	0.117724	28.94359	66.97117	0.641504	0.518140	2.924495
9	0.123701	28.77034	66.56157	0.745459	0.526520	3.396115
10	0.129298	28.66565	66.11096	0.819688	0.568681	3.835024
Variance Decomposition of PHP						
1	0.376471	4.898765	2.645871	92.45536	0.000000	0.00000
2	0.511555	9.559079	6.407663	81.43904	0.001514	2.592707
3	0.607862	12.53594	12.80638	70.36225	0.774006	3.521422
4	0.692169	15.04197	19.36086	59.77765	1.625565	4.193956
5	0.770209	16.69343	25.20008	51.14149	2.333442	4.631560
6	0.842436	17.79883	29.96103	44.48132	2.749472	5.009353
7	0.908994	18.54677	33.76729	39.38892	2.922089	5.374931
8	0.970308	19.08675	36.80202	35.44049	2.923736	5.747007
9	1.026984	19.50969	39.23669	32.30882	2.820165	6.124631
10	1.079650	19.87158	41.20464	29.76326	2.660509	6.500013
Variance Decomposition of SGD						
1	0.007852	31.60108	13.62225	0.189513	54.58716	0.000000
2	0.010632	31.30608	23.84211	0.109503	44.56260	0.179708
3	0.012828	32.57760	28.75953	0.146220	38.39080	0.125850
4	0.014630	33.16320	32.52496	0.228342	33.98520	0.098308
5	0.016171	33.52193	35.27160	0.290307	30.81876	0.097408
6	0.017515	33.71084	37.38844	0.321934	28.45662	0.122162
7	0.018707	33.80780	39.05597	0.330800	26.63429	0.171151
8	0.019780	33.85047	40.39754	0.326119	25.18439	0.241483
9	0.020757	33.86255	41.49309	0.314450	24.00040	0.329501
10	0.021626	33.85838	42.39765	0.299810	23.01296	0.431205
Variance Decomposition of THB						
1	0.463457	11.50217	9.694278	4.326637	4.417595	70.05932
2	0.641395	16.72898	10.86836	4.504026	2.353174	65.54546
3	0.776278	21.80006	12.24719	3.694267	2.184804	60.07368
4	0.880665	25.87024	14.09939	3.160226	2.538044	54.33210
5	0.971261	29.27332	15.94684	2.733705	3.222833	48.82330
6	1.053187	31.98578	17.38311	2.388187	3.975903	43.81202
7	1.129527	34.09623	19.72703	2.103375	4.680931	39.39244
8	1.201619	35.68557	21.59332	1.869069	5.278311	35.57372
9	1.270102	36.84464	23.41119	1.676615	5.753841	32.31372
10	1.335267	37.65889	25.16021	1.518151	6.115452	29.54729
Ordering: IDR, MYR, PHP, SGD, THB						

TABLE 6. Vector Autoregression Estimates

Before Turmoil					
	IDR	MYR	PHP	SGD	THB
IDR(-1)	0.594359	-2.42E-05	0.000113	5.10E-06	-0.000941
	(11.8224)	(-0.77037)	(1.17694)	(0.30437)	(-0.69887)
IDR(-2)	(((((((	((((E-((	((17E-05	-1.35E-06	-0.000556
	(6.45483)	(0.00813)	(0.33090)	(-0.08089)	(-0.41399)
MYR(-1)	-0.486525	0.941248	0.125898	0.018330	-2.967029
	(-0.00579)	(17.8910)	(0.78369)	(0.65375)	(-1.31751)
MYR(-2)	-17.46813	0.022891	-0.107016	-0.028156	1.777311
	(-0.20815)	(0.43597)	(-0.66747)	(-1.00620)	(0.79078)
PHP(-1)	-2.927297	-0.031177	0.698948	-0.005250	-0.034306
	(-0.10742)	(-1.82863)	(13.4253)	(-0.57779)	(-0.04701)
PHP(-2)	38.04828	0.042333	0.227629	0.008266	0.671817
	(1.39929)	(2.48843)	(4.38194)	(0.91177)	(0.62257)
SGD(-1)	-76.05461	-0.049150	0.319179	0.862380	2.221186
	(-0.48209)	(-0.49796)	(1.05901)	(16.3943)	(0.52572)
SGD(-2)	139.3196	0.084587	-0.406019	0.097536	-1.327291
	(0.88808)	(0.86183)	(-1.35475)	(1.86469)	(-0.31593)
THB(-1)	0.543348	0.000914	0.000606	0.000484	0.677041
	(0.27617)	(0.74255)	(0.16112)	(0.73761)	(12.8497)
THB(-2)	-1.025946	-0.002124	0.001812	-0.000231	0.210263
	(-0.51326)	(-1.69867)	(0.47444)	(-0.34588)	(3.92780)

During Turmoil					
	IDR	MYR	PHP	SGD	THB
IDR(-1)	0.675190	1.58E-05	0.000302	-1.03E-05	0.001188
	(4.92156)	(0.19522)	(0.39360)	(-0.64103)	(1.25817)
IDR(-2)	0.133696	-4.19E-05	-0.000447	1.00E-05	-0.000617
	(1.01311)	(-0.53760)	(-0.60608)	(0.65266)	(-0.67944)
MYR(-1)	847.0192	1.229884	1.46473	0.073367	1.847692
	(3.34406)	(8.22970)	(1.03428)	(2.48401)	(1.05993)
MYR(-2)	-468.6920	-0.267189	1.259327	-0.045161	-1.956345
	(-1.74019)	(0.68139)	(0.83636)	(-1.43796)	(-1.05541)
PHP(-1)	-15.86142	-0.006204	0.737937	-0.000145	0.040355
	(-0.78747)	(-0.52201)	(6.55320)	(-0.06155)	(0.29111)
PHP(-2)	25.18512	0.008126	0.016102	-0.000935	-0.074242
	(1.33821)	(0.73177)	(0.15304)	(-0.42621)	(-0.57319)
SGD(-1)	-72.06908	-1.057634	-3.222114	0.724189	-12.55276
	(-0.05597)	(-1.39210)	(-0.44759)	(4.82306)	(-1.41645)
SGD(-2)	330.6964	1.073744	-3.679487	0.156866	19.45235
	(0.25488)	(1.40262)	(-0.50726)	(1.03681)	(2.17840)
THB(-1)	-17.70708	0.008240	0.212337	-0.001162	0.889875
	(-0.97580)	(0.76967)	(2.09308)	(-0.54909)	(7.12541)
THB(-2)	-7.170527	-0.003954	-0.152696	0.000958	-0.025782
	(-0.38804)	(-0.36266)	(-1.47807)	(0.44437)	(-0.20272)

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